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BUSINESS COMPETITION
CASE STUDY: ROMANIA

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Abstract: In this paper we have analized the application and perception of economic competition in the business environment in Romania.
This paper is a theoretical approach of the legislation and also how national legislation is aligned in the field of EU legislation.
It is a generally accepted principle the idea that competition contributes to economic development. This principle is supported by both economic theory and practice. Basic arguments in support of competition policy were focused, over time, in particular on the efficiency gains that competition generates both at company level and the efficiency of the markets function (maximizing consumer welfare).
Obviously, the concept of a perfectly competitive market is purely theoretical, such a market doesn`t exist in reality. From the point of view of the competition authority, the functional unit is the relevant market. The relevant market is the main instrument which defines the framework within a competition occurs between businesses.
The Competition Council was established under the Competition Law no. 21 of 10 April 1996, with subsequent modifications and completions. In its capacity as national competition authority, the institution implement and ensure compliance with national and EU provisions on competition.
In the second part of the paper we have anayized penalties imposed by the Competition Council of Romania and the evolution of corporate fines between 2003-2011.

Key words: competition, law, Competition Council, companies, sanctions.

1. INTRODUCTION

Competition is the essence of the market economy. It means a choice between several alternative products or services. Where there is competition to achieve a more efficient allocation of resources because the manufacturer seeking a permanent relationship between them and spending. However, the manufacturer does not influence the market by itself, but do so only by competition with other manufacturers that always causes a fall in prices and thus market growth through stimulating acquisitions.

Competition modifies the value system of meaning increases consumers demanding, of the need for information, the rate of shift to other bidders. In the battle for market conquest bidders apply a number of principles, such as sophisticated concepts in marketing strategies for gaining dominant market in concerned segments, a simultaneous commitment to high quality and strong productivity combined with high stringency strategy of the performances orientation or economic sectors involving high technologies and gradual reduction activities in the areas in decline.

2. THE CONCEPT OF COMPETITION: DEFINITIONS

According to the Explanatory Dictionary of Romanian language, the edition from 1998 through competition mean:

a. A commercial rivalry, a struggle with economic means between industrialists, traders, monopolies, countries etc., to monopolize the market, the sale of products to customers and to obtain bigger gains.

b. Competition, rivalry in a field. Expression: To compete with someone = to seek emulate someone, aiming towards the same goal. [1].

Competition can be defined as all economic relations generated by their desire to achieve a better market as a price the most advantageous possible. [2].

Viewed from economic point of view, competition is always linked to market transactions, by supply and demand and the exchange process. Such competition is closely related to freedom of choice. It is known that the "force regulators largest market economy is the competition" [3].

Thus, "the competition is very active form of the free initiative, free enterprise, private property generated, and this is, in turn, an essential feature of the market economy, whose mechanism is competitive. It is open confrontation, rivalry between business sellers to attract bidders from their clients. However, competition expresses the specific behavior of all subjects about the ownership, conduct that is done differently depending on the competitive and the particularities of the various markets." [4].

Competition in business represents all relationships between those who operate in the same market to achieve their interests in terms of economic freedom. The competitor is the person (or entity) that competes with one another (or others) to achieve the same business goals. There are several classifications of competition. One of these differentiates between the fair and unfair. [5].

Fair competition is held in compliance with the rules by competitors and means deemed accurate and recognized considered as such by the regulations in force in each country.

Unfair competition is any fact or act contrary to fair practices in the commercial activity. This competition is governed by various international treaties and national legislation in Romania.

Another approach of competition that makes is the distinction between direct, indirect and potential competitors.

The direct competitors are who provide the similar products and services. They can be primary (strongest) or secondary (not exert considerable pressure on the business).

Indirect competition is the market offering products and services that can substitute for those provided by another firm.

Potential competitors are: on the one hand, firms which have been established, but there is information that will appear in a particular field of activity due to the emergence of favorable conditions, on the other hand, there are companies that exist on the market today with fields that are currently not regarded as similar, but possible in the foreseeable future to refocus.

The desire to obtain a dominant market position, attract more customers and eliminate current and potential competitors, businesses resort to a series of actions and illegal acts that have a negative effect on the competitive environment. Unfortunately, these effects are being felt not only by the other competitors, and consumers and even society in general. Therefore, all these illegal acts are punishable by law. In this regard, our country is in effect the Competition Law no. 21/1996 which aims to protect, maintain and stimulate competition and normal competitive environment.

3. ANTICOMPETITIVE PRACTICES

Anticompetitive practices consist of a wide range of business practices by which a company or group of companies are committed to restrict competition in the market, in order to maintain or strengthen their market position and increase its profits without effort to reduce cost and enhance the quality of a product. Such practices are:

a. agreements or concerted practices unfair, including those caused by dominance, similar of the monopoly;
b. mergers potentially generating strong position and tendentious behavior in market dominance;
c. granted state aid to the advantage of the privileged economic operators;
d. enterprises behaviors representing the state monopoly or other exclusive rights granted by public authorities. [6].

Common policy Competition is the first supranational policy in the Community institutions were the most active and consistent on an upward trend and which generates such as consonances member countries". [7].

The provisions of this policy are listed as firm obligations and had the greatest impact on the countries that have recently joined the EU, including Romania. Under the Treaty of Amsterdam on EU competition policy is governed in particular by Articles 2, 3, 12, 31, 36, 73, 80, 81, 82, 85,86, 87, 88, 92, 93, relating to both the general and competitive mechanisms in the single market (of the goods, services, capital and labor) with a special focus on the goods, namely: protection against anticompetitive activities. Rigorously promoted and institutionalized by rules and bodies, competition policy in the European Union today has taken on the dimensions necessary to become a crucial condition of market economy. The beneficiary of such a policy of creating a competitive environment and competition is the consumer protection. [10].

Regulation of competition in Romania is contained in Law Competition Law no.21/1996. This law became necessary to create specific discipline of the free market that regulates balance and favorable effects determine the normal development of the economy and consumer protection. Adoption of Competition Law in force since 1 February 1997 represented a decisive step in creating an economic environment in Romania with a competitive nature and imposing rules in this regard. The Competition Law no. 21/1996 and secondary legislation issued in its implementation, Romania to fulfill obligations under the Association Agreement with the European Union competition policy, ensuring a high degree of compatibility on the treatment and regulation of agreements, concerted practices, abuse of dominant position and of merger control.

Aim of competition law followed the line of European law, art. 5, which penalizes anticompetitive agreements and art. 6, which penalizes the abuse of a dominant position as correspondence art. 81 and art. 82 from EC Treaty. Thus, under Article 5paragraph (1) are "Any express or tacit agreements are denied between undertakings or associations of economic agents and concerted practices which have as their object or effect the prevention, restriction or distortion of competition on the Romanian market or on a part of it".[8].

Content of the law is addressed:

a. economic agents or associations of economic agents, individuals and legal entities, of nationality or of Romanian nationality or foreign, by the acts and deeds that cause effects of restricted commercial free-market competition;

b. central public administration bodies and local decisions that they operate in the market operations, having effects on competition, except as the measures taken to protect an major interest.

The objective of the Competition Act is to provide specific behavioral conditions to stimulate and to protect competition, and the ultimate goal is the development of an balanced, efficient and competitive economy on global market. All of this is a guarantee for social welfare and consumer protection, dealers are compelled to pursue its activities in good faith, according to fair practices with the interests of consumers and fair competition requirements" [9].

For law enforcement, the purpose of investigation and administration of penalties of deviations, and the policy of encouraging the promotion and protection of competition, to create conditions for the establishment of free market rules of the game in Romania, was established the institution of Competition Council. Competition legislation in Romania deals extensively with the following types of anticompetitive behavior:

3.1. Agreements between companies. From the economic point of view, the agreements are as follows:

● *horizontal agreements* which relate operators at the same level of economic processes (eg. agreements between producers, agreements between distributors);

● *vertical agreements* concerning businesses at different levels of the same economic process (eg. agreements between manufacturers and distributors of the same product). [11]. Agreements between businesses fall under the prohibition set out in Article 5 of the Competition Act when it is likely to have a substantial negative impact of forms of market competition, such as price competition, the quality and quantity of products, through innovation by diversity and the novelty offer. Agreements can have such effects by significantly reducing competition between the parties or between the parties understand this and others.

According to the Explanatory Dictionary of Romanian language, the cartel is an agreement between two or more companies in the same industry, to cooperate in setting prices and / or coordinate the market and by mutual agreement to restrict production [1]. The purpose of such agreements is to increase profits by eliminating competition. Identifying and breaking the cartels is an important part of competition law and anti-trust policy.

3.2. The abuse of a dominant position

Article 6 of Law 21 states: “It is forbidden to use any abuse of a dominant position by one or more economic agents on the Romanian market or on a substantial part of it, using competitive practices which have as their object or may have as result effect on trade or consumer harm."[8]. Such abuse may in particular consist in:

a) the imposition, directly or indirectly, of unfair prices for sale or purchase or other unfair trading conditions and refusing to deal with certain suppliers or recipients;

b) limiting production, markets or technical development to the disadvantage of consumers;

c) application to parties to transactions of unequal terms for equivalent services, causing in this way, some of them at a competitive disadvantage;

d) the conclusion of contracts to acceptance by the other parties of supplementary obligations which, by their nature or according to commercial usage, have no connection with the subject of such contracts;

e) charging excessive prices or predatory pricing, in order to eliminate competitors or export sale below cost, with the coverage differences by imposing increased prices to the domestic consumers;

f) the exploitation state of dependence in which the enterprise is another of such organization or enterprise that does not have an alternative under equivalent conditions and breaking contractual relationships for the sole reason that the partner refuses to submit to unjustified commercial conditions.

3.3. The economic concentrations: mergers and other concentrations between companies

Control policy foundation mergers and acquisitions in Romania are Articles 10 to 15 of the Competition Law. Thus, the Merger prohibited, resulting in the creation or strengthening of a dominant position, lead or may lead to the restriction, prevention or distortion of competition on the Romanian market or on a part of it.'

According to article 10 of this law through mergers mean:

a) the merger of two or more previously independent enterprises or parts of enterprises, or

b) acquisition, by one or more persons already controlling at least one company, or by one or more businesses, whether by purchase of securities or assets, by contract or by any other means, direct or indirect control one or more other enterprises or parts of them. [8].

According to paragraph (2): Creation of a joint venture performing on a lasting basis all the functions of an autonomous economic entity shall constitute a concentration under the provisions of par. (1).

In art. 14 are summarized the conditions that must be met for an economic concentration under the law:

"The provisions of this Chapter shall apply to economic concentration transactions where the aggregate turnover of the undertakings involved in the operation exceeds the RON equivalent of EUR 10,000,000 and when at least two of the undertakings concerned in the territory of Romania, each of a turnover higher than the RON equivalent of EUR 4,000,000. RON equivalent is calculated at the exchange rate of the National Bank of Romania for the last day of the financial year prior to the operation." [8].

4. SANCTIONS PROVIDED BY LAW FOR NON-COMPLIANCE WITH THE LEGAL PROVISIONS OF COMPETITION

The field of competition in Romania is represented in two aspects:

- on the one hand is governed by national legislation and
- secondly, the Community law arises which has shaped the direction with priority placed by the provisions of the Treaty on the Functioning of the European Union and applicable legislation in Romania.

At the national level the main legislation relating to mergers, agreements anti-competitive concerted practices and abuse of dominant position is the Competition Law 21/1996, amended and supplemented, and gravitating around the second law adopted by the Competition Council.

At European Union level the relevant provisions of the Treaty on the Functioning of the European Union are directly applicable in Romania, since any anti-competitive agreement, concerted practice or abuse of dominant position is investigated by the Competition Council which it affects the trade between Member States.

Competition law is applicable, subject to certain conditions, all companies (regardless of nationality) for activities in Romania or abroad if these activities have an effect on competition in Romania, and public or local authorities involved in economic transactions and an influence, directly or indirectly, competition in a relevant market.

The Competition Council is an autonomous administrative authority responsible for the secondary legislation and the application of competition rules in this area in Romania. The penalties provided for in the Competition Act are contained in Article 51 of this Law.

Non-notification of mergers or implement them without approval by the Competition Council, committed intentionally or negligently, may result in, among other things, fines of up to 10% of the total turnover achieved in the previous financial sanction.

Violation of the provisions relating to anti-competitive agreement, decisions of undertakings and concerted practices committed intentionally or negligently, may result in, among other things, fines of up to 10% of the total turnover achieved in the previous financial sanctions. Additionally, individuals who have a role in creating / implementing an anti-competitive agreements, decisions by associations of undertakings or concerted practices may be criminal penalties under certain conditions. Violation of the provisions relating to abuse of dominant position, intentional or negligent, may result, among other things, fines of up to 10% of the total turnover achieved in the previous financial sanctions. Any aid granted unlawfully or improperly used must be repaid with interest.

5. SANCTIONS APPLICABLE TO COMPANIES IN ROMANIA UNDER THE COMPETITION LAW

Competition Council decisions are unilateral administrative acts of individual finding breaches of the law and apply appropriate sanctions shall take the necessary steps to restore the competitive environment, be given access to confidential information, it handles complaints made under the provisions of this law, and applications and notifications merger. (Article 27 paragraph 5, the Competition Law) [8].

In the following table we analyzed the fines imposed by the Competition Council of companies in Romania since 2003 until 2011 under the Competition Law.

Tabel 1. Amount of fines between 2003-2011

Year	Amount of fines (RON)	Amount of fines (EURO)
2003	3.779.360	1.006.353
2004	2.726.143	672.590
2004	159.700.000	44.000.000
2006	55.235.010	15.671.729
2007	985.600.200	29.720.000
2008	113.204308	30.739.481
2009	8.755.512	2.377.471
2010	132.400.000	31.490.000
2011	1.246.641.342	249.164.875

Source: made by author based on data from www.consiliulconcurentei.ro.

It was found an increase of the fines imposed in the last culminating in 2011, when the amount was 9.3 times higher than the previous year. From the point of view of the nature of the breach of competition law, in 2011, 72% of the total amount of penalties for cartels were 22% for abuse of dominant position, 6% for anticompetitive vertical agreements. [5].

6. CONCLUSIONS

Analyzing the internal legislation of our country and the Community competition, we can say that Romanian law is consistent with Community law.

Competition Council's work is carried out on two main components: a preventive monitoring and supervision of market actors in these markets and a remedy designed to restore and ensure the development of a normal competitive environment.

The mission of the Romanian competition authority is to protect and stimulate the competition in the Romanian market to develop a normal competitive environment, because, ultimately, to ensure the best possible promotion of consumer interests.

In recent years it was observed an increase in the activity of the Competition Council materialized fines companies in Romania, as required by law.

7. REFERENCES

[1]. http//.www.DEX 1998.ro [19 Mar 2013];
[2]. McDonald, F., Dearden, F., (1999), *European Economic Integration, Person Education,* Third Edition;
[3]. Drăgan, G., (2005), *Uniunea Europeana între federalism şi interguvernamentalism. Politici comune ale UE,* Editura ASE, Bucuresti;
[4]. Drăgan, G., Miron, D., Marinas,L., Ilie, F., (2002), *Economia Uniunii Europene*, Editura Luceafarul, Bucureşti;
[5]. http//www.consiliulconcurentei.ro; [12 Mar 2013];
[6]. Cini, M., Mc Gowan, L.,(1998), *Competition Policy in the European Union*, The European Union Series;
[7]. Sută,N., Drăgan,G., Miron,D., (1999), *Integrare Economică Europeană*, Editura Economică, Bucureşti;
[8]. http//www.legalis2011 Legea concurenței nr.21/1996 republicată; [12 Mar 2013];
[9]. http//www.legalis2011.Legea privind combaterea concurenței neloiale nr.11/1991 republicată [19 Mar 2013];
[10]. http//www.eudirect.ro [10 Mar 2013];
[11]. Berinde, M., (2012), *Concurență şi competitivitate*, note de curs, Facultatea de Ştiințe Economice, Master an II, Universitatea din Oradea.

CANADIAN APPAREL INDUSTRY

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Abstract: The textile/apparel has changed dramatically in the last 20 years. The decisions by the World Trade Organization to eliminate quotas and reduce tariffs, the multiple free trade agreements signed between countries, the ease of doing international business, as well as many other factors have contributed to the migration of production activities from high labour cost countries to low labour cost countries. The first countries affected obviously were the most developed Western economies. Canada has not been an exception with an overall decrease in the value of textile/apparel shipments of more than 50 %.
To reduce the negative impacts of these changes, a number of approaches have been tried and projects implemented. This paper presents the most important factors that have contributed to the demise of textile/apparel production in Canada and provides a few numbers demonstrating the importance of the phenomenon. It also presents some of the solutions that have been put in place, both by the governments and the private sector, with more or less success. It concludes on some thoughts on the future of the industry in the most economically developed countries and some possible avenues to improve the situation.

Key words: Apparel, Textiles, Globalization

1. INTRODUCTION

In the last 20 years or so the situation of the Canadian, as well as the global, textile/apparel industry has completely changed. In Canada, as is the case in most high labour cost countries, the industry was redefined to focus on domestic product development rather than domestic production. Hence the "new" sector now includes manufacturers, wholesalers, offshore producers and vertically integrated retailers. This new definition better reflects the sector's contribution to the economy. It is not exclusive to Canada.

Likewise in Europe where the European Monitoring Venter on Change (EMCC) in a dossier on European textiles and clothing sector [1] states that "…As a result, in order to remain competitive, the industry has had to restructure and modernize itself, as well as to relocate its production to lower wage countries both within and outside the EU…. Today the competitive advantage of the European textiles and clothing sector lies in its focus on quality and design, innovation and technology, and high value-added products."

In its study on the impacts of the fashion industry on the economy the British Fashion Council [2] even includes all peripheral sectors as Figure 1 shows:

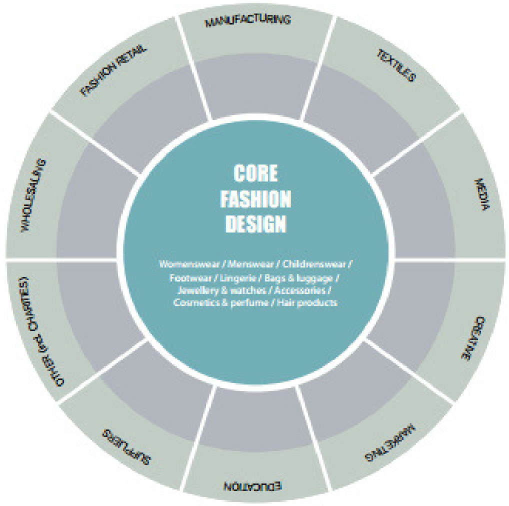

Figure 1: The UK fashion industry and its impacts

In order to discuss trends and strategies required to aid the apparel industry, one must therefore take a wider perspective. In Québec the *Ministère de l'industrie et de la finance* clearly stated its orientation [3]:

> « L'industrie de l'habillement occupe une place importante au Québec. Cette industrie est aujourd'hui frappée de plein fouet par la mondialisation des marchés. On assiste à une augmentation constante des importations des pays à bas coûts de revient vers les pays industrialisés. Compte tenu des nombreux emplois en jeu, la plupart des pays industrialisés tentent de mettre en place des stratégies pour appuyer le maintien de leur industrie. Le Québec n'échappe pas à ce phénomène mondial. Il devra donc développer de nouveaux modèles d'entreprises capables de demeurer concurrentielles. Pour assurer cette restructuration, le Québec doit se mobiliser et amener les différents intervenants à poursuivre un objectif commun de développement de l'industrie de l'habillement. »

2. FACTORS OF CHANGE

A number of factors have led to the new situation in the textile/apparel industry in Canada. The impacts are important. In the textiles industry, industrial shipments have fallen from 6,9$ billion in 2004 to 3,2$ billion in 2010; in the apparel industry they have gone from 7,8$ billion in 2004 to 2,5$ billion in 2010.

In no particular order, the main factors to this demise are:

North American Free Trade Agreement

This free trade agreement between the United States, Canada and Mexico eliminates all tariffs and quotas in trade between these countries. In the apparel industry, it is complemented with the Tariff Preference Levels which requires that the apparel exported free of tariffs must be made with textiles produced locally. Obviously Mexico has benefited greatly in all sectors with high labour costs as salaries are much lower in this country than in the other two.

Canadian Dollar

From a low value around 0,65$$_{US}$ in the early 1990s, the Canadian dollar has shot up to 1,02$$_{US}$ in 2011. This has had a direct impact on the cost of Canadian garments in the U.S.A going up by 35% in a few years. As the U.S.A. market accounts for most of the Canadian apparel exports (± 85%) the impact was enormous.

Concessions to Least developed countries

In 1993, the Canadian government granted a special status to 48 of the world LDC eliminating all quotas and tariffs on their goods. Since a number of these countries were either geographically close to Canada (Haiti, Jamaica, etc.) while others belonged to the Commonwealth (Bangladesh, Pakistan, etc.) they were well positioned to export to Canada.

World Trade Organization Agreement on Textiles and Clothing

As of the 1st of January 2005, the WTO agreed a drop on all quotas on clothing between member countries thereby opening the Canadian doors to all WTO members, the most important of them, from an apparel production point of view, being China, Vietnam, Cambodia, etc. In the same vein the WTO has also opted for a gradual decrease in tariffs on apparel trade starting on the 1st of January 2012.

Other free trade agreements

Over and above the agreements mentioned above, Canada also has a number of free trade agreements with, among others, South American countries. Likewise, the U.S.A. also have different trade agreements which impact negatively on Canadian apparel imports; for example the Caribbean Trade Partnership Act, the African Growth Opportunity Act, and the Andean Trade Preference Act, all of which allow for the shipment of U.S. made yarn and fabric to the countries where garments are then produced and exported to the U.S.A free of tariffs.

Outward Processing Remission Order

The OPRO is the Canadian version of the Andean Trade Preference Act allowing the shipment of Canadian textiles to different countries where they are transformed into garments and re-exported to Canada free of tariffs.

Increasing regulations

New regulations are brought in either by Health Canada or the Canadian Competition Bureau to ensure that garments meet safety, labeling or construction requirements.

Social and environmental compliance

The recent example of Dhaka has brought to the fore the need for Canadian companies to get more and more involved in the supervision of their outsourcing partners adding one more level of complexity to production management.

World Economy

Canadian apparel companies also have had to deal with the 2008 "crash". The U.S.A. market as well as the local market shrivelled when they have not totally disappeared with the result not only that sales decreased but also that a number of distributors/retailers have gone bankrupt and been unable to pay the purchased goods.

Demographic and consumption trends

The Canadian population is aging which brings a need to adapt but also general decrease in spending on fashion.

Apparel price deflation

With the arrival of products manufactured in low labour cost countries, prices have generally decreased. Canadian producer therefore needed to decrease their manufacturing costs either through productivity gains or outsourcing. Yet, at the same time, some production costs have increased. The price of cotton has gone up by more than 200% between 2005 and 2011. Transportation costs have also been influenced by the increased value of petroleum and, on some routes, the dearth of transportation alternatives.

Lack of planning

Finally, one must mention the poor state of management in the apparel industry for which business people only have themselves to blame. A survey conducted by the *Apparel Human Resources Council* on strategic planning found that only 22% of apparel companies in Canada have a strategic plan and only 32% have a succession plan. What this basically means is that the garment industry is a day-to-day affair.

3. INDUSTRY REACTION

The apparel industry has obviously reacted to these threats and changes in the environment. At first they clamoured for the reintroduction of quotas and tariffs. Yet this approach has only led to the protection of the most inefficient members of the industry in the past; a situation which has in part caused the inability of Canadian manufacturers to compete when markets opened. Moreover, consumers certainly perceive an advantage in being able to purchase a 6$ T-shirt or a 15$ dress shirt when these items were double or triple that price 20 years ago.

The sector has therefore looked at more positive solutions. The most important trends are:

Focus on the value chain

As shown in figure 2 [4] more and more companies are focusing on marketing and sales activities as opposed to manufacturing. This has meant either the development of a private label or, in the cases where such a label already existed, downward vertical integration to control, and benefit, by selling directly to consumers.

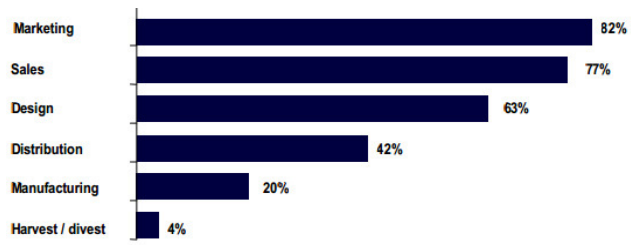

Figure 2: Focus on value chain

Unfortunately this shift has often meant that a manufacturer has sent its production offshore to concentrate on marketing activities and, although still very present in the Canadian business world, no longer shows in the manufacturing statistics.

New areas of interest

Companies focus more and more on:

- eco-friendly products;
- e-marketing and selling online
- opening new, non-traditional geographic markets (i.e.: China, Korea, Russia, etc.);
- adding new apparel categories;
- adding new products beyond apparel;

4. GOVERNMENT AND STAKEHOLDERS' REACTIONS

The different levels of government in Canada have intervened to try and save the apparel industry.

PRO-MODE Québec

The government of Québec, where more than 80% of the garment producing jobs are, put in place an 82 $ million subsidy program, spread over five years, to help companies accomplish the things mentioned above as new areas of interest. This program (figure 3) [5] focused on five strategies:

- foster the adaptation of business models
- encourage product introduction, marketing, and exporting
- support reliance on design and advanced technologies
- promote Montréal as a fashion center
- make the business environment more favorable

The total amount devolved to the program was divided:

- 15 $ million to the development of business models
- 15 $ million to marketing and exporting activities
- 40 $ to investment in design and advanced technologies
- 3 $ million to the promotion and recognition of Montréal
- 8,7 $ million to worker training

Figure 3: PRO-MODE Québec

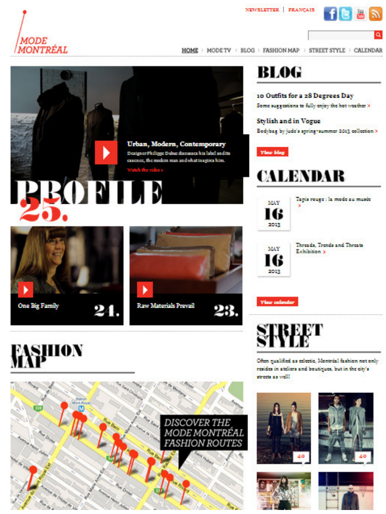

Figure 4: Mode Montréal

Mode Montréal

Of the 82 $ million offered by the government of Québec approximately 2 $ million was given to the city of Montréal, the province's metropolis, to promote the fashion industry in general but mostly its design component. The city launched a site enabling residents and visitors to rapidly inform themselves on fashion hot spots (figure 4) [5].

Vestechpro

Another investment of the government of Québec, in collaboration with a local college, was the creation of Vestechpro. This center's mission is to supply businesses with the latest information, and possibly training, on technological developments in garment production (figure 5) [6].

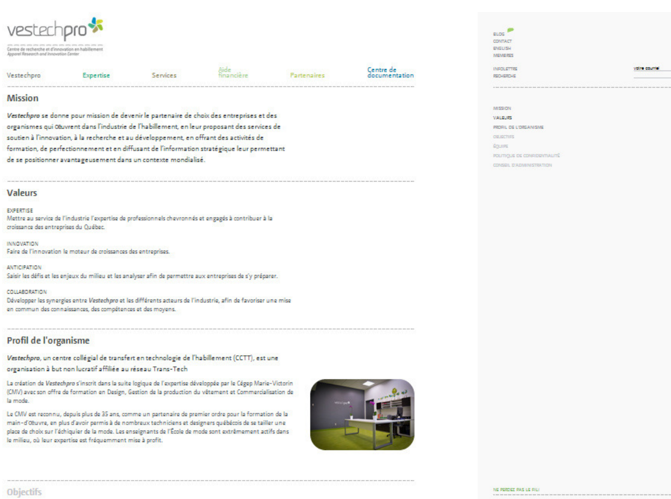

Figure 5: Vestechpro

Figure 6: PME 2.0 Cefrio

PME 2.0

In order to better understand the information technologies and their role in the apparel business while fostering an interest to implement such technologies, the government of Québec also created a program known as PME 2.0 [7] with a mandate to:

- survey IT usage in the apparel industry
- identify the best practices
- launch a number of test projects to eventually spread the results in the industry.

Concertation table

Finally, the government of Québec also put in place a concertation table, on which representatives of all fashion domains (design, production, distribution) sit with the objective to find avenues to pursue to reinforce the industry. One of the latest projects discussed is the implementation of a Prato like center of excellence.

Canadian Apparel Federation

Members of the industry have also invested in their future through the Canadian Apparel Federation which invests heavily in courses and conferences on the subjects of interest [8].

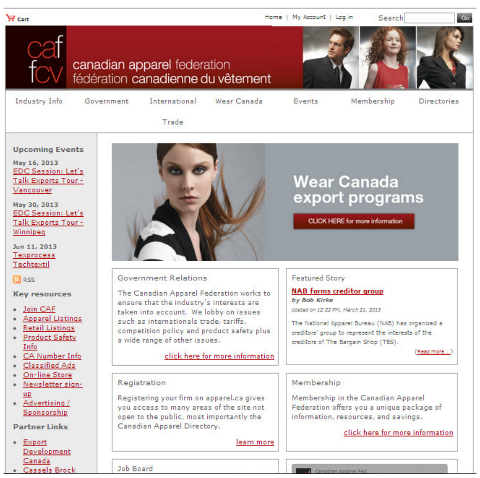

Figure 7: Canadian Apparel Federation

Figure 8: CTT Group

In the area of textiles, three major interventions can be found.

CTT Group

The first and most important in the creation of the *Centre de transfer des technologies* now known as the CTT Group. Similar to Vestechpro in the fashion sector, the CTT rapidly evolved and took the leadership role in organizing different activities and projects for the industry (figure 8) [9]. The CTT focuses on three areas:

- networking
- technical assistance
- textiles development.

Hightex Expo

Among the CTT's accomplishments, one of the most important is the creation of a yearly show where textile related businesses and academic have a chance to meet and exchange on the future or the industry (figure 9) [10].

Technology Roadmap

Industry Canada has also contributed to the survival efforts in the textile industry through its investments in the preparation of an industry roadmap identifying the main areas of potential growth and focusing the efforts on four specific types of textiles (figure 10) [11]:

- medical

- construction
- transport
- production.

Figure 9: Hightex

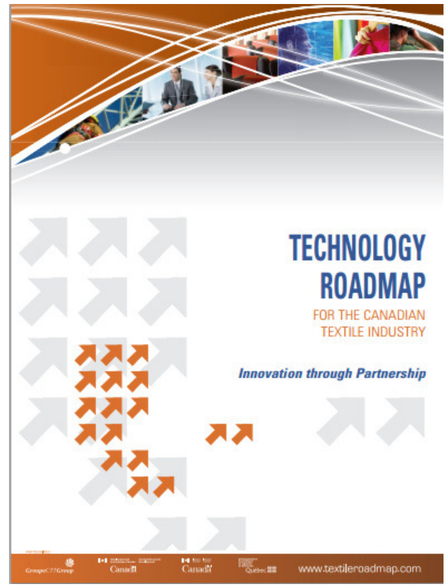

Figure 10: Technology Roadmap

5. CONCLUSION

Does the above discussion mean that the textile/apparel production sectors are dead in Canada? Definitely not! High volume, low cost, production of items such as cotton T-shirts will probably always stay with the current low labour cost producing country (whether China, Bangladesh or eventually another developing area of the world). Yet a number of factors point to a return of some high-end production in Canada and other economically advanced countries.

First is the increase in living standards and wages in China, the main garment exporter of the last decade. Hourly wages are now in the neighbourhood of 1,25$ an hour; although this nowhere compares to the average 13$ an hour in Canada, the increased transaction and transportation costs make it much less interesting than it used to be. The increase in internal consumption in China also makes it more and more interesting for Chinese companies to produce long runs for the internal market; this in turn impacting on the minimum orders and lead times for international orders. These factors make it, in some cases, impossible for Canadian companies to order from China and, in other cases, impossible to order repeats.

There will always be countries such as Bangladesh with a 0,25$ per hour labour cost. Yet, and this is the second element in favor of a return of some production to the Western world, the tragic events of Dhaka in the spring of 2013 will not only impact on their ability to maintain the working conditions allowing these rates but also on the consumers' perception of such products and modify their attitude from a solely price oriented decision making process to a more "social" approach.

We have already started to see more demand for local production in Canada. In fact the problem no longer is keeping our facilities busy. It more and more is in finding the qualified manpower to accept all potential orders. This qualified manpower was let go during the downturn and training programs were dropped by governments. We now find ourselves in a situation where we may no longer wish to outsource offshore but have to!

6. REFERENCES

[1] http://www.eurofound.europa.eu/emcc/content/source/eu08011a.htm
[2]http://www.fashion-manufacturing.com/wp-content/uploads/2012/04/BFC-The-Value-of-The-Fashion-Industry.pdf

[3]http://www.economie.gouv.qc.ca/bibliotheque/publications/page/profils-industriels-11036/?no_cache=1&tx_igaffichagepages_pi1%5Bmode%5D=single&tx_igaffichagepages_pi1%5BbackPid%5D=88&tx_igaffichagepages_pi1%5BcurrentCat%5D=76&cHash=f0276980ed35a20a4dd812751c74c3ed
[4] http://apparelconnexion.com/tools/files/b891ecaf-4376-7b1f.pdf
[5] http://www.modemontreal.tv/en
[6] http://vestechpro.com/?post_type=vestechpro&lang=fr
[7] http://www.cefrio.qc.ca/projets-recherches-enquetes/numerique-developpement-competences/pme-20/
[8] http://www.apparel.ca/
[9] http://www.gcttg.com/
[10] http://www.gcttg.com/en/our-services/events-hightex.html
[11]http://www.ic.gc.ca/eic/site/trm-crt.nsf/vwapj/textile-textiles_eng.pdf/$file/textile-textiles_eng.pdf

EVALUATION OF THE EMOTIONAL CLIMATE DURING DIFFERENT ACADEMIC ACTIVITIES

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Abstract: This paper aims to describe the general emotional climate at the *Faculty of Textiles-Leatherwork and Industrial Management* from Iasi, and then analyze how it is perceived by students the relation between their positive or negative emotions and creative behaviour during classes. The method used was survey based on two original questionnaires which contain only open questions. The preliminary quantitative research was focused on the interaction rules between members of the same group of students, but also among students and their academic staff. Taking in consideration the first study, in the second stage of the research the main attention was given to different types of emotions lived by students during different academic activities (courses, seminars, workshops or other practical activities). They had to indicate the type of emotions (positive or negative) and then they had to give some examples when thinking of their own experience. At the end of the second questionnaire, it was investigated what emotions can stimulate creativity and what emotions may block it. The results show a strong relation between enthusiasm, joy, interest and students' creative behaviour. The obtained results will be used for creating a positive emotional climate at the workshops of the "Creativity and innovation" discipline (Industrial Design specialization).

Key words: positive emotions, negative emotions, interaction rules, classroom environment.

1. INTRODUCTION

Any human activity, physical or intellectual, presumes strong, medium or low intensity emotions, usually seen as biologically primitive responses to certain stimulus [1]. Some emotions are shown, others are hidden, especially if individuals are at the workplace or studying in the classrooms.

There is an increasing interest in analyzing the quality of the emotional interactions between students and their professors or among teams of students working with their instructors [2, 3]. The explanation is that classroom environment clearly determines students' performances and creativity. It is not simple to define the emotional climate, a complex phenomenon that involves people's responses to different situations; the definition is: "a sum of feelings and attitudinal responses of individuals, shown during the interaction with the professor, manager, colleagues or customer" [4, 5].

The preliminary study took in consideration the model *"positive affectivity vs. negative affectivity"*, aiming to describe the general interactions between students and among students and their professors inside the Faculty of Textiles-Leatherwork and Industrial Management. The second stage of the research was based on the understanding of the first results, and the survey was focused on the emotions experienced by students during different types of academic activities (courses, seminars, workshops…). We wanted to investigate what are the most intense emotions, positive and negative, when and where students hide their emotions, what emotions improve their creativity and what emotions block it. The results are necessary for creating a positive emotional climate at the courses & workshops of the "Creativity and innovation" discipline.

In terms of methodology, a quantitative research was conducted between 2011 and 2013. The total number of participants was 85 (30 students replied to the questions contained in the first questionnaire, and 55 students expressed their opinions at the second questionnaire - 1st year students, 3rd year students and master students).

2. PRELIMINARY RESEARCH

The idea of this research came from the necessity to improve the interactions among students and the students' attitude shown to their instructor during the teaching process (flexible thinking, spontaneity, constant attention, interest). Later, it was proposed a new discipline "Creativity and innovation" for the students of the third year, so it was interesting to observe the relation between emotional climate and their creative behaviour.

At this survey there were 30 participants who answered to four questions (20 students from the first year and 10 students from the master studies):

I. Describe an intense moment that you remember from the period of time spent in the faculty.
II. What rules do you follow when you interact with other students?
III. What rules do you follow when you interact with academic staff?
IV. What word would you use to express best the emotional climate inside your group?

This preliminary research shows that all students keep vivid memories from the examination period of time because they experienced strong basic emotions as: fear, terror, anger, sadness, vigilance (Figure 1 depicts the emotions model created by Robert Plutchik in 1980). These basic emotions have different degrees of intensity ranging from light to very intense and together form a certain emotional pattern that is easily remembered by the person even after many years (so called "long term memory").

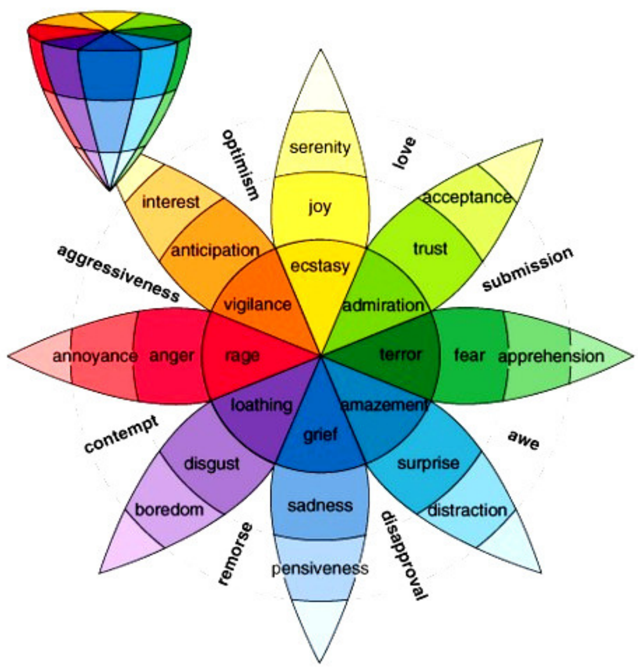

Figure 1: The emotions wheel (Plutchik, 1980) [4]

At the second question of the investigation, 53.3% of the respondents place on the top of the list "respect". Respect is not an emotion, but an expression of recognizing the value of another person and it is similar somehow to admiration, appreciation, honour and esteem [5, 6]. An emotional climate based on respect shows a positive attention given to your colleagues by listening their ideas, trying to understand the real meaning of their words, friendly debating and accepting with calm your colleagues' opinions.

At the third question, 86.67% of the students said that "respect" is a must when you interact with professors. In this case, showing respect proves recognition of the instructor's knowledge. The student follows the rules of etiquette, obeys, listens carefully, and doesn't argue if he has a different solution/opinion to a certain problem. The connection between professor and his students is based on communication and understanding, but sometimes both sides have to hide their real emotions and behave properly during the academic activities.

At the fourth question, 10% of the total number of students didn't write any opinion related to the group climate. A percentage of 50% of the students said that they felt a friendly atmosphere, harmony, unity and good communication in their group. This shows a positive emotional climate and team-based relations. Only one student of the total number of 30 wrote "competition" when referring to the group climate.

3. FINAL RESEARCH

Taking in consideration the results of the preliminary investigation, a second survey was conducted during 2012 and 2013. This time the number of participants was 55 and master students were included too. This time, the questionnaire contained seven questions:

I. Which emotions did you experience most frequently during:
   a. Course
   b. Seminar
   c. Workshop
   d. Other practical activities
II. Write top three emotions that you lived together with your colleagues
III. Write top three emotions that you had when interacting with your professors
IV. Explain top three emotions that you lived in your student's life.
V. Describe a situation when you had to hide/change your emotions as a student
VI. Give a single word to depict the emotional climate during the academic activities inside your group
VII. What emotions do you think that improve your creativity? What emotions do you think that block your creativity?

At the beginning of the questionnaire, it was given the classification of emotions in two categories:

- *Positive emotions* (interest, enthusiasm, curiosity, empathy, understanding, joy, pleasure…);
- *Negative emotions* (fear, apathy, regret, hate, hostility, anger, sadness, rage, terror…).

The survey was organized in the second semester. Students were instructed to write the type of emotions (positive or negative) and then to give one or more examples of emotions in that category they provided, emotions which they really experienced. The results are shown in the Table 1.

Table 1: The results of the first 4 questions (the second survey)

Question Code →	Ia		Ib		Ic		Id		II		III		IV	
	+	-	+	-	+	-	+	-	+	-	+	-	+	-
Number of emotions*	51	5	46	5	47	7	51	0	111	37	106	48	82	50
Percentages (%)	*91,1*	*8,9*	*90,2*	*9,8*	*87,04*	*12,96*	*100*	*0*	*75*	*25*	*68,83*	*31,17*	*62,12*	*37,88*

* each student can write one or more emotions of the same type (positive or negative)

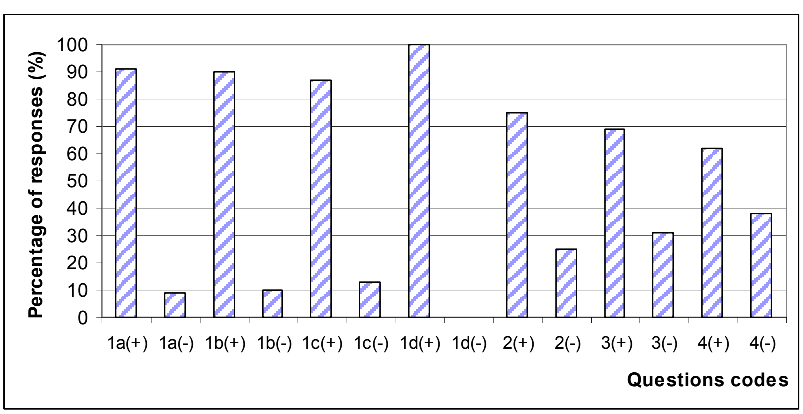

Figure 2: The results of the questions I, II, III and IV(first survey)

It is good to notice that students have positive emotions ranging 87 to 100% at the courses, seminars, workshops and practical activities. Just a few indicate the presence of negative emotions as fear to participate at that activity, shame because they didn't study enough, or even boredom during the seminar or course (in this case, the instructor has to be blamed because he didn't prepare an interesting lecture for his students and didn't succeed to stimulate their attention).

The biggest score was achieved at the practical activities – 100%. In this category are included scientific research of students, optional design projects, participation to facultative activities and exhibitions, etc.

As for *the second question*, 75% of total number of replies show positive emotions (joy, understanding, common interests, and pleasure) lived with the colleagues inside and outside the university. Only 25% of replies were focused on negative emotions. The obtained percentage (75%) is not very high as expected, this means that students of the same group don't spend too much time together or if they are forced to stay together in the classes, they don't care too much for developing a good emotional environment. It is possible that this emotional disonance is a consequence of the bad influence of computer (internet) which greatly affects the social relations in the past years.

Related to the interactions with professors *(the third question),* only 68% of replies show positive emotions as trust, admiration, serenity, enthusiasm and joy. There were students who didn't make any comments when thinking of this type of interactions. Usually students say that they have lived both emotions, positive and negative, depending on the situation. For example, exams always determine bad feelings, fear and great intellectual effort for hiding their emotions. Management of the emotions is better done for master students who have to make oral presentations and write papers.

Trying to explain the top three emotions lived in the students' life *(the fourth question),* only 62% of replies are referring to positive emotions, being written negative emotions too. The instructor's role is very important, and students remember severe professors most often than kind professors. It is necessary that a professor to have a good control of his personal emotions as anger, sadness, anxiety and talk with calm, show empathy and understanding.

As for the *fifth question* of the survey, it was noticed that 20 students from 55 (a percentage of 36%) refused to answer. Their ages are over 30 years. One possible interpretation of this great percentage might be that a student over 30 years knows by experience/instinct how to interact with the teaching staff. The results of the survey on this topic are shown in Table 2 and Figure 3.

Table 2: The results of the fifth question

Emotion	Replies, %
fear	51,43
anxiety	20,00
anger	11,43
blame	5,71
regret	5,71
disapproval	2,86
enthusiasm	2,86

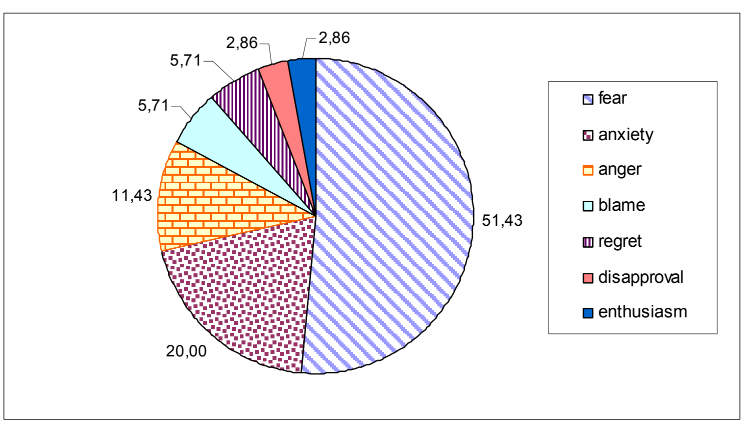

Figure 3: The results of the 5th question (%)

The majority of respondents (34 from 35, this means 97,12%) remembered conflicts and oral exams when answering at this topic. On those occasions they had to hide their emotions (usually fear, shame, anger, anxiety, regret) or change their mood to a joyful one - especially male students react like this. Stress appears due to the high intensity of emotions, the intellectual effort to hide them and because of the duration of these emotions. Sometimes a positive atmosphere help students to calm down and relax, forgetting or diminishing the negative emotions.

Only one student replied that she had to hide her positive mood during the academic activities by doing big efforts to remain serious in the class. She changed her mimics, she stopped laughing or smiling and she tried to pay attention to the professor's lecture.

The replies of *the sixth question* try to describe the emotional climate inside the group. The results are shown in Table 3 and Figure 4.

Table 3: The results of the sixth question

Emotion	Replies, %
common interests	29,17
joy	27,08
curiosity	16,67
understanding	14,58
boredom	6,25
unity	2,08
envy	2,08
disapproval	2,08

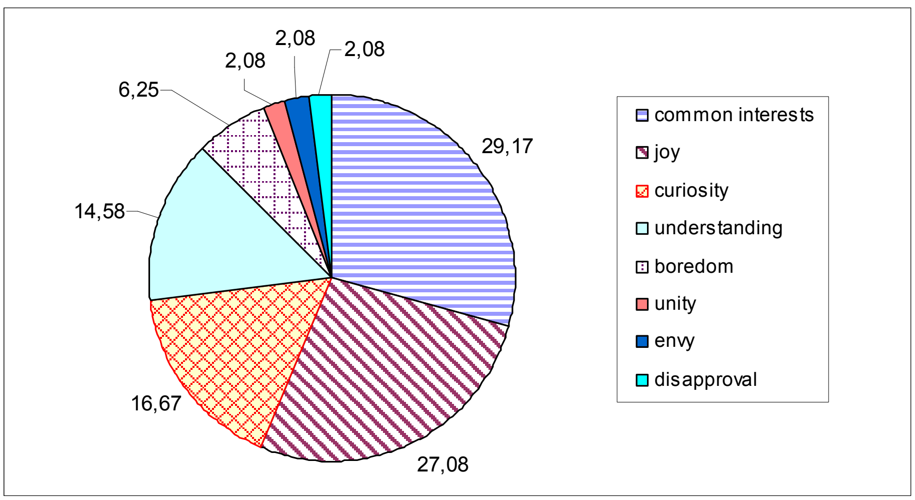

Figure 4: The results of the 6th question (%)

It is noticed that 89,58% of replies tell about a positive emotional climate based on common interests, joy, curiosity, understanding and unity, and 10,42% of replies describe a negative emotional climate characterized by boredom, envy and disapproval.

At the last question *(the seventh)* students were asked to give examples of emotions that improve or block their creativity. A proportion of 60,47% of replies give "enthusiasm" as a main emotion for improving the creative behaviour, and 23,26% from the total number of answers indicates curiosity (Figure 5). The second part of this question was focused on the emotions that block creativity. The majority of the replies (83,78%) was pointing to fear of making mistakes or to obtain a wrong result from the individual or team-based experiments.

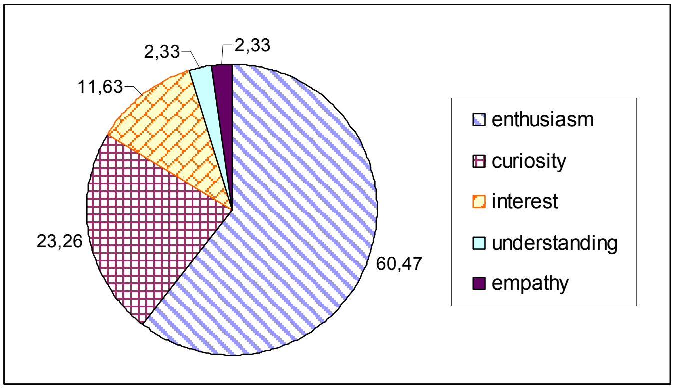

Figure 5: The results of the 7th question, emotions that improve creativity (%)

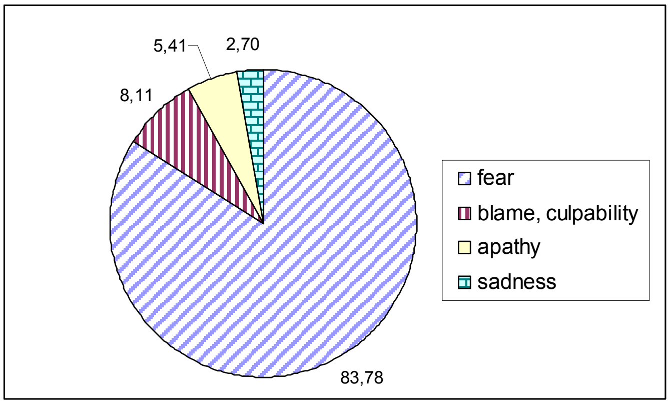

Figure 6: The results of the 7th question, emotions that block creativity (%)

4. CONCLUSIONS

The results of this research describe the general emotional climate, showing how students interact inside their groups and with the academic staff during different types of activities. It was shown that in many groups exist a positive emotional climate based on common interests, joy and curiosity. Exams are a source of fear and students try to hide their emotions as much as they can.

For improving creative behaviour, respondents wrote two main emotions: enthusiasm and curiosity. A warm climate, empathy and a good connection with the professor are favourable factors for individual and collective creativity. Fear, blame and apathy block creativity in almost all situations and generate emotional disonance, inhibition, low performances and poor flexibility in thinking.

5. REFERENCES

[1]. Averill, R.J. et al. (2001). Emotions and creativity, East and West, *Asian Journal of Social Psychology,* 4, 165-183, Available online (Accessed 15.10.2012):
http://people.umass.edu/jra/studiesofemotion/articles/creativity/EastWest.pdf

[2]. Brackett, M., Reyes, M.R., Rivers, S.E. et.al. (2011). Classroom emotional climate, teacher affiliation and student conduct, *Journal of Classroom interaction,* vol.46.1, p.27-36, ISSN 0749-4025.

[3]. Grining, C.L., Raver, C.C., Champion, K., et.al. (2010). Understanding and improving classroom emotional climate and behaviour, *Early education and development,* 21(1), 65-94, Taylor and Francis Group, ISSN 1040-9289. Available online: http://steinhardt.nyu.edu (Accessed 20.03.2013)

[4]. Plutchik, R (2001). The nature of emotions, Available from (Accessed 17.04.2013):
http://www.emotionalcompetency.com/papers/plutchiknatureofemotions%202001.pdf

[5]. Truta, C. (2011). Emotional management in the activity of a school psychologist, *Abstract of the Ph.D. Thesis*, University of Bucharest, Romania

[6]. http://www.emotionalcompetency.com , *Accessed: 19.04.2013.*

COLLABORATIVE TECHNOLOGIES AND KNOWLEDGE MANAGEMENT IN THE FASHION INDUSTRY

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Abstract: The fashion industry has shifted from a resource based industry to a knowledge based industry. This requires the education providers to deliver new training methods, permitting students and professionals to quickly master key technologies for designing and producing personalized products and fully make use of the knowledge in the entire supply chain. An appropriate information technology-based platform can provide necessary support to reach this objective. This paper examines the knowledge management in the fashion industry. Of all levels of knowledge existing in the textile supply chain, fashion design represents the most important added value. The value of fashion design is about 70% for important brands and 30% for the mass clothing. In this background, improving the quality of training on fashion design towards customer's personalized needs and exploration of textile and fashion knowledge of the entire supply chain are significant for developing a sustainable textile and fashion economy in Europe and preserving European fashion reputation in the world. Fashion designers attempt to design clothes which are functional as well as aesthetically pleasing. Today, most clothing is designed for the mass market, especially casual and every-day wear. Knowledge management within the fashion industry includes the way knowledge flows in production networks and supply chains, and the way knowledge of fashion moves across geographical boarders. Within the fashion industry it is not necessary neither possible to possess all the attributes of fashion design and creativity in-house, but rather it is important knowing where to acquire it within the wider fashion environment.

Key words: knowledge management, fashion, customization, CAD/CAM

1. INTRODUCTION

The competitive pressure of globalization is causing textile and garment manufacturers to lower production costs, increase their efficiency and to create leaner value-adding processes. To be able to cope with these changes, measures must be implemented, including the improvement of the internal organization, and the establishment of co-operations with external organizations to create a continuous supply–demand network. As a result, production logistics as well as information and communication technologies have gained importance, in order to keep job functions requiring higher qualifications within Europe (Zulch et al., 2011) [1]. Under the situation of economic globalization, the leading position of Europe in fashion culture and fashion industry has been attenuated because of quick transmission of new designs and fashion information on Internet, diversification of consumer's needs and significant relocation of its manufacturing to low-wages countries.

The fashion industry is the most fragmented industry in the European economy. It has similar knowledge management needs to those of most other industries. The apparel retailing business is dealing with a huge amount of information, such as thousands of style variations. In fact, the fashion business is more complicated than other businesses because apparel is consumer goods, the industrial goods. The greatest challenge for retailing apparel over the Internet, via mail order or in department stores is to offer apparel in the desired fit, and in the desired style, fabric and color. With information technology and digital technology, it is a natural progression for manufactured apparel to move from mass production to mass customization. In the trend of mass customization, KM is necessary for the fashion business (Jonas Kissling Hansen, 2009) [2].

2. KM TOOLS IN THE APPAREL BUSINESS BASED ON INFORMATION TECHNOLOGY

The fashion industry has shifted from a resource based industry to a knowledge based industry. This requires the education providers to deliver new training methods, permitting students and professionals to quickly master key technologies for designing and producing personalized products and fully make use of the knowledge in the entire supply chain. An appropriate information technology-based platform can provide necessary support to reach this objective (Xianyi Zeng et all, 2010) [3].

In addition, garments are expected to match the physical dimensions of the customer and thus offer a satisfactory comfort. Now more than ever, garment companies must be able to quickly adapt to customer requirements (Qin, 2008) [4].

Major trends in the garment industry are the following:

- **Structural changes** due to the changing demands as well as increasing global competition and mainly consist of the following six basic trends (Altenburg et. al, 2011) [5]: customization, moving manufacturing facilities to other countries, reduction in lead times, structural differentiations in retailing, changes in relationships between manufacturers and electronic markets, increasing vertical integration and coordination;
- **Technological challenges** are a consequence of the aforementioned structural changes, rapid and cost effective design of flexible manufacturing facilities is one of the focus areas for gaining a competitive advantage in today's fierce business environment (Jagstam et al, 2002) [6]: 3D body scanning, industrial customization combined with e-commerce.

Within the company, people deal with information through the Internet from customers, contractors, retailers, sourcing suppliers, and manufacturers. Some of the information that can be leveraged to knowledge is applicable for merchandising, garment customization, and business processes.

Like other most businesses, in the apparel business, the knowledge is a set of leveraged information. The knowledge has connectivity, leveraging, and applicability that are always necessary for transformation from the information. Most knowledge used in the fashion industry for developing products is considered as explicit knowledge.

The knowledge gained from customers is used for customers' additional knowledge. It creates new revenues with existing knowledge in the company or organization. Fashion shops records and Internet orders might be good example of how a firm gets customer knowledge. Customer knowledge is significantly important for customization with the following reasons:

- Better and timely design of new products and services;
- Early warning and competitive intelligence;
- Customer commitment and loyalty;
- The synergy of collaboration (Srikantaiah & Koenig, 2000) [7]

With increasing information technology, KM became a very important topic in the business world. In the fashion business, Internet, search engines, Intranets, and workflow tools are used for accessing the explicit knowledge that can be codified, can be stored and shared with receivers. Internet became a very important knowledge nugget for business to business (B2B) and consumers to business (C2B). The use of Internet not only changed consumers' life styles, but also business practices. It has an important point of connection between consumers and firms in the world.

This paper examines the knowledge management in the fashion industry. Of all levels of knowledge existing in the textile supply chain, fashion design represents the most important added value. The value of fashion design is about 70% for important brands and 30% for the mass clothing. In this background, improving the quality of training on fashion design towards customer's personalized needs and exploration of textile and fashion knowledge of the entire supply chain is significant for developing a sustainable textile and fashion economy in Europe and preserving European fashion reputation in the world.

Fashion designers attempt to design clothes which are functional as well as aesthetically pleasing. Though most clothing worn for everyday wear falls within a narrow range of conventional styles, unusual garments are usually sought for special occasions, such as evening wear or party dresses. Some clothes are made specifically for an individual, as in the case of haute couture or bespoke tailoring. Today, most clothing is designed for the mass market, especially casual and every-day wear.

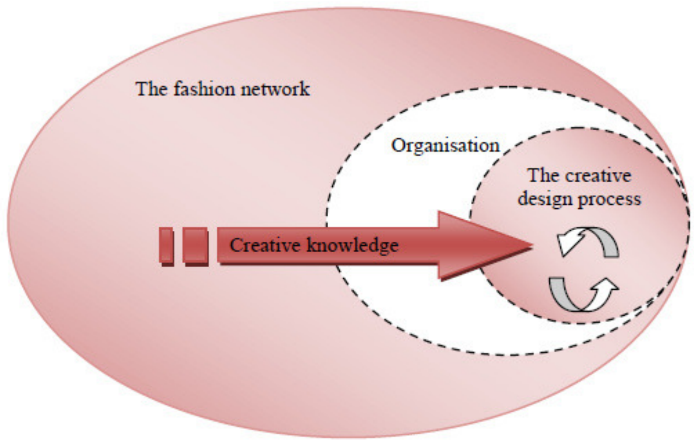

Figure 1: The creative knowledge transfer

Knowledge management within the fashion industry includes the way knowledge flows in production networks and supply chains, and the way knowledge of fashion moves across geographical boarders. Within the fashion industry it is not necessary neither possible to possess all the attributes of fashion design and creativity in-house, but rather it is important knowing where to acquire it within the wider fashion environment (Jonas Kissling Hansen, 2009) [2].

2.1 3D body scanning

Advanced and integrated technologies, such as the optical measurement, the electronic signal and data digital processing, the computer software and hardware, propelled the traditional 2D measurement of the anthropometric data towards a new trend – the use of a 3D body scanning technique for the anthropometric data achievement (Niculescu C. et all, 2010) [8].

The 3D Body Scanner used in the clothing sector research promises to revolutionize the way the clothing item will be manufactured and sold (Figure 2). The anthropometric data achieved by scanning have the potential to offer new insights for issues related to clothing dimensioning and fitting.

Virtual garment simulation is the result of a large combination of techniques that have also dramatically evolved during the last decade. Cloth simulation has however matured enough to introduce its potentials to the garment industry. The main needs to be fulfilled are mostly related to virtual garment prototyping, as well as visualization applications related to and virtual fashion and prototyping. Garment simulation makes it easy for designers, pattern makers and apparel manufacturers to present style decisions, test the fit of a garment and create accurate and visually stunning samples in less time and share them instantly, without expensive sewing and shipping costs.
Flat sketches often are not able to truly explain a designer's vision to the development team or potential buyers.

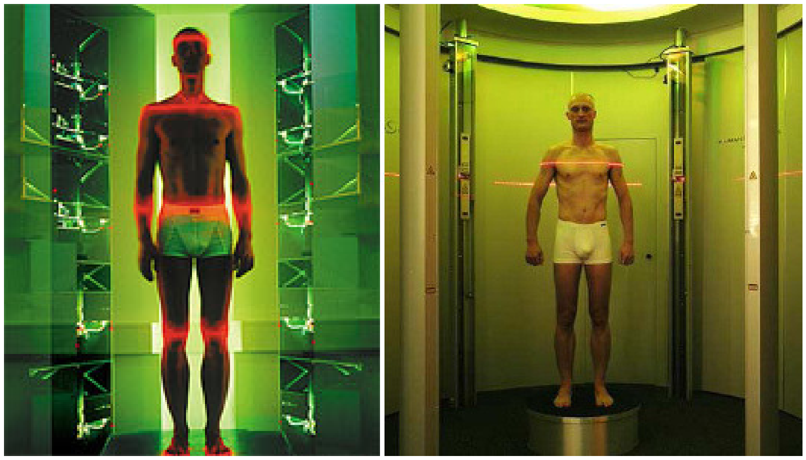

Figure 2: 3D Body Scanner VITUS Smart XXL

The present paper shows how efficient is to work with garment simulation, work method which make it possible for users to see the garment from any angle in a static pose or even in motion using a virtual mannequin. The virtual mannequin is obtained from the 3D scanning of the customer body and in the 3D garment simulation it can be tested the fit between the body and the garment. Regarding the results, the designer can change the initial pattern and correct the particular garment according to the customer needs. A pattern is a 2-dimensional representation of a 3-dimensional object; ultimately the garment will be worn by someone, and the pattern maker is responsible for the way that garments fits. Many pattern makers use 3D garment simulation to test their pattern blocks and basic shapes while they are drafting the pattern, to make sure that the balance and slopes of the garment are correct.

2.2 Virtual simulation

The software for garment simulation are a useful tool to create customized products. In order to obtain a correct fit, the pattern must first be correctly designed in 2D and must be developed to be able to generate, starting from 2D patterns the necessary data to generate the 3D physical model of the garment and execute the simulation.

The 2D dress pattern was designed using the geometrical method, in the PDS OPTITEX CAD software. Using the software you can create the important patterns line, add points and align then vertical. After the pattern is ready, you can add on the pattern the notches, the seam type which can be copied, duplicated or replicated for all the displayed patterns, the dart can be added, edited or cut.

Creating 3D cloth from 2D flat patterns requires additional information which consists of: initial 3D position and mannequin import, stitching information (What goes to what?), define materials and texture (Stretch, Rigidity…), colors, prints, logo's, stitch widths & textures (Shading). The work flow for obtaining the fit simulation, it is as it can be shown in the figure below: patterns must be created in 2D but also there is the possibility to import 2D patterns from different CAD systems.

OptiTex 3D gives the power to simulate cloth on a variety of body sizes and shapes. The virtual mannequin obtained by 3D body scanning is imported in the simulation software.

The next step is to add the stitches information between the 2D patterns. In order to be able to realize the simulation, the garments must have stitch information added on the segments which will be sewed together. After stitching all necessary segments, we are ready to verify the connections and run the simulation (Figure 3).

A very important fact in the garment simulation is the material mechanical properties and also the texture. In the 3D module there is the option to set the mechanical parameters of the cloth. The mechanical parameters that must be introduced are: bend, stretch, shear, shrinkage, weight, friction and thickness. If the garment do not fit properly on the parametric mannequin or the model must be changed, all the modification can be applied on the patterns from the right side and after that re-simulate the new patterns. If the model must be changed, or de designer wants to try how it would look a different model using the same mechanical fabric parameters and same mannequin, all it must be done is to apply the model changes in the left side of the working window, where are displayed the patterns and then re-simulate the garment (Figure 4).

There is an import way how to check the pattern fit on the body, called “tension map”.

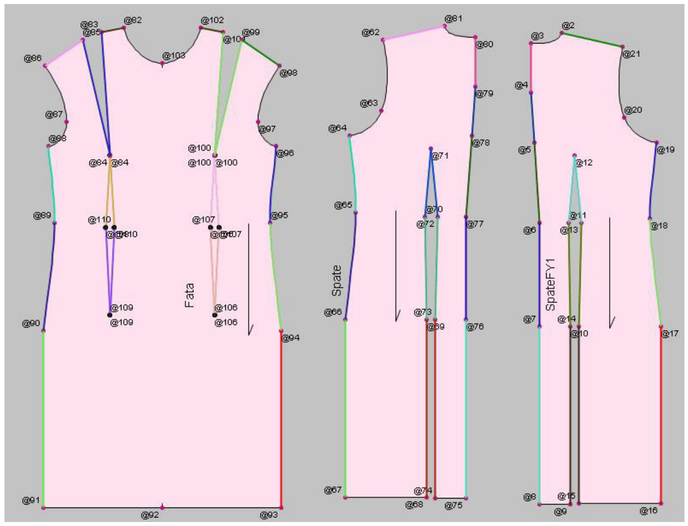

Figure 3: Pattern position in the simulation

Figure 4: Cloth simulation

Using this method it is possible to see where the garment fits correctly and offer a comfort sensation this would be displayed by green areas and blue areas and also can be noticed the places of the garment where it is too tight to the body and will not allow good movement, this will be displayed with red color (Figure 5).

The tension map for the front side of the garment shows that the patters are too loose at the chest line, at the waist line are too tight noticing the red area and at the bottom are at perfect dimension. The designer should modify the pattern at the chest line and waist line. The tension map for the back side of the garment shows that at the shoulders line the patterns are too lose and as the front side tension map shows, the waist line is too tight. The designer should modify the patterns at the shoulders line and waist line.

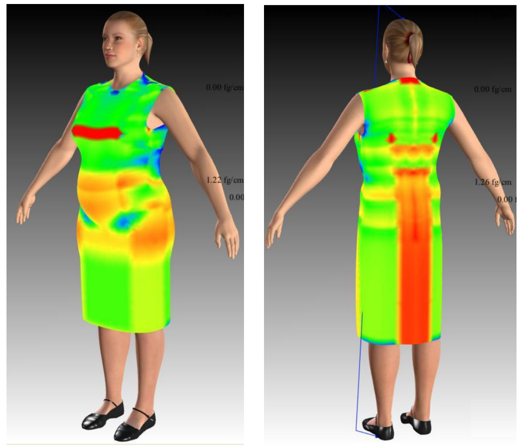

Figure 5: Tension map

3. CONCLUSIONS

In all businesses, knowledge appeared at a higher level than information with following criteria: connectivity, leveraging, and applicability. Knowledge was always relevant to environmental conditions, and was applicable in planned environments. The fashion businesses had tacit knowledge that appeared as both technical and business dimensions, and was related to informal know-how. Like most businesses, fashion businesses, knowledge in an explicit form appeared to be understood clearly; however, tacit knowledge gained through long experience was uncorroborated.

With the increased desire among customers for individualized and customized fashion products, an interest in 3D virtual garment simulation has been growing throughout the world. 3D garment simulation has used for many things, such as virtual fashion shows, online fashion communities, the virtual trying-on of garments, and more. The present paper aims to realize a dress garment simulation. The result will be the testing of the 2D designed pattern after the fitting on the virtual mannequin using specialized 3D software.

The present papers shows how efficient is to work with garment simulation for the Knowledge Management, work method which make it possible for users to see the garment from any angle in a static pose or even in motion using a virtual mannequin.

Clearly, Knowledge Management increased the efficiency of production and process in most companies, while fashion companies with interest in customization are beginning to realize the need of managing information and knowledge.

5. REFERENCES

[1] Zulch G., Koruca H. I., Borkircher M., Simulation-supported change process for product customization – A case study in a garment company, Computers in Industry, no. 62 (2011), pp. 568–577

[2] Kissling Hansen, J., (2009) How Knowledge is Transferred within the Danish Fashion Industry - Taking a knowledge management perspective on the creative design process, http://studenttheses.cbs.dk/bitstream/handle/10417/618/jonas_kissling_hansen.pdf

[3] Zeng, X., Zhu, Y., ,Koehl, L., Camargo, M., Fonteix, C. and F. Delmotte, F. (2010) A fuzzy multi-criteria evaluation method for designing fashion oriented industrial products, Soft Comput vol. 14, pp 1277–1285.

[4] Qin S.F., Lagoudakis E., Kangb Q.P., Cheng K., Customer-centric strategy for e-manufacturing in apparel industry, Applied Mechanics and Materials, no. 10 (12), (2008), pp. 39–44

[5] Altenburg T., Botzenhardt P., Stamm A., Weitz G., E-Business and KMU, Edited by: Deutsches Institut fur Entwicklungspolitik, Bonn, www.die-gdi.de

[6] Jagstam M., Klingstam P., A handbook for integrating discrete event simulation as an aid in conceptual design of manufacturing systems, in: Proceedings of the 34th Winter Simulation Conference: Exploring New Frontiers, Association for Computing Machinery, New York, NY, 2002, pp. 1940–1944

[7] Srikantaiah, T and Koenig, M. (2000). Knowledge Management for the information professional. ASIS

[8] Niculescu, C., Filipescu, E. and Avadanei, M., General aspects concerning the development of a female dimensional typology using 3D body scanning measurements, Industria Textila, pp 271-275

[9] Nonaka, I. and H. Takeuchi (1995), The knowledge-creating company. New York, Oxford University Press

[10] Su-Jeong Hwang, (2002) Knowledge Management (KM) for Mass Customization in the Apparel Business, http://Citeseerx.Ist.Psu.Edu/Viewdoc/Download

ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

TAXING IMPORTS FROM CHINA

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Abstract**:** A market economy is the economy in which both physical persons and legal entities act in a legal framework established by the government and where the government does not have a major intervention on the market. Competition provides choices, improves product quality through efficient use of resources and stimulates economic growth by increasing investments. Some of the economic resources are land, labor and capital. Another resource is entrepreneurship, that is the individual's capacity to transform the production of economic resources in a business. The role of competition in a market economy is to allow more people and businesses to use resources as efficiently as possible in order to obtain the best products. To have a market functioning properly, it must comply with principles such as the principle of good faith or the consumers. These principles give the manufacturers the freedom to conduct their business according to their own decisions and to be protected only if they base their success on their own merits. Following Noblelift's example and thinking now at the textile industry, it is necessary to impose a tax in addition to import duties, that covers potential losses caused by the practice of certain anticompetitive policies. Furthermore, most of the time, regardless the industry in which investigation is taken, at the end of it, following law suit that most Chinese companies can not afford to finance it, but they receive financial aid from the state, leading to a certain approval of anticompetitive practice from the state of origin.

Key words: market, economy, competition, principles, investments, resources

1. INTRODUCTION

In the context of globalization, markets have become more active, difficult to follow, therefore it was necessary to impose a set of rules to protect both market participants and to eliminate anticompetitive practices that might threaten the stability of the economic system. [1]. European Union has drawn up regulations in the competition field that had three goals: avoiding agreements between companies which may affect intra-community trade, abuse of dominant position of large companies and the intervention of state in case of state-owned companies. Dumping practices posed a threat to the economy of developed countries, being necessary to draw up an agreement in this sense, encompassing conditions that can be considered dumping practices, the effect of these practices is the elimination of competition in the market, in conclusion, unfair competition.

2. TEXTILE TRADE FROM CHINA

China plays an important role in the global trade in case of textile products, being the world's largest exporter and second largest importer, after United States of America. European Union signed an agreement on imports of textiles from China in 2005 that was valid until 2008.[2]

After this agreement, there was an increase of imports, that is from 25% to 40%. For products which have been liberalized in 2005, the market share of China increased by 145% in volume and 95% in value. Market shares held before 20005 by Pakistan, Indonesia, Thailand, South Koreea and so on, have been taken over by China. Due to the explosion of imports from China, the European Commission started an investigation in order to adopt measures to safeguard nine categories of textiles products. Following the investigation, the following measures have been adopted [3]:

- quantitative limits on imports from China, Uzbekistan, North Korea and Montenegro;
- dual monitoring systems;

- monitoring systems.

All these measures have been adopted and practiced until 2008, when the EU treaty with China expired. Since 2008, the European Commission has addressed a set of rules, customs entry and product charge based on weight and value. Customs duties are calculated on a percentage basis after an evaluation process that determines the value of goods by the customs authorities. Following requests from the companies that observe various anticompetitive practices used by various manufacturers, the European Commission will make an investigation during which will require different information on such practices as price and production cost, from the complainant producer. If it finds that there are dumping practices then the companies concerned will be penalized with the price difference between the price charged in the home and the price practiced to EU markets [4].

Given that the agreement was valid until 2008, I think it would be necessary to take a number of measures meant to prevent situations where companies accused of anticompetitive policies rely on state aid, which state in turn , it supports the producers, even if they do not respect market principles on which they operate. I believe that neither practicing duty based on the weight and value of the products is not as likely to boost competitiveness. To avoid this, it is necessary to introduce some taxes for non-EU manufacturers exporting textile products to the EU, charges to cover also the risk EU market is exposed at. The case to remember is that in 2008, when expiry of the agreement of the European Commission to China , there has been a flood of imports from China, and the price of products was 2-3 times lower than the one that local producers practiced. After this avalanche of Chinese products, all producers within European Union were affected. The practice of anti-competitive practices China has been proven by the European Commission who undertook investigations following complaints made by hand pallet trucks industry manufacturers. Following these investigations, it was confirmed that the cost of a finished product was denatured by 25% and producer prices charged by Chinese importer were 24 to 31% higher than the international ones practiced in the same period. Was found that the prices charged by Chinese manufacturer Noblelift not reflect market value, the conclusion this one was practicing the dumping prices. [5]

In the table below are represented the European Union imports from China. As we can see most of the imports are manufacturing, which is the percentage of 95.7% of total imports.Textiles and clothing originating in China have a percentage of 13% of imports of manufactures.

Table 1. European Union Imports from China

Product Groups	2008		2010		2012	
	Millions euro	%	Millions euro	%	Millions euro	%
TOTAL	247,815	100%	282,509	100%	289,915	100%
Primary products	9,611	3,9%	8,730	3,1%	9,544	3,3%
-Agricultural products	5,460	2,2%	5,913	2,1%	6,550	2,3%
-Fuels and mining products	4,152	1,7%	2,817	1,0%	2,994	1,0%
Manufactures	237,148	95,7%	272,529	96,5%	279,134	96,3%
-Chemicals	9,293	3,8%	10,998	3,9%	12,931	4,5%
-Textiles	5,686	2,3%	6,601	2,3%	7,125	2,5%
-Clothing	27,210	11%	30,515	10,8%	29,275	10,1%
-Other manufactures	194,959	78,6%	224,415	79,5%	229,803	79,2%
Other products	642	0,3%	839	0,3%	809	0,3%

Table1 : European Union Imports from China; Source:http://trade.ec.europa.eu.

In December 2012 the EU impose quantitative restrictions on imports of textile products from China. This regulation applies to 2013 and textile operators must submit an application for authorization imports, for an amount equivalent to the amount imported in 2012. Being imposed taxes on goods from China, the number of imported products in the EU is limited and, European manufacturers are given the chance to develop in EU market. Imports from China will not disappear

completely but they will not take over completely the EU market. A greater variety of manufacturers on the EU market offers customers a choice to compare products on the market.
According to World Trade Organization the major EU texile importers are: China, India, Turkey, Bagladesh, United States, Vietnam, Korea, Pakistan and Indonesia. In 2011 Bangladesh textile imports in Europe increased by 27%, while the United States imports to Europe increased only by 13%.According to WTO 2011 statistics if we eliminate China from the list of importers we will notice that the top positions are occupied by other low-cost countries such as Turkey and Bangladesh. So customers will adopt also goods imported from low cost countries and those produced in the EU. To save the European textile industry from being wiped out from Asian competitive threats, must be a concentration on innovation, research on fashion and design, creation and quality and the use of technologies. Also new discoveries in biomaterials, biotechnologies and environmentally-friendly textile processing might be a solution for saving European textile industry, and for make it more competitive.

3. CHINA AND DUMPED PRODUCTS

China has been the number one target of anti-dumping cases. A total of 640 anti-dumping cases had been filed against China's exports, between January 1995 and June 2008;20% of the world total. The economies that initiated the most anti-dumping cases against China are: United States, European Union, Japan, India, and Argentina. Products targeted in such cases include base metal, chemical, machinery and electrical appliances, and textile, accounting for 70% of all the cases. According to WTO, about 70% of all anti-dumping investigations against Chinese export have led to the imposition of some sort of anti-dumping measures. Often, high anti-dumping duties are levied on imports from China by such economies as the US, EU, and Brazil. The average anti-dumping duty against Chinese imports applied by the EU is around 41%, ranging from 10% to 102% and that by the US is 54%. Anti-dumping duties from some developing countries tend to be even higher. For instance, in 2004, Brazil imposed anti-dumping duties on 12 types of Chinese product, of around 77% on average [6].

Given the large number of existing cases of dumped products imported from China, imposing a tax regarding the risk faced by these countries once they receive imports from China would increase the price of goods and dumping cases will become rare. Another solution for removing numerous cases of dumping could come from the Chinesse government. It can perform more extensive checking of exports of goods. With China's entry into WTO, where imposed anti-dumping measures and copyright protection. But according to statistics, these measures haven't been successfully implemented because 20% of dumping cases around world are attributed to China. If China would have the necessary capacity to check the exports there would be no need for EU to take various measures and laws in order to avoid fraud. Since European manufacturers meet certain standards of quality and environmental protection, the cost of finished products has become increasingly larger. But China, with a cheap labor and low quality standards it can afford to produce at much lower prices than the EU.

Some companies are created specially to import counterfeit goods. To be able to enter the EU, they falsify documents, labels and mark them as being from different countries other than China . Most of these companies are registered as offshore and the income from the sale of counterfeit products are transferred in their offshore accounts.An example of tax fraud was discovered in Romania in August 2012. Fraud Investigation Service found 310,000 articles lingerie and toys imported from China without origin documents. Romanians and Chinesse citzens were accused of fraud and money laundering. They are suspected that in the period 2007-2012 made over 2,000 imports of goods (toys and textiles) from China in Romania,worthing over 60 million dollars.Part of the goods were sold without documents . They obtained, around 1.2 million dollars and the money were transferred to an offshore account in the British Virgin Islands in order to disguise the illicit origin of the income.Counterfeit goods are bursting off the streets of Europe, with worrying consequences for the European textile industry. According to the OSCE (Organisation for Security and Cooperation in Europe) counterfeit goods now form up to 9% of total world commerce, the equivalent of 450 billion dollars. A considerable portion of this is from fashion items: 20% from textiles and clothing, 5% from watches, 10% from perfumes and cosmetics. This has had profound repercussions on the labour market.[7] 70% of imported products is through fake seized airlines and mail access to the EU. Aviation and express and mail is small batch goods the main mode of transport. In 2009, the European Union seized by the customs of the land transport of counterfeit imported products also presents the sharply the situation. But by waterway transportation into the eu's fake import product still in being tracked down the first fake imported products.Chinese often describe counterfeits items as *shanzhai*, a term that originally described the mountain fortress of a bandit. 'Shanzhai' literally means small mountain village, but it's now used to describe fake products that have names similar to famous brands. It became an accepted name for fake goods after 'Shanzhai Cellphones' produced by small individual workshops in southern China became popular in the mainland market in the late 2000s.[8]

4. CONCLUSIONS

Following Noblelift's example and thinking now at the textile industry, it is necessary to impose a tax in addition to import duties, that covers potential losses caused by the practice of certain anticompetitive policies. Furthermore, most of the time, regardless the industry in which investigation is taken, at the end of it, following law suit that most of the Chinese companies cannot afford to finance it, but they receive financial aid from the state, leading to a certain approval of anticompetitive practice from the state of origin. Manufacturers and importers from countries with record of such practices represent a greater risk to use such practices, so it would be necessary to impose some taxes that cover some of the losses in the prejudiced state.

This fee would be necessary to apply according to the field of activity and the volume of imports existing on that sector.

China's main exports are electronics and equipment, followed by clothing and steel. In 2011, 73% of counterfeit textiles retained at the customs came from China. [9]

Since February 16 2012, EU imposed an anti-dumping duty for the ceramic products, this tax being resulted from the complaints various local producers. After the completion of the investigations, the European Commission determined the dumping margins practiced by Chinese manufacturers which were included in the investigation, they provided both accounting statements and various samples of the imported product. In conclusion, it was noticed a 60% level of the dumping margin, compared to the EU price, before customs duties. The total volume of imports from China decreased by 9% the period under review. It should be noted, however, that imports from China decreased less, as a percentage, than overall consumption in the EU. In fact analyzed from the perspective the whole period considered, the market share of imports from China increased from 64.8% in 2008 to 66.9% in 2010.

Anticompetitive behaviors were noticed following complaints made by EU producers. Following these complaints, European Commission initiated investigations meant to verify both Chinese importers products, financial statements and production costs and the producers of other origin. [10]. In EU, textile industry manufacturers face with the problem of dumping prices, as well as the problem of counterfeits goods and the tax evasion. Every day, nearly 50 containers loaded with 800 tons of illegally imported textiles and footwear from China and Vietnam enters the EU. Imported products are for companies specifically created to receive them. It is very hard to find out who is behind them. These companies buy millions of tons of clothing in their first months of existence and when they should pay the VAT they disappear.[11]

Tax evasion, dumping or counterfeit are most frequent in the textile imports from China and the EU is losing tens of millions of euro every year due to this fact. [12]

Considering that there were certain anti-dumping duties imposed on various textile products such as the open mesh fabrics, these taxes are occurring only after various complaints made by competitors in that market, not being applied to all textile products depending on the market share and also depending on the possible existence of certain practices to affect the integrity of the market participants.

4. REFERENCES

[1] McCann, Jack (2011). *China's textile and apparel industry and the global market: five competitive forces*
[2] European Comission.*Eu- China textile agreement 10 June 2005. Brusseles 12 June 2005.*
]3] Don Sussman, David Lundy .(2011). *Textile and Apparel Imports from China; Statistical Reports*
[4] Amending Implementing Regulation *(EU) No 1008/2011.2013. imposing a definitive anti-dumping duty on imports of hand pallet trucks and their essential parts originating in the People's Republic of China.* Available at: http://eur-lex.europa.eu.
[5]Official Journal of the European Union dated in 11.05.2012. Reference: MEMO/05/201.
[6]] Liu and Vandenbussche (2002) *EU anti-dumping cases against China: An overview and future prospects with respect to China's WTO membership*". Catholic University of Leuven, Belgium
[7] Tianshu Chu and Thomas J.Prusa.(2004) "*The reasons for and the impact of anti-dumping protection: The case of People's Republic of China"*
[8] Li Yuefen. "Why has China become a target of anti-dumping activities?", 2004
[9]Giorgio Xenellis, (2009). *General and regional statistics.*
[10]Yudhi Dharma Nauly. (2011) Does *Import Competition Lower Number of Labor and Wage?.*
[11]Swen Pan, Mark W. (2006). *Textile safeguard arguments comparing the effects to free market conditions*
[12]McCann, Jack (2011). *China's textile and apparel industry and the global market: five competitive forces.*

RESEARCH OF DESIGN'S PARAMETERS OF DRIVE MECHANISM OF RA 14 DOBBY AND DEVELOPMENT OF THE DRIVE MECHANISM

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Abstract: There are three different principles to perform shedding motion which are; cam mechanism, dobby controlled mechanism and jacquard controlled mechanism. A dobby mechanism consists of three main parts; drive mechanism, selection mechanism and mechanism for transferring motion to the frames. Rotary dobby mechanisms are being used in shedding process of high-speed weaving machines. In this paper, design and synthesis of a novel drive mechanism had been explained. The drive mechanism, which is used in this research, is an eight component lever-gear mechanism. The most important innovation is in the motion transmission mechanism on the main shaft of rotational dobby. It is known that main shaft in rotary dobby has dwell period in only one direction. The novel drive mechanism is designed to make equally timed, double stand-by positioned oscilational motion. After designing of the rotary dobby, the mechanisms are produced and montaged. It was confirmed that dobby run well and durably with all mechanism and shedding process is precisely carried out. The experimental values of dwell angles at the right and left dead-center positions are similar to theoretical values. Experimental results show that; if the drive mechanism and dobby is generated with advanced technology, it is possible to use it in dobby industry.

Key words: Oscillational motion, gear-lever mechanism, rotary dobby, drive mechanism,

1. INTRODUCTION

There are three basic motions on a weaving machine. These are shedding, picking and beat-up. The shedding mechanism separates the warp threads into two layers or divisions according to pattern. There are three different principles to perform shedding motion which are;

1. Cam controlled mechanism
2. Dobby controlled mechanism
3. Jacquard controlled mechanism

Cam controlled mechanisms are limited to 8 shafts. These mechanisms are simple and small in size. *Jacquards* can impose practically no limitation on the design. Every end across the full width of the weaving machine can be controlled individually and weft repeat can be of any desired length. The other method of controlling frames is by *dobby* and its main advantage is that can be woven a repeat of more than ten picks. Dobbies are controlled by pattern chains and are also programmable. A dobby mechanism consists of three main parts; drive mechanism, selection mechanism and mechanism for transferring motion to the frames.

Lee et. al. (2004) [1] are introduced a new method to design a cam for cam controlled mechanism. The design and the kinematic analysis of the system is quite hard for the reasons which is the mechanism consist of complex units and has a lot of joints between the first cam of mechanism and frames.

Basic difference that distinguishes the rotary dobbies from the other known dobby constructions is the transfer of one way intermittently rotational movement to the main shaft. In order to obtain this movement specific cam mechanisms are used in driving mechanism. But this system is needed to use specific and highly complex mechanisms which are consisting of particular bearings (Staubli – Dobby Machines Catalog, 2006) [2].

There are other mechanism for equally-timed stand-by oscillation movement; these are lever mechanism, gear-lever mechanism or with servo motor beside cams. However most of lever and gear-lever mechanisms are consist of cams.

Abdulla et. al. (2011) [3] introduced a research about double intermittently mechanism which contained slider-crank. According to this research the construction of mechanism is complex and not suitable to use in practice.

Abdulla and Yurik (2006) [4] introduced a special eight component lever mechanism to get intermittently rotational movement and synthesized the mechanism. According to synthesis, this mechanism isn't capable to use cause of high acceleration values.

Abdulla et. al. (2009) [5] introduced a double intermittently mechanism which contained sine mechanism and rod gears. The intermittently movement of the mechanism is almost 60°. According to this article, the mechanism isn't strength because it consists of two sine mechanism and it isn't capable to use in high-speed dobbies.

Abdulla and Abdullayev suggested an eight component lever-gear mechanism design for 180° equally timed intermittently oscillation movement. The double - equally timed - intermittently eight component mechanisms are analyzed kinematically and constructively. As a result of these researches, a new mechanism which has oscillation movement below 180° is synthesized. According to SAM 6.1 software results, experimental and theoretical values of dwell angle of the mechanism are similar. That shows us the system can be used on dobby machines instead of cams [6].

2. DESIGN OF DRIVE MECHANISM OF NOVEL ROTARY DOBBY MECHANISM

The drive mechanism is designed and produced to make equally timed, double stand-by positioned oscilational motion. The kinematic diagram of the mechanism is given in Figure 1.

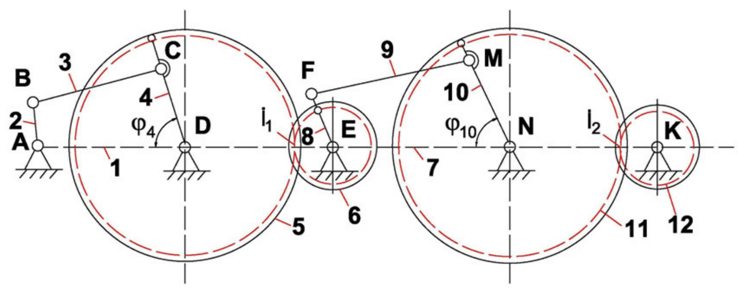

Figure 1: Kinematic diagram of novel drive mechanism

The drive mechanism built up using drive component **2** and kinematic chains **3-4, 5-6, 9-10**. These kinematic chains have zero degrees of freedom. The transmission rate of main shaft is 1:2. The rotational motion of drive component **2** is transformed to 180° oscillating motion of **DC** component with the aid of **ABCD** four-bar mechanism. The displacement of **DC** component can accepted symmetrical with **DE** axis.

When first four-bar mechanism **ABCD** is at the right dead-center position, second four-bar mechanism **EFMN** is at left dead-center position. And surely when first four-bar mechanism **ABCD** is at the left dead-center position, second four-bar mechanism **EFMN** is at right dead-center position.
When four-bar mechanism **ABCD** is at dead-center position, rotation of component **2** can be accepted insignificant. In this position angle of rotational of component **DE** is small and point **E** displace on an arc-shaped path which its center point is **M**. During this period **EF** component has to stand-by. The same situation is repeated for right and left positions of **EF** component. The length of **EF** lever adjusts for 180° rotational motion of gear **12**.

3. SYNTHESIS OF DRIVE MECHANISM

The gear **12** must have intermittenly oscillation motion until 180°+2λ angle to work dobby machines. The value of the angle of λ depends on the lock mechanism. Oscillation angle of gear **11** find in equation 2 as follows:

$$\varphi_{11} = \frac{\pi+2\lambda}{i_2} = \frac{z_{11}(\pi+2\lambda)}{z_{12}} \quad \textbf{(1)}$$

In the above equation, i_2 is conversion rate of gear pair **11-12**.

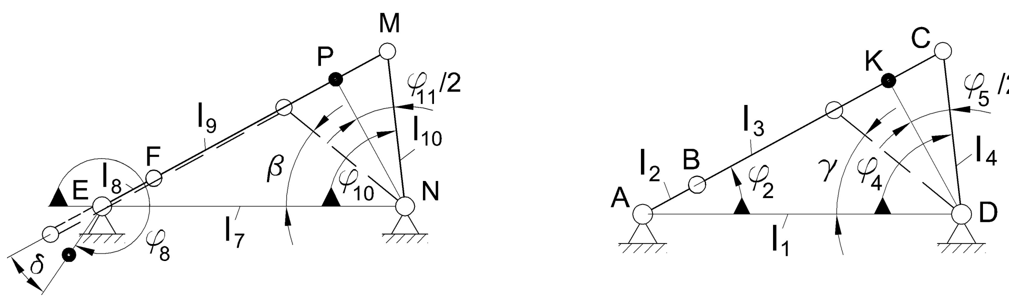

Figure 3: **(a)** Account schema of KLMN four-bar mechanism, **(b)** Account schema of ABCD four-bar mechanism

Correlations between the dimensions of parts of the four-bar mechanism **EFMN** can be found in the chart given in Figure 3. The length of component **10** is calculated by the following equation. This equation is based on the equality of the duration of oscillating back and forth motion of the main shaft.

$$l_{10} = {}^{l_8}\!/_{\sin(\varphi_{11}/2)} \quad \textbf{(2)}$$

Obtaining the standby movement at the dead-center position of drive mechanism and the value of dwell angle are provided with extra move until δ angle at right and left positions. The component **8** is connected to gear **6**, therefore δ angle is expressed as the rotational angle of the gear **5**.

$$\delta = (i_1\varphi_5 - \pi)/2 \quad \textbf{(3)}$$

In the **(3)** equation, i_1 is transmission ratio of gear pairs **5-6**. The component **4** and gear **5** move together. Hence, oscillation angle of the component **4** can be written as φ_4 from **(3)** equation.

$$\varphi_4=\varphi_5+\gamma=(\pi+2\delta)/i_1 \quad \textbf{(4)}$$

Synthesis conditions of EFMN four-bar mechanism is valid in ABCD mechanism. For this reason, the length of the component **4** calculated in **(5)** equation as shown in the Figure 4.

$$l_4=l_2 / \mathrm{Sin}(\varphi_4/2) \quad \textbf{(5)}$$

On the other hand, dimensions of component 1 and 7 is determined by the size rate of the component 2 and 8.

$$l_1/l_2=k \text{ ve } l_7/l_8=m \quad \textbf{(6)}$$

If k and m are expressed as above, the numerical values of k and m are selected over 3.

For calculating the dimensions of the components which built up the mechanism, firstly the λ and δ angles values are selected. λ angle value is equal to zero because that value is connected to the operating condition of the lock mechanism. The value of the δ angle selected from an ideal value in the first calculations because it determined dwell angle and dwell angle tolerance. The δ angle is selected 6° in the first analysis.

The length of drive component 8 of the four-bar mechanism EFMN has been accepted 38 mm and the length of the component 9 has been accepted 256,5 mm. Construction principles were taken into consideration when this values selecting. At that rate, if oscillation angle of the gear **11.** $\varphi_{11}$and the length of the drive component 8 (l_{10}) calculated, the values are given:

φ_{11}= 60° **(7)**

l_{10} =76 mm **(8)**

Dimension of the component 7 calculated from geometric analysis of Figure 3.a

l_7 =264,81 mm **(9)**

Rotation angle of gear 5 and component 4, that connected to gear 5, calculated in (4) equation:

φ_5 =64° **(10)**

Dimensions of AB and BC components were determined as l_2 =38 mm and l_3 =118 mm. According to this, the length of the CD and AD components are calculated as follows:

l_4=71,71 mm **(11)**

l_1=132,75 mm **(12)**

4. CONCLUSIONS

Kinematic analysis of the mechanism was carried out using SAM 6.1® program. The results are shown in Figure 4.

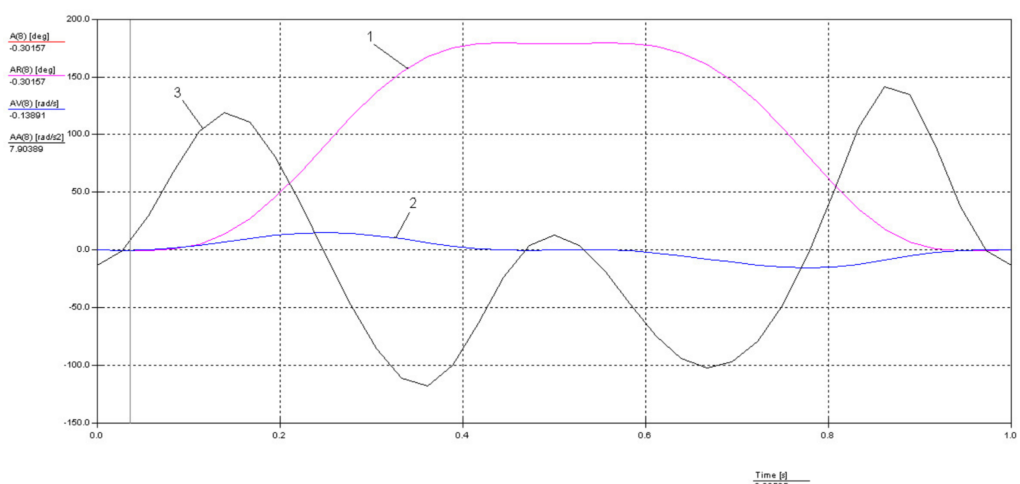

Figure 4: (1) Angular position, (2) velocity diagram and (3) acceleration diagram of 9th cogwheel that drawn with SAM 6.1®

The dwell angle is observed 63° on the right side and 60° on the left side in the above graph. These values, which are equal to 126° and 120° rotation of the main shaft of the weaving machine, should be sufficient for reading and implementation of the program in the dobby. The dobby experiment set is given in Figure 5.

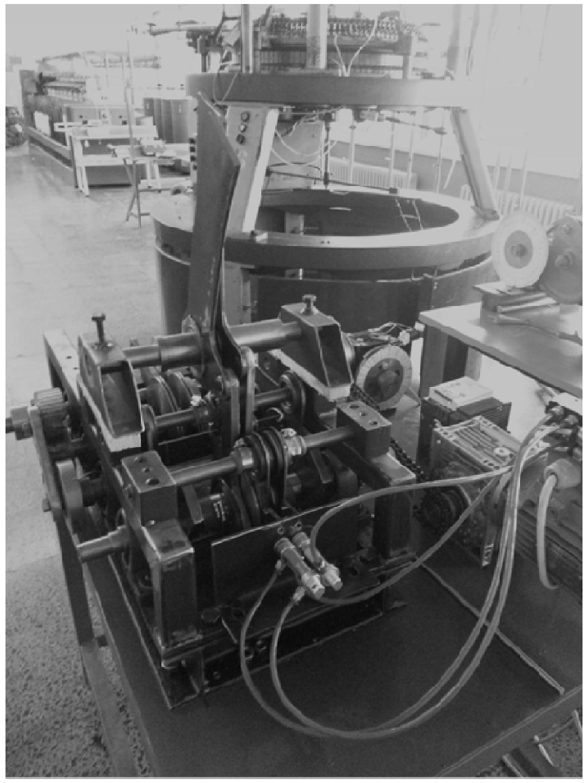

Figure 5. General appearance of dobby experiment set

The experimental values of dwell angles at the right and left dead-center positions are similar to theoretical values. Experiments were made at speeds equivalent with the 120-140 rpm speeds of main shaft of the weaving machine because that dynamic balancing of experiments set hasn't done on the dobby. Experimental results show that; if the drive mechanism and dobby is generated with advanced technology, it is possible to use it in dobby industry.

5. REFERENCES

[1]. Lee, S., Shin, J., Lee, S.,D., Kim, D., (2004). Analysis and Design of a Driving Mechanism for the CamType Dobby System, *Journal of Korean Fiber Society*, 41 (1), p.56 – 58.
[2]. *Staubli – Dobby Machines Catalog*, 2006
[3]. Abdulla, G., Abdullayev, R., (2011). An Investigation About The Dobby Drive Mechanism, *ICONTEX 2011 International Congress of Innovative Textiles*, s.84-91. İstanbul.
[4]. Abdulla, G., Yürik D., (2006). Rotatif Armür Makinesi İçin Beklemeli 180° Salınım Hareketi İleten Kol Mekanizmasının Sentezi, *UMTİK 2006 The 12th International Conference on Machine Design and Production*, s.81-90. Kuşadası, Muğla.
[5]. Abdulla, G., Akçalı, K., Abdullayev, R., (2009). Analysis and Synthesis of Gear-lever Mechanism Which Makes an Oscillation Movement Below 180 Degress for Rotary Dobbies, *International Symposium on Engineering and Architectural Sciences of Balkan, Caucasus and Turkish Republics*, p.148-155. Isparta.
[6]. Abdulla, G., Abdullayev, R., 2011. An Investigation About The Dobby Drive Mechanism, *ICONTEX 2011 International Congress of Innovative Textiles*, s.84-91. İstanbul.

ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

EVALUATION OF FIBRILATION BEHAVIOR OF TENCEL FABRICS

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Abstract: Natural and synthetic cellulose fibres are essential for the day-to-day functioning of the textile industry. Thanks to their features, these fibres give clothing and apparels the highest confort: softness, strength, good look and functionality.
Lyocell is a relatively new generic name given to a cellulosic fiber, which is produced under an evironmentaly friendly process by dissolving cellulose in the tertiary amine oxide N-methylmorpholine-N-oxid (NMMO). This fiber shows some advantatges characteristics over other cellulosic fibers, such as a high dry and wet tenacity and high wet modulus.However, the nature of the bonding between the elementary fibrils is thought to affect the ability of the fibre to undergo localised separation of fibrous elements at the surface, known as fibrillation.
Scanning electron microscopy (SEM) is used to study the fibrillation grade by some authors. This visual evaluation is not quantitative and objective. For this reason, in this work we evaluated the fibrilation of the tencel samples by espectophotometer. Results show how accurate the process can be. It offers a quick and effective measurement on the fibre fibrillation. In order to evaluate if the process was correctly designed, samples were studied both by spectrophotometric measurements and by SEM observation originally and after some laundry cycles.

Key words: Liocell, laudering, spectectophotometer, SEM,.

1. INTRODUCTION

During the last two decades, scientific and technological interest in the development of environmentally friendly systems based on the use of non-aqueous solvents for dissolving cellulose has increased. [1] Tencel fibre is of the lyocell typo of spun fron a solution of cellulose in terniary amine N-oxide. Such fibres have a degree of cristallinity of the ordre of 90%, and are composed of elementary fibrils partially separated by elongated voids. [2]

For this reason, lyocell fibres are distinguished by their specific ability to fibrillate in a wet state under the impact of external mechanical effects [3, 4]. Fibrilation means the detachment of fibrils along the fabric surface of individual fibers swollen in water, which is caused by mechanical stress. Textile fabrics made of lyocell staple fibres undergo controlled fibrillation and defibrillation by specific finishing processes. [5] Fibrilation may be desirable in applications where a peach-skin appearance is required, but it notably affects the dyeing conformity and lwashability of end-use textile products.[6]

Optimal methods of characterising fibrillation tendency are being searched for. Testing methods are usually based on investigating wet abrasion resistance of individual fibres [7] or woven fabrics, on indirect assessment through testing fabric porosity, as well as on variants of testing including the analisys of fibre microscopic images [8] and determination of fibrillation index FI [6].

In this work, scanning electron microscopy (SEM) is used to study the fibrillation grade by some authors. This visual evaluation is not quantitative and objective. For this reason, in this work we evaluated the fibrilation of the tencel samples by espectophotometer. Focused on getting some conclusions, the results of each washed sample have been compared with the results of the unwashed fabric and it could be observed that this method of analisys it is effective to value the fibrilation of the fabric after laundering.

2. EXPERIMENTAL

A green weft knitting fabric (4 wales/cm and 7 courses/cm), 100% tencel with a weight 314 g/m^2.

Tencel Fabric was washed by following UNE EN ISO 6330 method no. 6N^h, 5 cycles of washes were carried out.

Changes in surface morphology were also observed with a scanning electron microscope FEI model Phenom (Fei, Oregon, USA). Prior to sample observation, samples were covered with a gold–palladium alloy in a Sputter Coater EMITECH mod. SC7620 (QuorumTechnologiesLtd., EastSussex, UK). Samples were then examined with suitable accelerating voltage and magnification.

The samples were measured with a MINOLTA CM-3600d reflection spectrophotometer in specular component excluded (SPEX). The CIELAB coordinates of samples and the colour-difference were calculated for the Illuminant D65 and the 10° observer. Instrumental measurements were repeated 3 times throughout the visual tests period. The color differences were calculated by following the norm UNE-EN ISO 11664-4 "Colorimtry. Part 4: CIE 1976 L*a*B* Colour space".

3. RESULTS AND DISSCUS

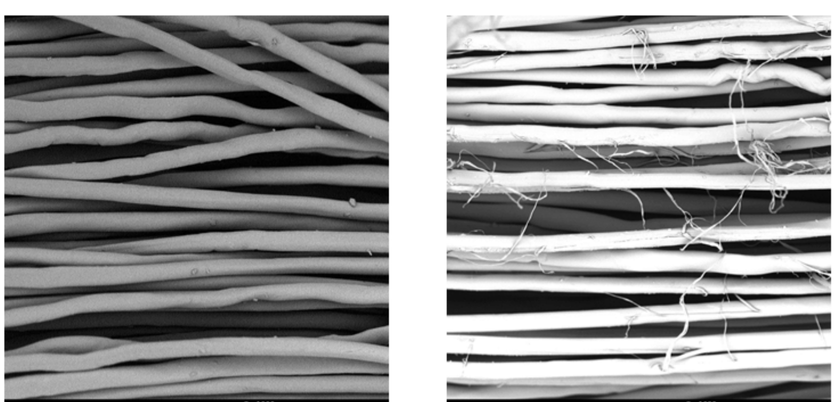
We evaluated the change of the samples after 5 cycles of laudering, noticed with the naked eye. To obtain the differences of colour ($DE_{L,a,b}$) of the laundered samples, the reflection spectrophotometer was used. We compared the results of the washed samples with the results of the previous sample and the results of the standard sample, unwashed fabric.

Table 1: CIELAB colour differences for washed samples

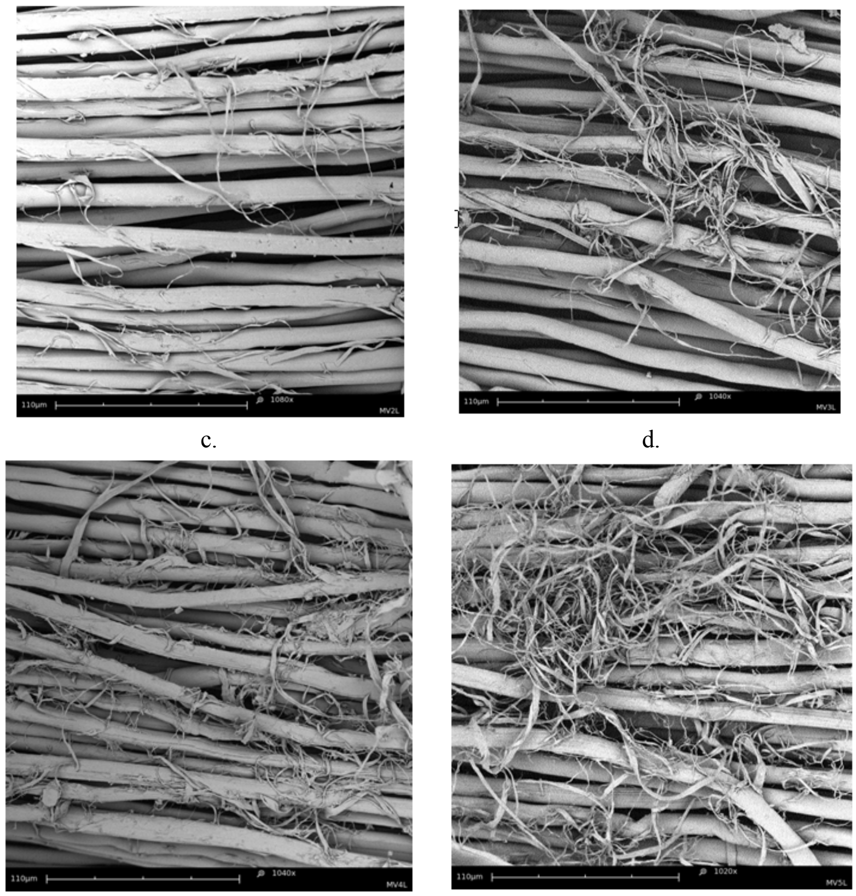
	DE(L, a, b) previos sample	DE(L, a, b) standard sample
MV1L	3,03	3,03
MV2L	0,86	3,02
MV3L	0,92	3,14
MV4L	0,52	3,28
MV5L	0,49	3,22

The sample with one washed show the largest colour difference, as after the first laudering the sample is shrunk. If we observe the results by comparing the washed sample over the previous, after 2 and 3 laundering the sample show significant differences. On the other hand, when the fabric is washed 4 and 5 times these differences are smaller.

To check these results, some images from SEM were taken from the fabrics that have been studied in this project. In Figure 1, we can observe the unlaundered sample show smooth and clear fibers. However, the fibrillation appear after the first laudering. As expected, the fibrillation increased with consecutive laundering processes. After 3 washing cycles, figure 1.f we can see long fibrils tangled on the surfance. These results check the results obtained with the spectrophotometer.



a. b.



c. d.

e. f.

Figure 1 : SEM images from tencel fabric a) before laudering, b) after 1 laundering, c) after 2 laudering, d) after 3 laudering, e) after 4 laudering, f) after 5 laudering

4. CONCLUSIONS

To sum up, this work has shown a procedure to measure the fibrillation of the tencel fabrics by reflection spectrophotometer. This is quantitive and easy method to check the fibrillation of the sample. These results have been corroborated by scanning electron microscope SEM. Visual evaluation and results of the spectrophotometer of the ehashed samples revealed that the grade of the fibrillation increase the greater number of the laudering caused by wet friction during the process of the lundering.

5. REFERENCES

[1] Carrillo, F., Colom, X., Suñol, J.J., Saurina, J., (2004) Structural FTIR analysis and thermal characterization of lyocell and viscose-type fibres. European Polymer Journal, 40, pp. 2229-2234. [5]
[2] Crawsshaw, J., Cameron, R.E. (2000) A small angle X-ray scattering study of pore structure in Tencel cellulose fibres and the effects of physical treatments. Polymer, 41, pp. 4691-4698.
[3] Morgado, J., Cavaco-Paulo, A., Rouselle, M.A., (2000) Enzymatic treatment of lyocell-clarification of depilling mechanisms, Textile Research Journal, 70 (8), pp. 696-699.
[4] Ortlepp, G., Beckmann, E., Mieck, K.P, (1999), Fibrillated lyocell filament yarns- tha basis for novel yarn structures, Melliand Textilber/Int. Text. Rep, 80(6), pp. 123-124.
[5] Beceren, Y. (2008), Visual evaluation of the surface of tencel/cotton blend fabrics in production and cleaning processes. Fibres and textiles in fastem Europe, 16(3), pp. 39-43.
[6] Udomkichdecha, W., Chiarakorn, S., Potiyaraj, P., (2002), Relationships between fibrillation behavior of lyocell fibers and their physical properties. Textile Research Journal, 72(11), pp. 939-943.

[7] Fang, K., Hao, L., Hu, X., and Shao, H., (2003), Ester crosslinking treatment for reducing the fibrillation tendency of Lyocell fiber, Textile Research Journal, 73, pp. 1013-1016.
[8] Marini, I., (1994) Lenzing lyocell fibers. Man-Made Fiber Year Book (CTI), 22-26.
[9] Ibbett, R. N., Hsieh Y.L. (2001), Effect of fiber swelling on the structure of Lyocell fabrics. Textile Research Journal, 71(2), pp. 164-173.
[10] Valldeperas, J., Carrillo, F., Lis, M., Navarro, J. A., (2000)Kinetics of enzymatic hydrolysis of lyocell fibres, Textile Research Journal, 70 (11), pp. 74-84.
[11] Udomkichdecha, W., Chiarakorn, S. (2001) Factors to predict the fibrilation tendency of lyocell fibers. J. Sci Res. Chula. Univ., 26(1), pp. 49-56.
[12] Lenz J., Schurz J., Wrentschur E. (1993) Properties and structure of solvent-spun and viscose-type fibres in the swollen state. Colloid & Polymer Science, 271 (5) , pp. 460-468.

STUDY OF ABRASION RESISTANCE OF PLAIN AND KNITTING FABRICS

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Abstract: Nanotechnology processes are present into the textile field. One of these processes involves encapsulated nanoparticles or nanoproducts, know as microcapsules. Microencapsulation technology is used into textiles to confer new properties and added value. There are a lot of different active core microcapsules used in the textile industry such as durable fragrances, skin softeners, insect repellents, dyes, vitamins, antimicrobials, phase change materials, etc. The effect of microcapsules is usually measured by the presence of a property such as odour measurements when flavours are encapsulated. Neverthless, some properties such as hydration, antibacterial, insect repellents, etc., can´t be tested without analytical methods.
Microcapsulated products can be applied on fabrics by impregnation, bath exhaustion, foam, spraying and coating. The most extended industrial application is by padding. Microcapsules useful life can be affected by fabrics testing and maintenance to which they are subjected during their lifetime. This work studies flavour microcapsules behaviour on plain and knitting fabrics applied by impregnation when these fabrics are subjected an abrasion test.
Scanning electron microscopy (SEM) has been used in order to determinate the quantity of microencapsulated products that remains on fabrics after abrasion tests. We concluded that the abrasion resistance test destroy the microcapsules deposited on fabrics.To sum up, we can indicate that depending on the fabric structure the abrasion test result can differ from one fabric to other.

Key words: fragrance microcapsules, impregnation, abrasion test, cotton fabrics, SEM

1. INTRODUCTION

Microcapsules applied on textiles have become a way of modifing textile properties [1,2]. In recent years, textile industry is one of the industry sectors that has increased the consumption of microcapsules.

Fragance encapsulation is one of the applications of microencapsulation technology in the textile sector. Microencapsulation technology allows us an opportunity that can favour its durability on fabrics.

In the textile sector the most extended microcapsules industrial application is by padding. Fabric structure is an important parameter to consider in the microcapsules application on fabrics [3]. Furthermore application procedure, bath composition, fibres nature (hydrophobic vs hydrophilic character), cross section, fabric weight and fabric wave, are variables to consider in the application of microencapsulated products into textile substrates [4,5] in order to ensuring the stability and durability of microencapsulated.

Textiles in their useful life are submitted to washing, drying, ironing, abrasion, etc. These processes affect the stability of microencapsulated products. A previous research [6] shows the washing effect on plain and knitting fabrics. The aim of this work is to determinate the stability and durability of flavour microcapsules on the fabric surface after the application of an abrasion test. Therefore, we studied and compared the behaviour of plain and knitting fabrics.

Martindale method, UNE-EN ISO 12947-1, has been used in the test abrasion. Fabrics surface has been characterized by scanning electron microscopy (SEM).

2. EXPERIMENTAL

2.1 Materials

Lavender fragrance microcapsules were supplied by COLOR CENTER (Tarrasa, Spain). The wall material was melamine formaldehyde. An acrylic resin was applied in order to bond the microcapsules to the fabric, also supplied by COLOR CENTER.

Fabrics used in the research were 100% cotton and had different characteristics, these are shown in table 1.

Table 1: Fabrics characteristics

Sample	Structure	Weight (g/m^2)
Cotton 1	Plain	115
Cotton 2	Plain	210
Cotton 3	Weft Knitting	180

Fabrics 1 and 2 had been chemically bleached with peroxide in an industrial process. Also Fabric 1 has received a finishing treatment.

Fabric 3, weft knitting fabric, was prepared in a flat knitting machine (Matsuya Corporation, Japan) gauge 12.

2.2 Fabric Treatment

Fragances microcapsules were applied to the surface of the fabrics by impregnation. An acrylic resin was used as a binder. As a result, thermal treatment in the form of hot air was applied to cure the resin and to induce microcapsules adhesion on the fibre surface. For the process, a horizontal foulard was used. Bath treatment was composed of 10g/L of resin and 60g/L of commercial microcapsules, it had been studied previously [5].

2.3 Abrasion Test

Abrasion tests were performed by the Martindale method, UNE-EN ISO 12947-1. The abrasion cycles were applied 125, 250, 500, 750, 1000, 1250, 1500, 1750 and 2000.

2.4 Instrumental Techniques

A scanning electron microscopy Phenom microscope (FEI Company) was used for fabric surface observation. Each sample was fixed on a standard sample holder and sputtered with gold and palladium.

3. RESULTS AND DISCUSSION

Fabric weight (g/m^2) has an important influence in the number of microcapsules deposited on fabrics for the same padding treatment [3,6].

Figure 1 shows SEM micrographs of cotton fabrics with microcapules after 125 abrasion cycles. Certain differences can be observed. In fabric *b* (Cotton 2 - 210 g/m^2) we can observe microcapsules with a spherical shape. These microcapsules are situated in the grooves which form the kidney – shaped fiber section, therefore they will be more protected from the abrasion effect. In fabrics *a* and *c* only can be observed microcapsules shells without an active core.

The abrasion action destroys the microcapsules as increases the number of abrasion cycles regardless the fabric weight. The abrasion effect can also affect cotton fibers, it can be observed in figure 2, SEM micrographs after 2000 abrasion cycles.

Figure 1: SEM micrographs of cotton fabrics after 125 abrasion cycles
(a) Cotton 1. (b) Cotton 2. (c) Cotton 3

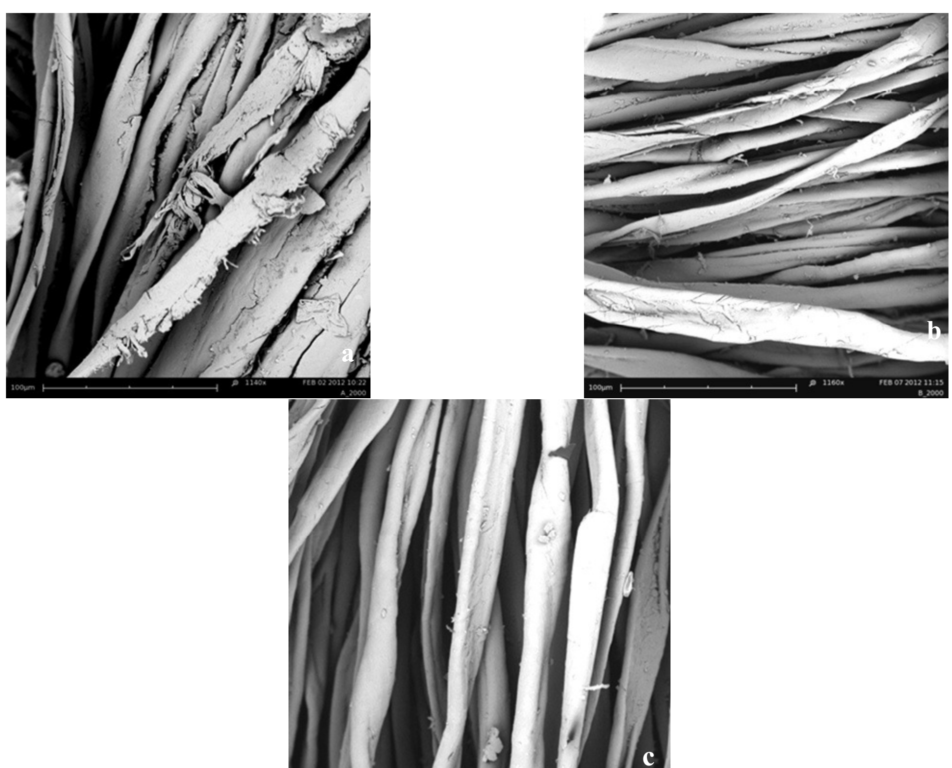

Figure 2: SEM micrographs of cotton fabrics after 2000 abrasion cycles
(a) Cotton 1. (b) Cotton 2. (c) Cotton 3

4. CONCLUSIONS

The present researh compares the stability and durability of microcapsules on the plain and knitting fabrics surfaces after test abrasion resistance. Certain differences can be observed. Depending on the fabric weight the abrasion test result can differ from one fabric to other. The weaving process does not influence in the number of microcapsules that remain on the fabrics after abrasion cycles. The number of microcapsules deposited on the fabrics after padding treatment is higher in fabrics with higher weight (g/m^2), therefore they remain longer on fabrics after abrasion cycles. The continuos abrasion cycles affect fibers stability and the microcapsules durability.

5. ACKNOWLEDGEMENTS

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6. REFERENCES

[1]. Rodrigues, S.N., Martins, I.M., Fernades, I.P., Gomes, P.B., Mata, V.G., Barreiro, M.F., Rodrigues, A.E. (2009). Scentfashion®: Microencapsulated perfumes for textile application. *Chemical Engineering Journal*, Vol. 149 (1-3),2009, 463-472, ISSN 1385-8947.
[2]. Nelson G., Application of Microencapsulation in textiles, *International Journal of Pharmaceutics* 242, 2002, 55-62.
[3]. Monllor P., Capablanca L., Diaz P., Bonet M.A., Fabric structure influence in the deposition of flavour microcapsules, *Proceedings of International Scientific Symposium. "Innovate solutions for sustainable development of textile industry"*, 2008, 13-16, ISBN 1582-5590, Oradea (Rumania).
[4]. Capablanca L., Bonet M., Monllor P., Bou E., Díaz P., Variables evaluables en la aplicación de microcápsulas a tejidos, *Revista de Química Textil* Vol. 202, 2011,48-56., ISSN 0300-3418.
[5]. Capablanca L., Bonet M., Monllor P., Bou E., Díaz P., Vida Útil de las Microcápsulas sobre tejidos, *Revista de Química Textil* Vol. 195, 2009,36-50, ISSN 0300-3418.
[6]. Capablanca L., Bonet M., Monllor P., Montava I., Washing behavior of plain and knitting fabrics, *Proceedings of International Scientific Symposium. "Innovate solutions for sustainable development of textile industry"*, 2012, 13-16, ISBN 1843-813X, Oradea (Rumania).

TRANSFER OF WATER VAPOUR THRU THE ARTICLES KNITTED ON SMALL DIAMETER CIRCULAR MACHINE

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Abstract: The clothing must have, in addition to the protective function of the body, esthetic and hygienic functions. The comfort that the clothing is providing is influenced by processes of transfer of heat and moisture. These processes are considered as processes more complex, and which take account of: production and transfers heat and the humidity of the human body and transfer them in the framework of the system your body- clothing-environment, and second, the ventilation to and from the environment by clothing.
To improve the understanding on this complex topic the paper presents one of the methods to analyze the comfort parameter on the knitting articles realized from different raw material on the small diameter circular knitting machines.
In the analysis processes of transfer of moisture by textile materials it is necessary to make a distinction between moisture transport in the form of vapour (molecule) and the in the liquid form (drop). [4]
The transfer of moisture by textile materials increases with the increase in permeability of the air, due to the structure of the fabric.
In the purpose to analyze the type of the yarn influence on the transfer of humidity in the status of vapor thru the knitted fabric, there were tested different samples knitted from 8 types of yarns.

Key words: *comfort, water vapour, sock, plated single jersey, raw material.*

1. INTRODUCTION

Water vapor transportation through a fabric is one of the most important fabric attributes that contributes to wear comfort. It is generally defined as a measure of the mass of water vapor that is transported across unit area of the fabric under specific conditions of temperature and vapor pressure gradients between the two sides of the fabric under study [1], [2].

The new direction of development in knitting industry is to improve the functions of textile products and the knitting technology in the purpose for making textiles that can keep rain, heat, and moisture away from the body, provide a good sense of touch, and offer comfort.

The information from the literature shows that the dynamic nature of the moisture exchange between the skin and outer environment through clothing is the key to understand the role moisture plays in clothing comfort [3].

On the basis of physical interpretation of these features, may be forming some processes of transfer of heat and humidity in the system body - cloth- environment. Must be taken into consideration requests such as physical and climatic conditions that cause these processes.

The mechanisms of transfer of moisture from your body toward environment through clothing are illustrated in figure 1. [4], [5]

- The diffusion of water vapor is carried out thru the pores of the fabric;
- Adsorption on the surface moisture migration and fibers are depending on the characteristics of their surface;
- Absorption and desorption represents the mechanism of transfer of sweat in the status of vapors and/or in liquid form, in and out of the fibers, backed on many times by a process of inflation of fiber, if the type of polymer allows it;
- Condensation-evaporation or evaporation takes place via free spaces;

- Convection and the air ventilation of wet from the microclimate underclothing are determined by the movements carried out from the person.

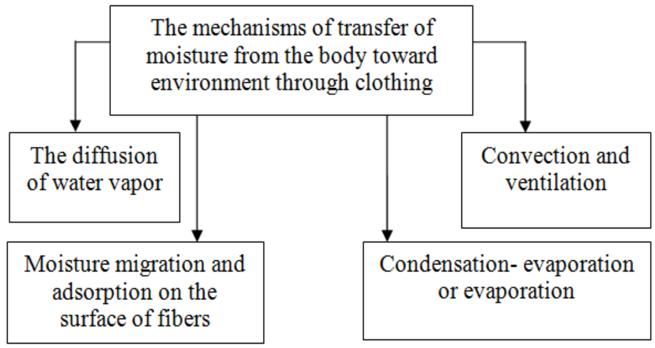


Figure 1. The mechanisms of moisture transfer thru the body toward environment through clothing [4], [5]

Vapours penetrate by diffusion in the material, as a result of the difference between the values in partial pressure in underwear microclimate and the environment and also as a result of sorbtion - desorption.

The transfer of moisture by textile materials increases with the increase in permeability of the air, due to the structure of the fabric. [4], [5]

Knowledge of mechanisms for water transfer specific on various structures of textile materials has a great importance for correlation of their characteristics with specific characteristics of the activity of persons who are wearing the products.

2. SAMPLES

All samples were knitted in the same pattern: plated single jersey. In all the cases, the plated yarn is polyamide 6 (figure 2). To obtain samples we used circular knitting machines with small diameter MATEC MONO 4. (Cilinder diameter: 3 $^{1/2}$", Number of needels: 156, Gauge: 14Ef)

In table 1 are presented the characteristics of samples.[6]

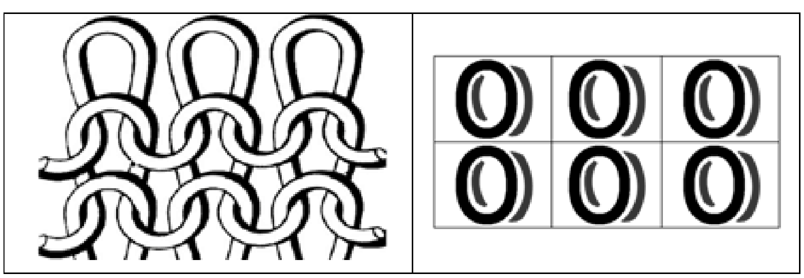


Figure 2. Plated single jersey knitted fabric [6]

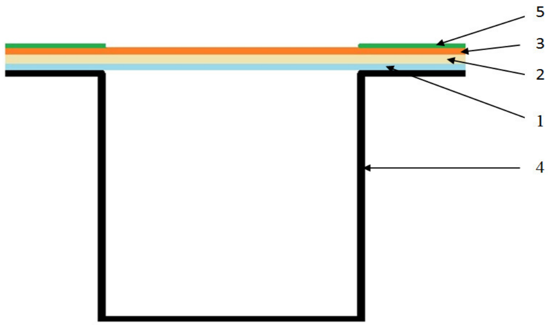
Table 1. Sample parameters

No. of sample	Raw of the yarn	Fineness of the yarn (Nm)	Raw of the plated yarn	Fineness of the plated yarn (dtex)	Fabric density (wales / 50 mm)	Fabric density (rows/ 50 mm)	Fabric thickness (mm)
1	Cotton	34/1	Polyamide 6	44/12x2	45	55	0.99
2	Organic cotton				45	55	1.07
3	Cotton +soybean 50%+50%				45	55	1.04
4	Polyester +Viscose, 50%+50%				45	55	0.96
5	Tencel				45	55	1.00
6	Bamboo +Viscose, 50%+50%				45	55	0.98
7	Viscose +Silk, 90%+10%				45	55	0.96
8	Recycled Polyester, RS				50	60	1.06

3. METHOD AND TEST PROCEDURE

In order to establish the ability to transport moisture in vapor status thru the knitted fabric for stockings we made tests using the Herfeld method with glasses.

Over the Herfeld glass (4) fits a thin sheet waterproof (1), on top of which sits a porous material (sponge) (2) with a thickness of 3 mm. We were pipetting 1 ml of water, in a uniform manner throughout the entire surface. Over the sponge is placed a sample of knitted fabric (3) that is secure with a plastic ring (5) (figure 3).[4]



1 – plastic sheet waterproof
2 – sponge
3 – knitted fabric
4 – Herfeld glass
5 – plastic ring

Figure 3. The assembly from the Herfeld glass, foil, sponge and knitted fabric [4], [5]

To weigh separately:

- knitted fabric before to be placed over the sponge water-soaked (m_{ti});
- the assembly from the Herfeld glass, plastic sheet, sponge saturated with water (m_a).

For 30 minutes, from 5 in 5 min., we have measured the weigh separately the support (the assembly from the Herfeld glass, plastic sheet, sponge saturated with water) and the fabric (m_t) It can be determined exactly how much water picks up the material from the support and how much water is transferred to environment through evaporation. We weight the assembly after 30 minutes and we note it m_{ar}. The quantity of moisture picked up by the plastic ring, being extremely low, was disregarded.

The weight of knitted after 30 minutes was note m_{tf}

After 30 minutes the quantity of water lost by evaporation C_{vap}[%] was calculated on the basis of the relationship [4].

$$m_t + m_a = M \quad \textbf{(1)}$$
$$m_{ti} + m_{ai} = M_i \quad \textbf{(2)}$$
$$m_{tf} + m_{ar} = M_f \quad \textbf{(3)}$$
$$C_{vap} = (M_i - M_f)x100 / M_i \ [\%] \quad \textbf{(4)}$$

4. RESULTS

Tabel 2. Results

No.	Yarn type	$mti_{[g]}$	$m_{a\ [g]}$	$M_{i\ [g]}$	weight after 5min. [g]		weight after 10min. [g]		weight after 15min. [g]		weight after 20min. [g]		weight after 25min. [g]		weight after 30min. [g]			Cvap [%]
					M	m_t	*M*	m_t	*M*	m_t	*M*	m_t	*M*	m_t	m_{ar}	m_{tf}	*Mf*	
1	Cotton	1.58	114.61	116.19	116.16	2.21	116.12	2.31	116.07	2.35	116.04	2.33	116.00	2.30	115.96	113.69	2.27	0.201
2	Organic Cotton	1.81	117.20	119.01	118.95	2.52	118.90	2.59	118.86	2.55	118.80	2.52	118.76	2.47	118.71	116.28	2.44	0.245
3	Cotton+soybean 50%+50%	1.76	118.64	120.40	120.34	2.63	120.29	2.59	120.23	2.54	120.17	2.48	120.13	2.43	120.08	117.70	2.39	0.264
4	Polyester+Viscose, 50%+50%	1.57	119.75	121.32	121.24	2.44	121.15	2.36	121.07	2.27	121.01	2.21	120.93	2.14	120.86	118.80	2.07	0.377
5	Tencel	1.70	117.29	118.99	118.97	2.60	118.92	2.58	118.87	2.52	118.81	2.47	118.76	2.41	118.71	116.35	2.36	0.238
6	Bamboo+Viscose, 50%+50%	1.83	123.42	125.24	125.15	2.69	125.07	2.61	125.00	2.54	124.94	2.48	124.87	2.41	124.81	122.46	2.35	0.347
7	Viscose+Silk., 90%+10%	1.71	118.67	120.39	120.35	2.64	120.30	2.59	120.24	2.52	120.19	2.47	120.14	2.42	120.09	117.72	2.37	0.246
8	Recycled Polyester, RS	1.82	119.66	121.48	121.43	2.73	121.36	2.66	121.29	2.58	121.22	2.51	121.15	2.45	121.10	118.70	2.39	0.319

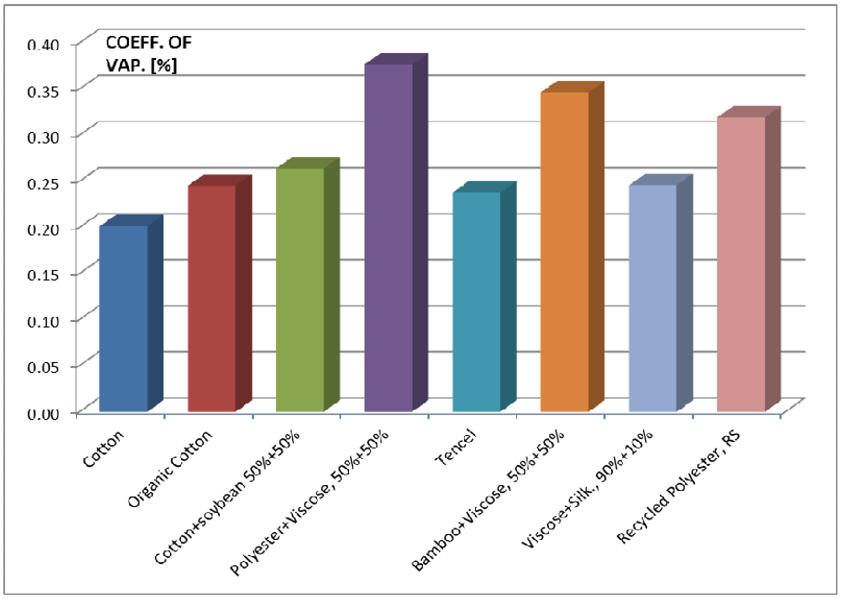


Figure 4. Coefficient of vaporization (C_{vap})

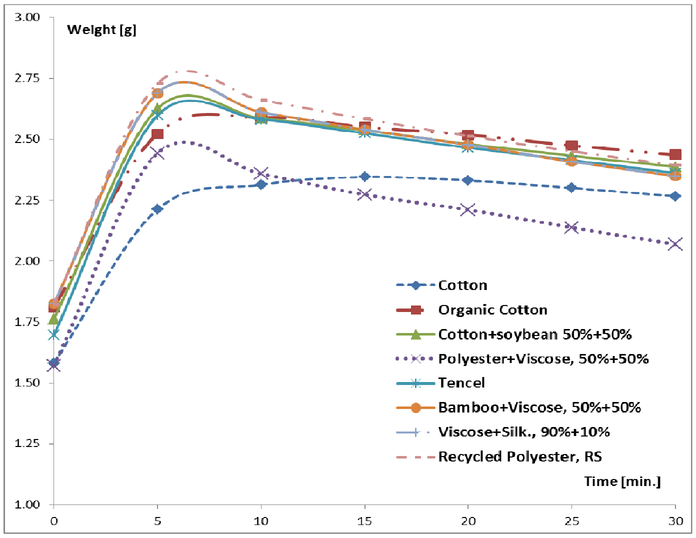


Figure 5. Graphical representation for absorption of water and its evaporation

Samples 8 and 6 have the ability to absorb the largest quantity of water in a shorter time (Figure 5). The lowest moisture absorption capacity has sample 1. Comparing samples 1 and 2 (cotton and organic cotton) we observe a better capacity to absorb moisture for sample 2.

The presence of polyester and viscose fibers increases the absorption of moisture. Regarding the capacity of vaporization, samples 4 and 6 have good properties of moisture transfer (0.377% and 0.347%). At the opposite pole are samples 1 and 5 (0.201% and 0.238%).

The organic cotton sample transfers with 21.8% more moisture than the cotton classic. Samples 5 and 7 (composed viscose) has approximately the same coefficient of evaporation (0.238% and 0.246%).

Comparing samples 4 and 8, we see that the presence of viscose increases the evaporation rate by 18.1%.

5. CONCLUSIONS

The yarn type and it's structure are influencing the transfer of humidity in the status of vapor thru the knitted fabrics.

The tests relveled that the socks knitted on the syntethic yarns have a increased capacity to transfer the water by evaporation and the socks kitted with cellulose yarns have a reduced capacity to transfer the water by evaporation, but a greater capacity of absorbtion.
In order to increase the transfer of humidity in the status of vapor thru the socks, we recomand to knit plated fabrics from syntethic yarn knitted as plated yarn, in contact with the skin, realysing a conductive layer and the natural yarn as ground, to create the absorbtion layer.

6. REFERENCES

[1] McCullough E.A., Kwon M, Shim H.; A Comparison of Standard Methods for Measuring Water Vapor Permeability of Fabrics; Measurement and Textile Technology 2003, 14, 1402-1408.
[2] Pause B.; Water Vapor Permeability of Coated Fabrics and Laminates; Journal of Coated Fabrics 1996, 24, 311-320.
[3] M. V. Vivekanandan, S. Sreenivasan - Dynamic Transportation of Water Vapor through Cotton and Polyester-Cotton Blended Fabrics, http://www.jeffjournal.org/papers/Volume7, (2013)
[4] Fărîmă Daniela – Confortul și funcțiile produselor textile și din piele - îndrumar de laborator, Editura Performantica, Iași 2007.
[5] Fărîmă Daniela – Confort si performanta in sport, Ed. Performantica, Iasi 2007
[6] http://www.apparel-merchandising.com/2012/06/introduction-to-fully-fashioned_2193.html

ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

STUDY CONCERNING THE QUALITY LEVEL OF WOOL-TYPE YARNS AFTER THE CLEANING OPERATION

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Abstract: The work presents the experimental results concerning the elimination of rare defects from wool-type yarns by means of the Leophe FR-30 electronic cleaners installed on the Mettler spoolers.
In order to appreciate the yarn quality level and the efficiency of the cleaning operation, we have analyzed the irregularities on short sections (U%), the frequency of imperfections within 1000 m yarn and the frequency of rare defects/100 km yarn before and after the cleaning operation, for the following yarn range:

- yarn Nm 48/l (45% wool + 55% pes);
- yarn Nm 52/l (45% wool + 55% pes);
- yarn Nm 56/l (45% wool + 55% pes);
- yarn Nm 45/l (100% wool);
- yarn Nm 52/l (100% wool);
- yarn Nm 56l/ (100% wool).

The detection of yarn defects, determination of their frequency, classification and cleaning of yarn defects were performed by means of the Classimat capacitive measuring systems, through the analysis of the obtained measuring signals, in terms of:
- defect thickness: the measuring signal amplitude detected as overtopping of the control limit, expressed as percentage deviation as reported to the rated value of the yarn count/diameter;
- defect length, i.e. the duration of overtopping the control limit at the signal level, detected as duration/impulse.

Key words: imperfections, Cassimat classification, cleaning, linear irregularity, flaws categories, defect thickness, yarn count/diameter.

1. INTRODUCTION

The aspect quality of the yarns, which determines in a certain measure the aspect quality of the woven and knitted products, depends on both the number of frequent defects (imperfections), and the number of rare damaging defects, be them short, intermediate and mainly long and thick.

The irregularities and imperfections can be diminished through preventive measures, acting on the technological process, the raw material and the utilized equipment, while the severe and damaging defects can also be removed after yarn manufacturing, through the cleaning operation. The cleaning operation means, in fact, the replacement of a severe, large defect with another one, of a smaller size, namely a knot [1], [2].

The idea that the electronic clearer with extremely severe adjustment can entirely solve the problem of yarn quality is quite wrong, because the yarn knots, which inevitably replace the defects, will in turn, have a negative influence on the product aspect, diminishing the spoolers yield and producing the increase of the number of needles breakages [3].

That is why the most efficient way to obtain yarns with a diminished number of defects is to prevent their occurrence in the yarn as much as possible.

The results of the analyses carried out on the six articles proposed for investigation are synthetically presented in terms of the following aspects: frequency of rare defects per 100 km of yarn before and after the cleaning operation, according to the Classimat system. In order to make easier the results processing and interpretation, the following symbols were used:

V_1 – yarn version destined to cleaning with R_1;

V_1^* - the same yarn cleaned with R_1;
V_2 – yarn version destined to cleaning with R_2;
V_2^* - the same yarn cleaned with R_2;
V_3 – yarn version destined to cleaning with R_3;
V_3^* - the same yarn cleaned with R_3.

Each yarn was cleaned for three clearer adjustment versions:

- R_1 representing L=3; D= 2; N=7;
- R_2 representing L=2; D= 2; N=7;
- R_3 representing L=2; D= 2; N=5,

Where: the selector L performs the adjustment for establishing the length of the removed defects; selector D performs the adjustment to establish the thickness of the removed defects, and selector N performs the adjustment to establish the thickness of the short defects [4], [5], [6].

2. EXPERIMENTAL PART

There have been investigated six assortments of wool-type yarns, whose physical- mechanical characteristics are presented in Table 1.

Table 1: Physical-mechanical characteristics of yarns

1.	Name of blend	67%Wool+33%Pes			100% Wool		
2.	Yarn count (Nm)	48/1	52/1	56/1	45/1	52/1	56/1
3.	Color	brown	white	green	grey	black	black
4.	Yarn count non-uniformity, (%)	2.0	2.0	1.4	1.6	1.6	2.4
5.	Breaking load (cN)	336	254.4	200.4	103	84.8	84.2
6.	Non-uniformity of breaking load, (%)	18.0	15.64	18.44	11,2	10.84	14.4
7.	Breaking elongation, (%)	20.45	21.7	19.2	6,2	8.3	7.1
8.	Torsion, (tors/m)	550	545	600	604	605	627
9.	Humidity, (%)	5.2	5.3	6	11,8	12.9	15
10.	Uster Values: Uster irregularity, (%)	12.7	13.6	15.2	13,7	15.7	13.76
	Thin places/1000 m	260	271	426	323	397	160
	Thick places/1000 m	61	59	103	116	126	55
	Nops/1000 m	47	42	33	14	12	72

The automatic determination of the number of rare defects in terms of the defect length and thickness was performed by means of the Uster- Classimat installation which ensures the detection of defects, their classification in terms of their length and thickness, and their numerical recording within the 16 classes [2].

For a more efficient comparison at a qualitative level, of various yarn types in terms of their content of rare defects, they were classified as follows:

T- total number of defects, including defects from all the classes;
D- thick and long defects, severe and damaging defects respectively;
DL- a wider range of thick and long defects, severe and damaging defects respectively;
C- short defects;
CL- a wider range of relatively short defects, with limited length;
I- intermediate defect.

The obtained results are summarized in Table 2.

Table 2: Categories of defects recorded on the Uster- Classimat installation

No.	Name of blend	Nm_F	Yarns color	Groups of defects/100 km fir					
				C	CL	I	D	DL	T
1.	67%Wool + 33%Pes	48/1	brown	752	918	201	18	25	1144
2.	67%Wool +33% Pes	52/1	white	734	935	198	10	27	1160
3.	67%Wool + 33%Pes	56/1	green	551	729	827	70	135	1691
4.	100% Wool	45/1	grey	327	525	372	22	104	1001
5.	100% Wool	52/1	black	381	614	388	45	124	1126
6.	100% Wool	56/1	black	711	987	529	69	186	1702

The analysis of the severe defects rendered evident that, out of all, the thickening type imperfections have the bigger weight. Table 3 illustrates as an example the types of defects and their weight for the Nm 56/l yarns, made of 100% wool and of wool and polyester blended fibres.

Table 3: The weight of severe defects, in terms of causes, for the Nm 56/l yarns

No.	Defect cause	67%Wool +33%pes		100% Wool	
		green		black	
		Absolute frequency	Relative frequency (%)	Absolute frequency	Relative frequency (%)
1.	Weaves at the spinning machine	3	1.31	6	5.81
2.	Adjacent lint	9	3.29	11	10.6
3.	Incorporated lint	8	3.53	14	13.5
4.	Series of fibres wrapped around the yarn	7	3.1	-	-
5.	Lashings	7	3.1	15	14.56
6.	Thick places	185	84.4	57	55.33
7.	Foreign bodies	-	-	-	-
8.	Total analysed defects	219	100%	103	100%

These defects are generally produced by the spinning machine, through a faulty operation of the working organs of the drafting assembly. They can even occur within an impeccable drafting train, due to certain defects included in the strain of the finishing train.

The values recorded for the yarns Nm 52/l and Nm 56/l were classified within the world quality levels, being summarized in Table 4.

Table 4: Defects classification on quality world levels

Class of defects	Values recorded at the analysed yarns							
	67%Wool+33%Polyester				100%Wool			
	white		green		black		black	
	recorded value	quality level	recorded value	quality level	recorded value	quality level	recorded value	quality level
1	2	3	4	5	6	7	8	9
A_1	734	78%	552	70%	381	70%	716	95%
A_2	56	30%	77	50%	52	50%	118	80%
A_3	6	25%	10	27%	11	50%	22	76%
A_4	0	< 5%	1	10%	0	< 5%	5	75%
B_1	206	95%	204	95%	254	> 95%	327	> 95%
B_2	30	60%	64	80%	51	94%	97	95%
B_3	5	30%	26	78%	21	93%	51	> 95%
B_4	2	30%	10	78%	8	90%	22	> 95%
C_1	121	95%	323	> 95%	225	> 95%	279	> 95%
C_2	13	35%	51	94%	47	> 95%	53	> 95%
C_3	4	30%	18	80%	23	> 95%	20	95%
C_4	0	5%	5	75%	13	> 95%	11	> 95%
D_1	99	> 95%	352	> 95%	266	> 95%	380	> 95%

D_2	21	75%	106	> 95%	93	> 95%	139	> 95%
D_3	4	50%	23	> 95%	12	80%	22	> 95%
D_4	0	5%	4	70%	7	95%	2	25%

Taking into account the total number of defects $T= A_1 = B_1 + C_1 + D_1$ for the yarns from the (67% wool+ 33% pes) blend, the world quality level is over 75%.

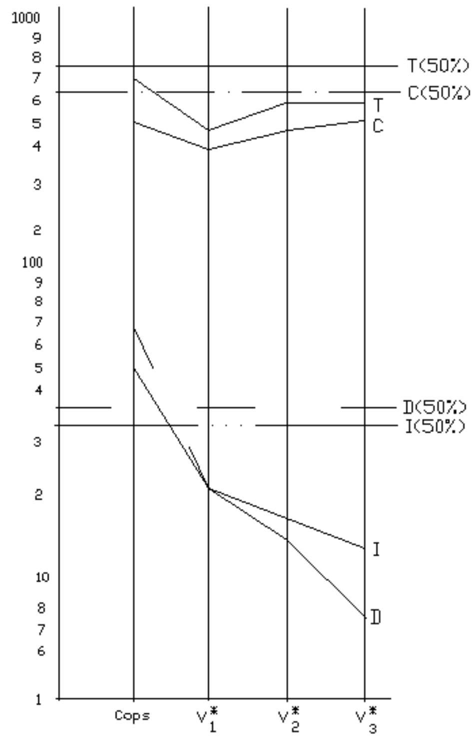

Figure 1: variation of the main defects categories for the yarn Nm 52/lmade of 67% wool and 33% pes, as compared to the world level of 50%

3. CONCLUSIONS

1. Irrespective of the yarn count or the nature and properties of the blended yarns, the analysis of the frequency and causes of thickness defects from the investigated assortments allowed establishing the necessary measures for their diminution.
2. For the studied yarns, the thickness defects with major weight, from the group of those considered as damaging, are represented by thick places, lashings, adjacent and incorporated lint.
3. The thick places are produced, on the one hand, by the long or short range irregularities of half- finished materials, and on the other hand, by the inadequate adjustment of the drafting assemblies.
4. The presence of naps is the result of the spinning machine insufficient cleaning program, and the faulty operation of the lint air blowers.
5. Lashings are produced by inadequate operation of the broken yarns catching devices.
6. Besides the usual physical and mechanical characteristics (yarn count, yarn count irregularity, breaking elongation, breaking strength, torsion, torsion irregularity), the quality of a yarn includes at least to an equal extent, its aspect characteristics.
7. The yarn quality aspect sets the conditions for both the products aspect and the technological process development.
8. The obtained results permit to draw up a program or organizing and technological measures meant to ensure the diminution of the thickness defects frequency, i.e. to improve the yarns quality.

4. REFERENCES

[1]. Bordeianu, D. L., Oană D., (2006), *Tehnologii generale textile,* Editura Universității din Oradea.
[2]. Neculăiasa, M., Hristian, L., (2004), *Metrologie Textilă*, Editura Performantica, Iaşi.
[3]. Neculăiasa, S. M., (2002), *Sisteme pentru monitorizarea calității produselor textile*, Editura Performantica, Iași.
[4]. ZellwegerUster, Systeme USTER CLASIMAT Classement des defaults du fil.
[5]. Caraiman, M., Glodean, G., *Influența unor reglaje a grupurilor cardatoare la carda cu cilindri pentru lână asupra caracteristicilor firelor*, Revista Română de Textile Pielărie, nr. 1-2/1997.
[6]. *** (2002), *Manualul inginerilor textiliști, Vol. I,* Editura Agir, București .

ANNALS OF THE UNIVERSITY OF ORADEA
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POLYAMIDE66 COMPOSITES REINFORCED WITH SHORT GLASS FIBERS

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Abstract: Fiber reinforced polymeric composites are being used due to their high strength and low weight advantages in many industries such as automotive and aerospace. Glass fibers, which have the same components as conventional glass, are widely used for reinforcing polymeric composites due to their high tensile strength values and relatively low costs.
In this study, Polyamide66 (PA66) composites reinforced with glass fibers at 1 wt%, 10 wt%, 15 wt%, 20 wt%, 25 wt% and 30 wt% are produced in small dogbone shaped samples. The production of the fiber reinforced composites is done via melt compounding using laboratory scale twin screw extruder and injection molding machines respectively. The tensile strengths of the samples are tested and the theoretical tensile strength values of the composites are calculated according to the Rule of Mixtures for the longitudinal direction.
There is a decrease in strain percentages for all fiber reinforced samples compared to 100% PA66 samples. The tensile strength values show an increase for fiber reinforcement values after 10 wt % glass fiber reinforcement; however there is a decrease in the tensile strength of the composite which has 1 wt% glass fiber. The measured tensile strengths of the composite samples show lower values than the results predicted from the Rule of Mixtures for longitudinal direction. The difference between measured and predicted results might be due to fiber orientation distributions in composites and weak interfacial bonding between matrix and fibers.

Key words: glass fiber, composite, Polyamide 66, Rule of Mixtures, tensile strength.

1. INTRODUCTION

Fiber reinforced polymeric composites are made of fibers of high strength and modulus combined in a polymeric matrix where both fibers and the matrix keep their physical and chemical properties; the composite material gains properties at a combination of the two components that can't be achieved by using only the fibers or the matrix [1].

Fiber reinforced composites such as straw reinforced bricks have been used in early history. However, the increase in usage of fiber reinforced composites starts with the Second World War to find substitutes for metallic materials [1, 2]. Nowadays, fiber reinforced polymeric materials are used in many industries such as automotive, aerospace, communication, aircrafts, sports equipments and transportation [1, 2, 3].

Glass fibers have the same components as conventional glass and glass fibers are produced by extruding the molten mixture through spinnerettes [4]. Glass fibers are widely used for reinforcing polymeric composites due to their high tensile strength values and relatively low costs compared to other synthetic fibers such as carbon fibers and aramid fibers [5, 6]. Glass fibers have high tensile strength; heat and fire resistance, chemical resistance to most chemicals, moisture resistance, and are non-conductive [2, 3].

\`The Rule of Mixtures\` is one of the most widely used methods of predicting the strength of a composite [7]. Equation 1 gives the formula for fiber reinforced composite strength in the case for longitudinal direction.

$$\sigma_c = \sigma_m \times v_m + \sigma_f \times v_f \quad (1)$$

Volume (V) and volume fraction (v) equations are given in Equations 2–5:

$$V_c = V_m + V_f \quad (2)$$

$$v_m = \frac{V_m}{V_c} \quad (3)$$

$$v_f = \frac{V_f}{V_c} \quad (4)$$

$$v_c = v_m + v_f = 1 \quad (5)$$

where: σ_m: Tensile strength of matrix

σ_f: Tensile strength of fiber

σ_c: Tensile strength of composite

v_m: Volume fraction of matrix

v_f: Volume fraction of fiber

v_c: Volume fraction of composite

V_m: Volume of matrix (mm^3)

V_f: Volume of fiber (mm^3)

V_c: Volume of composite (mm^3)

In the literature there are many studies on the tensile strength of glass fiber reinforced polymeric composites and predicting the strength of the produced fiber reinforced composites [8–13].Thomason et al observed an increase on tensile strength for 10-60 w/w glass fiber reinforcement in polypropylene composites [8]. Factors such as fiber content, fiber length, fiber orientation, void content and coupling agents used might affect the properties of fiber reinforced composites [8, 12, 13].

2. EXPERIMENTAL APPROACH

In this study, short glass fiber reinforced Polyamide 66 composites are produced in small dog-bone shaped samples via melt compounding. The composites are produced having 1 wt%, 10 wt%, 15 wt%, 20 wt%, 25wt% and 30 wt% of glass reinforcements. To evaluate the effect of glass fiber reinforcement pure PA66 (100 wt% PA66) samples are produced as well.

2.1 Materials and Method

Polyamide 66 is among engineering polymers and is widely used in automotive industry and in domestic aplliances.Thermoplastic Polyamide 66 polymer granules produced by Eplon® nylon resins (Eplon 66 NC) is used as the matrix, the short E-glass fibers (product code PA2) having 105 µm diameter, 4.5 mm fiber length and 1350 MPa tensile strength values from Camelyaf, Turkiye are used as the fiber reinforcement for the composites produced.

Glass fiber reinforced composites are produced in Kocaeli University Chemical Engineering Department Laboratory using DSM microcompounder, a laboratory scale twin screw extruder, and DSM microinjection machine, a laboratory scale injection molding machine,. respectively. The polymer granules and glass fibers are fed to the twin screw extruder heated to 270° C and the extruder is set to 100 rpm while the injection machine is set to 9 bar pressure, 280° C barrel temperature and 30° C mold temperature values. The shear mixing is applied for 2 minutes at the twin extruder before feeding the molten polymer mixture to the injection molding maching for glass fiber reinforced composites. Pure samples of 100% PA66 are produced using the same parameters. The sample codes and their matrix and fiber weight percentages are given in Table 1.

The composites are produced in dogbone shaped samples having length of 76 mm, thickness of 2.20 mm and a width of 12.80 mm at the tips decreasing to 4.40 mm width in the middle of the dog-bone shape Tensile strength values are obtained testing the produced samples on Lloyd LC, 5kN universal testing machine at 25 mm gauge length and 10 mm/min testing speed.

Table 1: Codes and weight contents of the samples produced in the study

Sample code	PA66 (wt %)	Glass fiber (wt %)
PA100	100	_
PAGF1	99	1
PAGF10	90	10
PAGF15	85	15
PAGF20	80	20
PAGF25	75	25
PAGF30	70	30

2.2 Results

The tensile stress-strain curves for samples are given in Figure 1. The tensile strength test results and strain percentages are given in Table 2. There is a decrease in strain percentages for all fiber reinforced samples compared to 100% PA66 samples. The tensile strength values show an increase for fiber reinforcement values after 10 wt % glass fiber reinforcement; however there is a decrease in the tensile strength of the PAGF1 sample which has 1 wt% glass fiber.

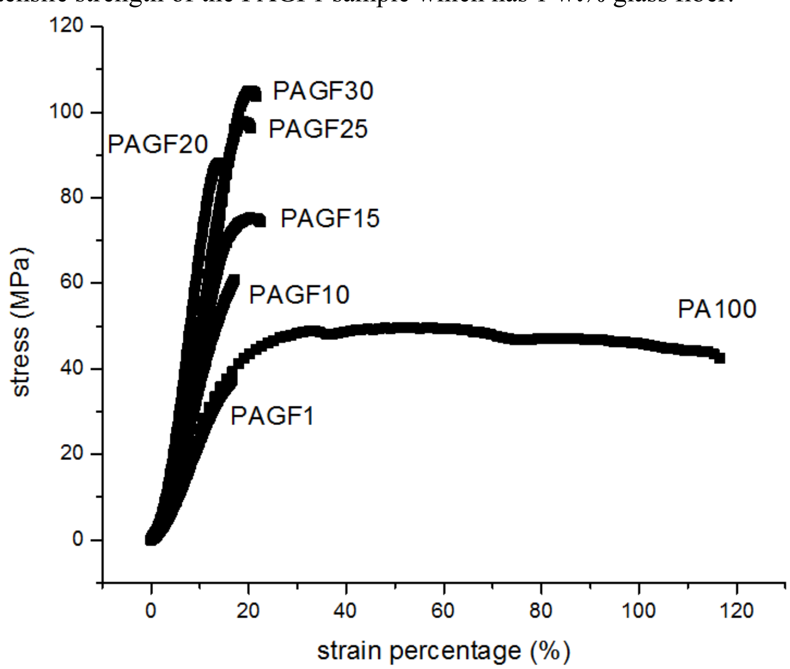

Figure 1: Tensile stress-strain curves of glass fiber reinforced PA66 composites

Table 2: The tensile strength test results of glass fiber reinforced PA66 composites

Sample code	Tensile strength (MPa)	Strain percentage at break (%)
PA100	53.68	113.46
PAGF1	34.07	16.57
PAGF10	63.64	14.69
PAGF15	76.53	22.34
PAGF20	90.32	21.07
PAGF25	90.69	20.42
PAGF30	105.68	21.18

In Figure 2, the measured tensile strength results are compared with the theoretical predictions made using Rule of Mixtures (ROM) assuming fiber orientation in the longitudinal direction. The calculated volume percentages of the samples are given in Table 3.

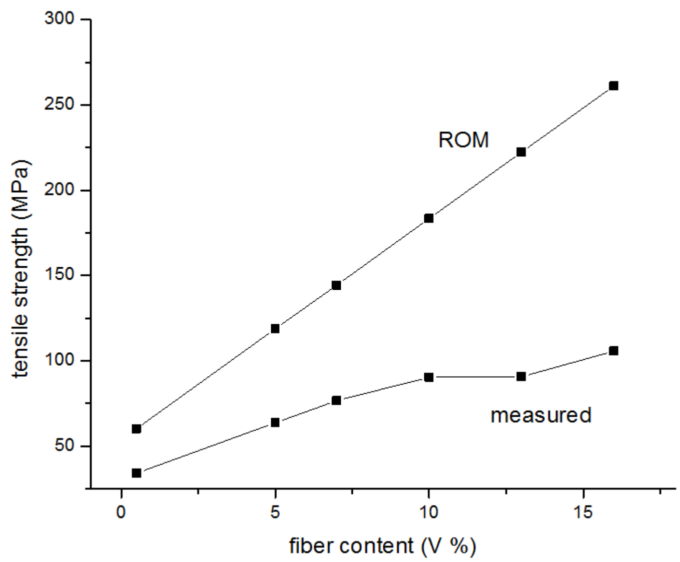

Figure 2: Graph of and measured tensile strength and predicted values using Rule of Mixtures (ROM)

Table 3: Matrix and fiber volume percentages of the samples produced in the study

Sample code	PA66 (V %)	Glass fiber (V %)
PA100	100	_
PAGF1	99.5	0.5
PAGF10	95	5
PAGF15	93	7
PAGF20	90	10
PAGF25	87	13
PAGF30	84	16

CONCLUSIONS

The tensile strength properties of glass fiber reinforced Polyamide 66 composites and the effect of glass fiber reinforcement on the composites is investigated in this study. Compared to pure PA66 samples, a decrease in tensile strength is obtained for 1 wt% of glass fiber reinforcement, while for higher glass fiber reinforcements (between 10 wt % and 30 wt% glass fiber reinforcements) an increase in tensile strength is obtained.

The strain percentages of all composites reinforced with glass fiber show strain values smaller than the pure PA66 sample. The tensile strength values of the glass fiber reinforced composites at reinforcement values higher than 10 wt % showed increase; however glass fiber reinforcements decrease the strain rates of the composites.

The measured tensile strengths of the composites show lower values than the results predicted from the Rule of Mixtures for longitudinal direction. There are many factors affecting the properties of fiber reinforced composites such as fiber content, fiber length, fiber orientation, void content and coupling agents used [8, 10, 11, 12, 13].The difference between predicted and measured values obtained in this study might be due to fiber orientation distributions in composites and weak interfacial bonding between matrix and fibers.

Increase in tensile strength of composites (having glass fiber reinforcement higher than 10 wt %) is obtained in this study. Glass fiber reinforced polyamide 66 composites having high glass fiber contents might be used in applications requiring higher tensile strengths and smaller strain requirements than Polyamide66 components.

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4. REFERENCES

[1] Mallick, P.K. (1993). *Fiber Reinforced Composites Materials,* CRC Press, ISBN 0824790316.
[2] Peters, S.T. (1998). *Handbook of Composites*, Chapman&Hall, ISBN 0412540207.
[3] Bunsell, A. R. & Berger, M. H. (1999). *Fine Ceramic Fibers*, CRC Press, ISBN 0824719514.
[4] Kolesov, Y.I., Kudryavtsev, M.Y. & Mikhailenko, N.Y. (2001). Types and Compositions of Glass for Production of Continuous Glass Fiber (Review). *Glass and Ceramics,* May 2001, vol 58, issue 5-6, pp 197-202, ISSN (Print): 0361-7610.
[5] Wambua, P., Ivens, J. & Verpoest, I. (2003). Natural Fibers: Natural fibers: Can They Replace Glass in Fibre Reinforced Plastics? *Composites Science and Technology,* 63, 2003, 1259-1264, ISSN: 0266-3538.
[6] George, J., Sreekala, M.S. & Thomas, S. (2001). A Review on Interface Modification and Characterization of Natural Fiber Reinforced Plastic Composites. *Polymer Engineering and Science*, September 2001, vol 41, no 9, 1471-1485, ISSN (Print): 0032-3888.
[7] Chou, T. W. (1992). *Microstructural Design of Fiber Composites*, Cambridge University Press, ISBN 052135482X.
[8] Thomason, J. L., Vlug, M. A., Schipper, G. & Krikort, H.G.L.T. (1996). Influence of Fiber Length and Concentration on the Properties of Glass Fiber-Reinforced Polypropylene: Part 3. Strength and Strain at Failure. *Composites Part A*, 27A, 1075-1084 (1996), ISSN: 1359-835X.
[9] Fu, S. Y., Lauke, B., Mader, E., Yue, C. Y., Hu, X. & Mai, Y. W. (2001). Hybrid Effects on Tensile Properties of Hybrid Short-Glass-Fiber- and Short-Carbon-Fiber-Reinforced Polypropylene Composites. *Journal of Materials Science*, 36(5), 1243-1251 (2001), ISSN (Print): 0022-2461.
[10] De Morais, A. B. (2006). Prediction of the Longitudinal Tensile Strength of Polymer Matrix Composites. *Composites Science and Technology*, 66, 2990-2996 (2006), ISSN: 0266-3538.
[11] Thomason, J. L. (2001). Micromechanical Parameters from Macromechanical Measurements on Glass Reinforced Polyamide 66. *Composites Science and Technology*, 61, 2007-2016 (2001), ISSN: 0266-3538.
[12] Hagstrand, P. O., Bonjour, F. & Manson, J. A. E. (2005). The Influence of Void Content on the Structural Flexural Performance of Unidirectional Glass Fiber Reinforced Polypropylene Composites. *Composites Part A: Applied Science and Manufacturing*, 36, 705-714 (2005), ISSN: 1359-835X.
[13] Lee, N. J. & Jang, J. (1998). The Use of Mixed Coupling Agents to Improve the Performance of Polypropylene Based Composites Reinforced with Short Glass Fiber. *Composites Science and Technology,* 57(12), 1559-1569 (1998), ISSN: 0266-3538.

A CASE STUDY ON THE ACCEPTANCE QUALITY LEVEL (AQL) FOR WOVEN GARMENTS QUALITY INSPECTION

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Abstract: The purpose of this paper is to highlight the types and number of defects identified during inspection of woven garments, specifically for trouser production according to the maintained Acceptance Quality Level.
Acceptance quality level (AQL) is an important field of statistical quality control. Garments manufacturing units and their buyers both are using this method to inspect the product quality before shipment. In this study, a survey has been carried out within eight reputed woven garment units in Bangladesh, for the same product (trouser) shipment according to the recommended rules for AQL 1.5 and 2.5 inorder to identify the defects produced during production.
The Survey results revealed that the types of identified defects are not same for all manufacturing units. Fifteen common types of defects were found both for AQL level 1.5 and 2.5.
Conclusions: This study has shown that there are a lot of defects which can come with woven garments (trouser) production. These defects vary from factory to factory according to the process, working procedure and management system and it can be identified through inspection procedure by using AQL tool. This article has also described that some common defects have been found in both AQL 1.5 and AQL 2.5. If those common defects can be eliminated then woven garment (trouser) quality can be improved as well as rejection percentage can be reduced.
This paper presents some limits due to the fact that it focuses only on the trouser production. And this survey has been carried out only on eight reputed garments factory in Bangladesh. This implies that more research about the findings should be carried out to generalize the results.

Key words: AQL, Garments inspection, Trouser, Common defects, Bangladesh

1. INTRODUCTION

The activities required for meeting the planned or desired quality target, for conformance, is termed quality control. Quality control is very much essential to identify the defects of a process and to ensure quality of the products [1]. Acceptance Quality Level (AQL) is a well known approach of statistical quality control. By maintaining required AQL level, maximum profit, good quality products, customer satisfaction and wide market can be achieved [2]. Export earnings of Bangladesh carry more than 76% contribution from the garment industry. Bangladesh has the one of the biggest garment industry in the world along with China, India, and Mexico. Reputed and well known brands in the US and Europe are ordering their garments in Bangladesh because of the high quality products in a low manufacturing cost [3]. Most of the garment factory of Bangladesh are practicing AQL for inspecting their products, but could not be able to maintain properly due to the lack of will, knowledge, technical support, higher investment and proper quality management system.
In this research work, a study has been carried out on eight different garment factories in Bangladesh to know their maintained AQL, which has been practicing for woven garment (trouser) production. A survey has been conducted in order to identify the amount and types of defects through inspection according to their maintained AQL.

2. LITERATURE

2.1 Inspection

Inspection is the process of measuring, examining, testing or otherwise comparing the unit of product with the requirements. This is a common system for examining product quality including garments products. Various types of inspection are being used according to the customer expectations [4].

Basically inspections can be categorized as i) **Normal inspection ii) Tightened inspection** and iii) **Reduced inspection.**

Normal inspection is used with no evidence that the quality of product being submitted is better or poorer than the specified quality level. Tightened inspection under a sampling procedure plan uses the quality level as for normal inspection, but requires tight acceptance criteria.

Reduced inspection under a sampling plan uses the same quality level as for normal inspection, but requires a smaller sample for inspection.

The term "Rejection" is closely related to the inspection procedure. A product is called rejected when its functionality or service qualities are impaired due to deficiencies of manufacturing work or due to imperfections of materials or due to any other type of defects. A product becomes a rejection when it loses sale-ability in a market. A single defect in the most visible area of a garment may make it a reject. Rejection is measured by the number called "Rejection number" which is defined as the minimum number of defects or defective units in the sample that cause rejection of the lot represented by the sample [4].

2.2 Acceptance Quality Level

The "Acceptance Quality Level" is defined as the maximum percent defective (or the maximum number of defects per hundred units) that, for purpose of sampling inspection, can be considered satisfactory as a process average [2].

Acceptance Quality Level of product is an important field of statistical quality control that was popularized by Dodge and Roming and originally applied by the US military for the testing of bullets during World War II. If every bullet was tested in advance, no bullets would be left to ship. On the other hand, if none as tested, malfunctions might occur in the field of battle, with potentially disastrous results. Acceptance Sampling plans help in distinguishing between the acceptable and the unacceptable lots. The basic assumption here is that if the proportionate sample is randomly drawn from a lot, the sample would represent the quality level of the lot and based on this the acceptance decision can be made. Acceptance Sampling is the middle of the road approach between 100 percent inspection and no inspection [5]. Early work in controlling product quality was on creating standards for producing acceptable products. By the mid-1950s, mature methods had evolved for controlling quality, including statistical quality control and statistical process control, utilizing sequential sampling techniques for tracking the mean and variance in process performance. During the 1960s, these methods and techniques were extended to the service industry. During 1960–1980, there was a major shift in world markets, with the position of the United States declining while Japan and Europe experienced substantial growth in international markets. Consumers became more conscious of the cost and quality of products and services. Firms began to focus on total production systems for achieving quality at minimum cost. This trend has continued, and today the goals of quality control are largely driven by consumer concerns and preferences [6].

2.3 Defects and Defectives

A defect is any non-conformance of the unit of product with the specified requirements. A defective is a unit of product, which contains one or more defects. Failure to meet requirements with respect to quality characteristics are usually described in terms of defects or defectives. Defects are mainly categorized in three type's e.g. i) Critical defects, ii) Major defects, iii) Minor defects. [7]

A critical defect is on which judgment and experience indicates is likely to:

-Result in hazardous or unsafe conditions for individuals using, maintaining, or depending upon the products; or

- Prevent performance of the planned function of a major end item. A critical defective is a unit of product that contains one or more critical defects.

A major defect is one, other than critical, that is likely to result in failure, or to reduce the usability materially of the unit of product for its intended purpose. A major defective is a unit of product that contains one or more major defects. A minor defect is one which is not likely to reduce the usability materially of the unit of product for its intended purpose, or is a departure from established standards having little bearing on the effective use or operation of the unit of product. A Minor defective is a unit of product that contains one or more defects.

2.4 AQL sampling plans

During product inspection a guided sampling plan should be followed to maintain AQL

There exist three types AQL sampling plans for inspecting the products from a consignment [2]

a) Single Sampling Plan: In this sampling plan one sample of items is selected at random from a lot and the disposition of the lot is determined from the resulting information. These plans are usually denoted as (n, c) plans for a sample size n, where the lot is rejected if there are more than c defectives. These are the most common (and easiest) plans to use although not the most efficient in terms of average number of samples needed.

b) Double Sampling Plan: In double sampling plan, the following three decisions' can be made after the first sample is tested, such as:

- Accept the lot
- Reject the lot
- Inspect again

If the outcome is (Inspect again) and a second sample is taken, combination of both samples is considered for the final decision.

c) Multiple Sampling Plan: This is an extension of the double sampling plan where more than two samples are needed to reach a conclusion. The advantage of multiple sampling is smaller sample sizes.

Table 1. Chart for reading of Acceptance Quality Level

SINGLE SAMPLING PLAN FOR NORMAL INSPECTION							
SAMPLE SIZE CODE LETTERS							
Lot Size	General Inspection Levels			Special Inspection Levels			
	I	II	III	S1	S2	S3	S4
2 to 8	A	A	B	A	A	A	A
9 to 15	A	B	C	A	A	A	A
16 to 25	B	C	D	A	A	B	B
26 to 50	C	D	E	A	B	B	C
51 to 90	C	E	F	B	B	C	C
91 to 150	D	F	G	B	B	C	D
151 to 280	E	G	H	B	C	D	E
281 to 500	F	H	J	B	C	D	E
501 to 1200	G	J	K	C	C	E	F
1201 to 3200	H	K	L	C	D	E	G
3201 to 10000	J	L	M	C	D	F	G
10001 to 35000	K	M	N	C	D	F	H
35001 to 150000	L	N	P	D	E	G	J
150001 to 500000	M	P	Q	D	E	G	J
500001 and over	N	Q	R	D	E	H	K

Acceptance Quality Levels (Normal Inspection)																							
Sample Size Code Letter	Sample Size	0		0.1		0.15		0.25		0.4		0.65		1		1.5		2.5		4		6.5	
		Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re
A	2																					0	1
B	3																			0	1		
C	5																	0	1				
D	8															0	1					1	2
E	13													0	1					1	2	2	3
F	20											0	1					1	2	2	3	3	4
G	32									0	1					1	2	2	3	3	4	5	6
H	50							0	1					1	2	2	3	3	4	5	6	7	8
J	80					0	1					1	2	2	3	3	4	5	6	7	8	10	11
K	125			0	1					1	2	2	3	3	4	5	6	7	8	10	11	14	15
L	200	0	1					1	2	2	3	3	4	5	6	7	8	10	11	14	15	21	22
M	315					1	2	2	3	3	4	5	6	7	8	10	11	14	15	21	22		
N	500			1	2	2	3	3	4	5	6	7	8	10	11	14	15	21	22				
P	800	1	2	2	3	3	4	5	6	7	8	10	11	14	15	21	22						
Q	1250	2	3	3	4	5	6	7	8	10	11	14	15	21	22								
R	2000	3	4	5	6	7	8	10	11	14	15	21	22										

2.5. AQL chart reading method

- Lot or batch size

Lot or batch size indicates the total number of pieces that the inspector is going to check or inspect. (I.e. if any buyer has offered a shipment of 600 pieces of order quantity, the batch size of this shipment will fall under 501 to 1200 pieces (Code-J).

- Sample size code letter

This code indicates a range of batch size. (Code 'J' means the lot size range is from 501 to 1200 pieces.

- Sample size

It means that how many pieces will be picked up for inspection from the total offered pieces (Batch). For Sample size code letter-J, sample size will contain 80 pieces.

- Ac (Accepted)

The number in this column denotes that if the inspector finds up to the recommended number of defective pieces the shipment will be accepted by the buyer. For instance: For Sample size code letter-J (1.5 AQL) Ac number will be 3. If the defects number would be 3 or less than 3, then the lot would be accepted.

- Re (Rejected)

The number in this column denotes that if the inspector finds that much defective pieces or more than the listed number, the shipment will be rejected (or asked to the manufacturer for 100% inspection and re-offer for final inspection) by the buyer. For instance: For Sample size code letter-J (1.5 AQL) Re number will be 4. If the defects number would be 4 or more than 4, then the lot would be rejected [2].

3. RESEARCH METHODOLOGY

This survey has been conducted within eight reputed woven garment factories (Table: 02) in Bangladesh, located near by Dhaka city. All factories are practicing different levels of AQL for their inspection. Data has been collected according to the AQL 1.5 from first four garments factories (Srl. No. 1-4) and according to the AQL 2.5 from rest four garments (Srl. No. 5-8) only considering one woven garments product (trouser). During inspection, single sampling plan and general inspection level II has been maintained and from each factory 4 lots of size 2500 pcs has been inspected with a sample size 125. An AQL checklist has been prepared for each factory and all information's regarding identified faults have been enlisted according to the maintained AQL level. Finally, the different defect percentage has been summarized by graphical presentation for analysis.

Table 2. Features of the selected garments factories

Serial No:	Name of Garments Industries	Number of Sewing Line	Maintained AQL Level	Garments Type
01	OPEX GROUP	210	1, 1.5, 2.5	100% export oriented woven garments
02	DISARI NDUSTRIES (PVT) LTD	22	1.5, 2.5	100% export oriented woven garments
03	REZAUL &BROTHERS (PVT) LTD	40	1.5, 2.5	100% export oriented woven garments
04	GOLDSTAR FASHIONS LTD	26	1.5, 2.5	100% export oriented woven garments
05	FCI (BD) LTD	60	1, 1.5, 2.5	100% export oriented woven garments
06	M-YEW FASHION LTD	08	2.5, 4	100% export oriented woven garments
07	CAPRI GARMENTS LTD.	12	2.5, 4	100% export oriented woven garments
08	SINCERE APPARELS LTD	20	2.5, 4	100% export oriented woven garments

4. DATA ANALYSIS AND DISCUSSION:

The graph in Fig. 01 presents the percentage of different types of defects, which were identified during inspection, maintaining AQL level 1.5. It is shown that the most occurring faults are Fabric holes (8.16%), Uncut thread (7.15%), loose thread (5.5%), Seam puckering (5.19%), Broken stitch (4.77%) and Skip stitch (4.64%). On the other hand Pile formation (0.90%), Uneven stitch (0.91%), Washing defects (0.92%) is less in percentage. In fig.02, it can be clearly seen the phenomena of those faults, when it was maintained AQL level 2.5. Here Uncut thread (7.42%), Loose thread (6.01%), Uneven pick (6.03%) and Brocken stitch (5.53%) are the major faults. Pile formation (0.67%), Seam puckering (1.34%), and Inside seam open (1.42%) have been indicating lower percentage in this case. It has also been noticed that the types of faults have been varied factory to factory. But some common faults were found in all the cases. Finally, identified common faults have been enlisted as percentage (Table: 03) and found that difference are not always proportional for all faults on the basis of Acceptance Quality level.

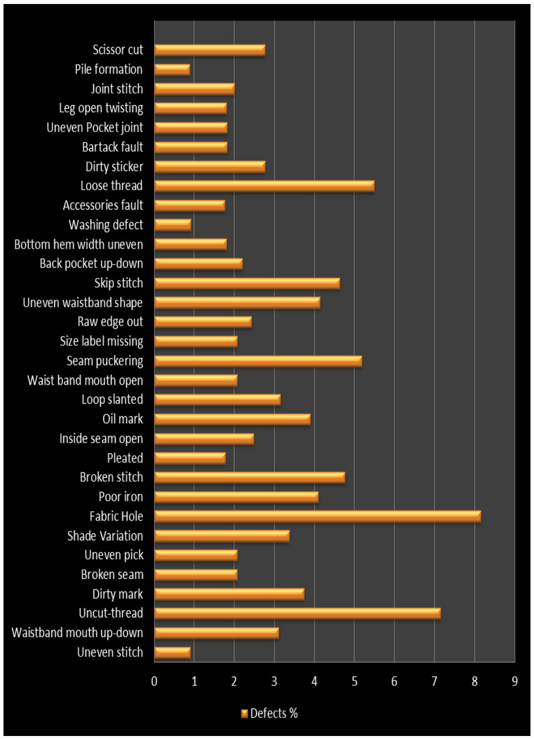

Figure1. Identified defects at AQL 1.5

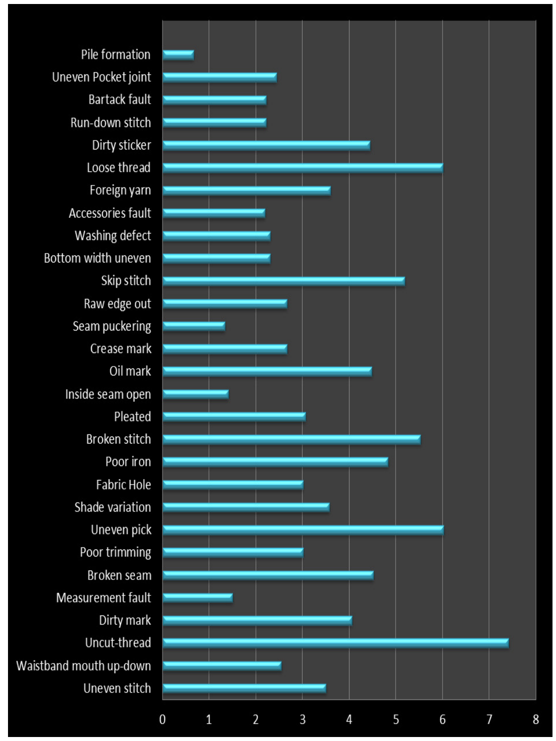

Figure 2. Identified defects at AQL 2.5

Table 3. Indentified common faults/defects for both AQL 1.5 and 2.5

Defects Name	AQL 1.5	AQL 2.5
Uneven Stitch	0.91%	3.51%
Uncut thread	7.15%	7.42%
Dirty mark	3.75%	4.06%
Shade variation	3.38%	3.58%
Poor Iron	4.1%	4.84%
Broken Stitch	4.77%	5.53%
Pleated	2.49%	3.07%
Oil Mark	3.9%	4.49%
Raw Edge out	2.44%	2.67%
Skip stitch	4.64%	5.2%
Bottom Hem width uneven	1.81%	2.31%
Washing Defects	0.92%	2.31%
Accessories Fault	1.77%	2.2%
Loose thread	5.5%	6.01%
Uneven pocket joint	1.83%	2.45%

5. CONCLUSIONS

This study has shown that there are a lot of defects which can come with woven garments (trouser) production. These defects vary from factory to factory according to the process, working procedure and management system. These can be identified through inspection procedure by using AQL tool. This article has also described that some common defects have been found in both AQL 1.5 and AQL 2.5. If those common defects can be eliminated then woven garment (trouser) quality can be improved as well as rejection percentage can be reduced.

6. REFERENCES

[1] Hasin, A. A.M, (2007). *Quality Control and Management,* Bangladesh Business Solutions, ISBN Nr. 984-300-000511-5, Dhaka, Bangladesh.
[2] Mehta, P.V.,(1982). *An Introduction to Quality Control for the Apparel Industry*, ASQC Quality Press, Mareel Dekker inc., New York.
[3] Kashem, M. A.,(2008). *Garments Merchandising,* Its ed. Lucky-One Traders, Dhaka, Bangladesh.
[4] Sakthivel, K., (2008). "Various Methods of Inspection Systems for Apparels". Available from: .http://www.fibre2fashion.com/industry-article/15/1483/various-methods-of-inspection-systems-for-apparels1.asp. Accessed: 20/10/2012
[5] Bheda,R.(2010). What is acceptable quality level? Available from: http://rajeshbheda.com/pdf/rbc-article9.pdf Accessed: 20/11/2012
[6] McGraw-Hill Concise Encyclopedia of Engineering (2002). "Product quality-Encyclopedia" Available from: http://encyclopedia2.thefreedictionary.com/Product+quality. Accessed: 30/11/2012
[7] Juran. J.M., (1999). *Juran's Quality Hand Book, fifth Edition*, McGraw-Hill publication, , ISSB Nr. 007034003X, New York.

TEXTILE MEMBRANE DESIGN: CASE STUDY OF A MEMBRANE HOUSE PROTOTYPE IN PORTUGAL

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Abstract: The increasing speed in which technology is developing, as well as the social and economical changes are quickly turning buildings constructive systems and building design methodologies obsolete. The research on faster, cheaper and environmentally more respectfull building technologies are growing concerns in buildings design. These are some of the advantages of textile membranes. In a few millimetres membrane we have a self-supporting material, a sunlight filter capable of absorbing or reflecting the ultraviolet or infrared ligh and an isolating material for thermic or acoustic purposes. But there is some problems regarding such structures: the complexity of the calculations needed in such a minimalist engineering, regarding its structural design, the visualisation of its forms - sometimes complex geometries, and the optimization of its functional performance - limited but also potentiated by its lightness and ephemerality. Computer-aided design has allowed designers of textile membrane structures to calculate its loads and determine their effect on projects quickly and more precisely, exploring various alternatives and options, turning the process not only cheaper, but also exploring new possibilities on the use of more efficient structures. There are also a significant number of softwares avilable that allow the functional performance evaluation of buildings, and that can also be used to evaluate textile membrane solutions with advantages related with easy and quick prediction of the building thermal performance during its service life. The apparently simple final result is normally the product of a very complex multi-criteria optimization process, from the membranes selection, the building design and calculation and the constructive systems adopted.

Key words: Textile membranes, design, modular house, form finding.

1. INTRODUCTION

After the energetic crisis of the seventies and specially with the more recent episodes of economic crisis in the developed world, we assist that the weight per square meter of building construction is tendencially decreasing, thanks not only to a technological evolution that allows it (we have insulation and mechanical resistance capacities that are equivalent and even better than traditional thicker and heavier walls, beams and covers), but also associated with the necessity of sparing resources. We are now regarding the growing importance of the self-adjustable, self-cleaning (such as the Teflon), flexible materials and even materials that are capable to change their form (such as the shape-memory alloys) or their appearance and translucity (such as the reactive membranes and glasses). We are now making intelligent buildings - the Domotics are now a common issue. We expect in a short time the self constructive building systems, or buildings that can behave like living beings, that can breathe, that can adapt themselves to different atmospheric conditions or that can even self-repair in case of damages. Also the methodologies of project are in constant evolution, with the digital design technologies opening new paradigms on architectural and engineering thinking.

2. THE TEXTILE MEMBRANES DESIGN

There is a new architectural tendency spreading that bets on the introduction of more efficient structures, lighter and technologically advanced. One of its more representative materials is the textile membrane, a technical textile material with a growing market. Due to their reduced weight and tensile resistance properties, a few millimetres membrane can be a self-supporting material suitable for covering big spans, a sunlight filter capable of absorbing or reflecting the ultraviolet or infrared light and protect from the rain and moisture.

2.1. Deciding the surface geometry

The practical way of making a thin, flexible membrane sufficiently stiff and flutter-proof to function as a tensioned facade, roof or canopy is by a combination of curvature and pre-stressing. The deliberately induced curvature enables the membrane to transmit lateral loads which it could not do when flat. With the introduction of prestress, the membrane structure gains tensional stability, providing stress throughout the all surface and allowing it to achieve resistance to compression and bending forces as wind buffeting or uplift, that otherwise would deform and even tearing the membrane. The pre-stress must be high enough (usually half a tonne per metre width of fabric), and never be reduced to zero by opposite external forces. The sequence of diagrams in figure 1 illustrates the tensioned membrane structure static principle. As we can see in figure 1(a), if a point P is restrained by tension members anchored at A and B, that point will obviously be held stable against upward forces but will be unable to resist downward forces. Conversely, a point P that is restrained by tension members anchored at C and D will be held stable against downward forces but not upward ones, as it can be seen on figure 1 (b). And a point that is restrained by two opposed directions APB and CPD will be stable against forces from all directions, as scheme 1(c) shows. The hyperbolic curvature characterizes most of tensioned membrane geometries, the typical form is known as “sail” or “saddle” – figure 1(d).

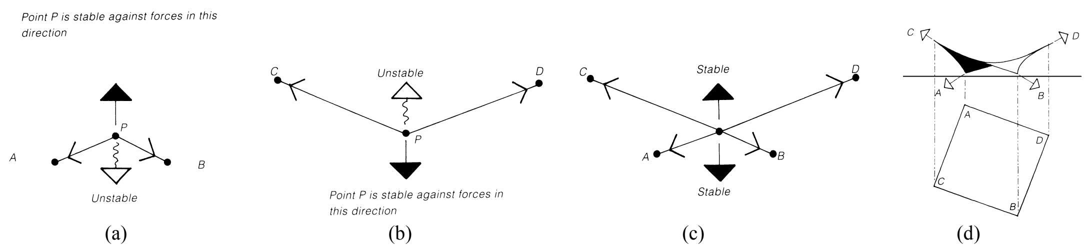


Figure 1: Diagram of tensioned membrane structure static principles: unstable (a); unstable (b); stable (c, d) [1].

If a flexible membrane is simultaneously curved in two opposite directions A-B and C-D, as shown in figure 1(c) and held in that shape by the application of pre-stress, then each individual point on its surface represents the condition shown in figure 1(d) and gets stable against all external forces. This simple principle is the key to understand even the most complex tensioned membrane forms.

The form of a tensioned membrane flows directly from the geometry of the boundary from which it is stretched. The boundary must be continuous.

The support and restraining on a tensioned membrane structure is done by masts, cables, lintels, arches, ring beams, trusses, anchorages, and even existing conventional heavy structures. Manipulating these elements lends to different design possibilities. Functional analysis (appearance, use, force transmission, interior conditioning) and form-finding are interdependent, so the process should be done simultaneously. Form-finding process involves a physical or virtual model to determine general shape and a computer analytical model to provide the final geometry. The two models can be done in sequence or simultaneously.

2.2. Computer-aided design

Computer aided design has allowed tensile structure designers to calculate loads and determine their effect on designs quickly and more precisely and to explore various alternatives and options in their work. Computer-aided design programs for these structures require specialized knowledge of the fabrics, so most of them are proprietary software programs or done in collaboration with specific membrane producers data, that are not completely revealed. Many specialist design firms have programmes giving highly reliable and accurate fabric shapes in response to stated design parameters. Two stages are involved:

• First the computer finds a form that a 'pure' membrane would assume if stretched between the proposed boundaries with uniform tension in all directions.

• Then the physical characteristics of the proposed membrane material are fed in and these inevitably produce a slightly modified form - taking into account, for instance, whether the woven material is more stretchy along its weft than its warp.

At all stages the designer has the facility of pushing and pulling the displayed forms and changing them in all sorts of ways until a satisfactory solution is reached - testing alternative support positions; different boundary shapes; different ways of collecting the surface tensions into cables and transferring these through the structure into the ground; and different types of membrane. The display can use colours to show how highly stressed the various parts of the structure are, and whether any parts of the membrane are not in tension (which, of course, is not acceptable).

In recent years, several CAD programs, primarily from European companies, have reached the market. The programs offer varying degrees of visualization and calculating capabilities, some intended more for "predesign" shape determination before precise formfinding and structural load analysis to be done. Those who wish to take advantage of CAD's benefits to the fullest and till the construction phase, will in general still need to consult with membrane producers, when the membrane properties are not included in the software.

Computer aided design is now extremely powerful but has disadvantages. One is that the designer may achieve correct answers without necessarily having any clear understanding of its underlying physical principles. The other is that even the best computer image gives a less realistic understanding of shape than an accurate physical model. For instance, relatively flat horizontal areas may seem on a computer diagram to be sufficiently curved. A frequently used approach can be to use physical modelling for preliminary form-finding and visual form-testing, and computer analysis for precisely determining the final shape, validating it for structural stability and generating the fabric-cutting patterns. The latter must be extremely accurate, and for this the computer is very useful.

While design cannot be reduced to a strict linear process it is helpful to see the design of a tensioned membrane as the sequence of stages that can be seen at figure 2.

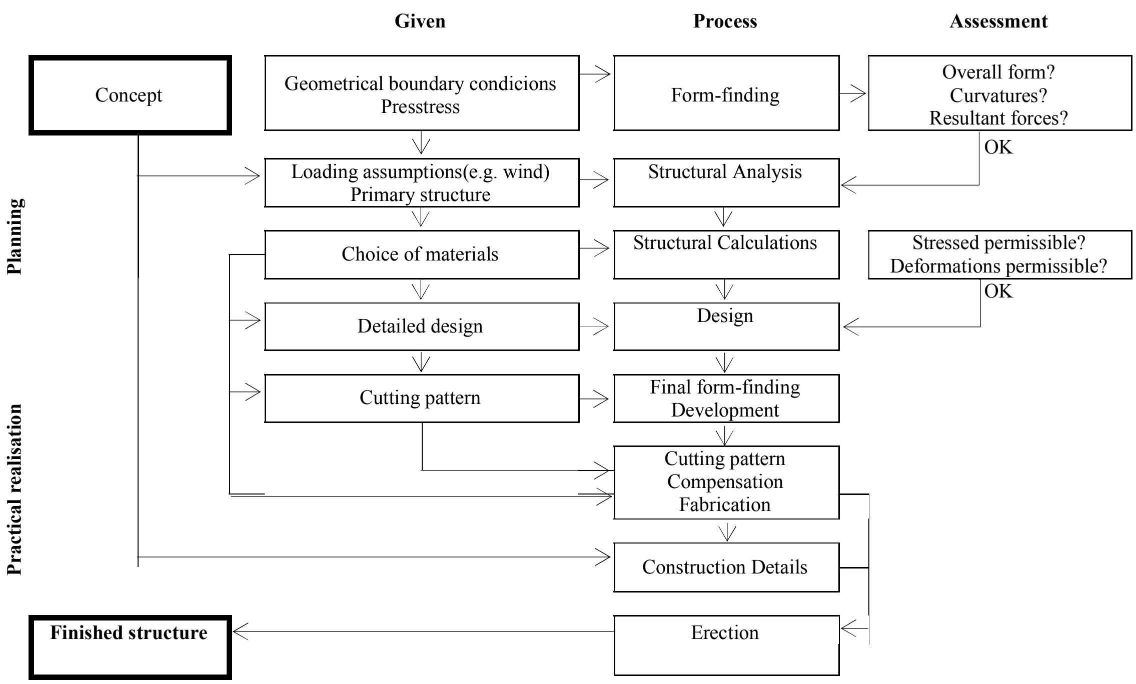


Figure 2: Diagram of textile membrane stages of design process (adapted from [2]).

2.3. Fine-tuning the theoretically-derived shape

Forms obtained by small-scale model or computer form-finding and calculated may satisfactorily resolve all structural stresses, but there may still be practical reasons for wanting to modify the shape thus established. These could include:

• Snow load dispersal. In cold climates a mass of snow may slide down the steeper sections of a fabric canopy and settle on the flatter areas, causing a deep deflection. This deflection may then become a water-filled pond which sags even deeper as more meltwater flows in, leading ultimately to membrane tearing. For this reason horizontal flat areas should be avoided or, alternatively, drained by means of gutters inserted in the fabric.

• Rainwater dispersal. Again it should be considered whether ponding may occur on the theoretically-derived shape.

• Appearance. The theoretically-derived form may not 'look right' and repeated modification may be required, possibly using large-scale physical models, to create a right-looking profile.

• Practical problems such as jointing or pre-stressing, particularly in areas of sharp curvature and in the cutting patterns.

During all these steps and specially in the cutting patterns, the computer is very useful, because all these fine-tuning is very delicate and can easily lead to the structure failure if a minor mistake is done, specially when using less flexible materials as PTFE-coated fibreglass fabric. In the case of large canopy structures, which may be subjected to unusual stress, a full-scale model may be needed to test and verify structural behaviour.

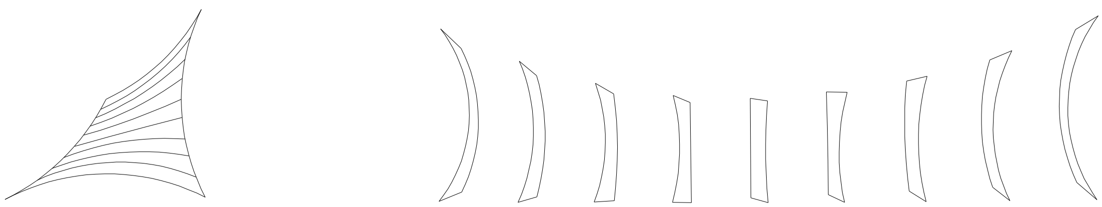
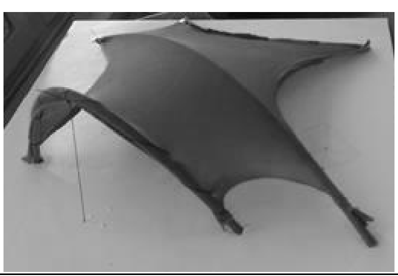
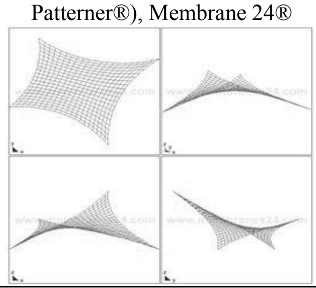
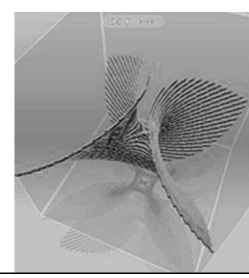


Figure 3: Patterning **e**xample for cutting a tensioned membrane surface by Membrane 24® software.

Tabel 1: Synthesis of form-finding process [3].

Experimental modeling	**Infotmatic tools/ Numerical moddeling**	**Combination of experimental and numerical modeling**
With stretch fabrics or tensioned nets. 	Form-finding, Structural design, Calculating the amount of fabric needed to define the cutting patterns and the dimensions of other structural components. (examples: MCMlite®, Tensyl-XM®, Rhino membrane®, Form Finder®, Patterner®), Membrane 24® 	Create 3D digital models from series of taken photographs to experimental models, at various angles, using photogrammetry. (example: 123D catch®) 

3. CASE STUDY: MODULAR MEMBRANE HOUSE IN PORTUGAL

3.1. Lightweight means sustainable

The minimum use of materials in buildings implies a minimum overall weight of buildings and so smaller environmental impacts due to the extraction of raw materials and to their transformation processes. It also allows the reduction of energy consumption during the construction and a proportional reduction on loss factors and transport energy.

The use of membranes and polymeric foils in lightweight façade and coverings can be a sustainable option. Even if it is considered that their life span could be half of glass, their significantly lower weight per square meter makes these solutions very competitive in terms of thermal and lighting performance indicators and embodied energy, what can be seen on Table 2. An ETFE foil can weigh 40 times less than any transparent glass alternative and presents approximately 15 times less embodied energy per square meter.

Table 2: Relevant properties of some translucent and transparent materials.

	Visible Light Transmission (%)	Weight (kg/m^2)	Embodied Energy (kwh/m^2)	Thermal Resistance (m^2.°C/W)
Clear glass 6mm	85	14.40	73.6	0.16
Double glass 6(10)6mm	70	28.80	147.2	0.35
Polycarbonate clear panel (10mm)	83	2.00	48.4**	0.32
PVC coated polyester	26	0.84	18.3**	0.17
idem, two layers with air gap of 100mm	13	1.68	36.6**	0.37
PTFE coated fiberglass	21	0.81	14.4**	1.03*
idem, two layers with air gap of 100mm	4–6	1.62	28.8**	1.21
ETFE foil (0,2mm)	95	0.34	4.83	0.16
idem, two layers with air gap of 100mm	n.a.	0.64	9.66	0.35

*[4]
**Deduced values by the author [5] (considering just the embodied energy to make the two components of the material and excluding manufacture)

3.2. Membrane House Prototype

A test cell where the environmental and structural potentialities of low span membranes can be explored is built on the Azurém Campus of the University of Minho, in Guimarães. This prototype is composed by two modular cubes joint together with 2,5 x 2,5 x 2,5m (Figure 5(b)). Its main structure is made of aluminium profiles of 70x70mm, which section can be seen on Figure 4b). The west and east façades are made of an opaque white polyester/PVC membrane of 2,5 x 2,5m fixed to the aluminium profiles by a PVC rod (figure 4). Its structural stability is assured by four poles of steel with 20cm long tensioned against the membrane by two crossed steel cables fixed to the corners (Figure 5(b)), that also assure the cross stabilization of the panels. The same system was reproduced on the covering; but in this case, the steel cables are tensioned with higher stress so that covering can assure a slight slope. South and North façades are free for lightweight façade systems testing.

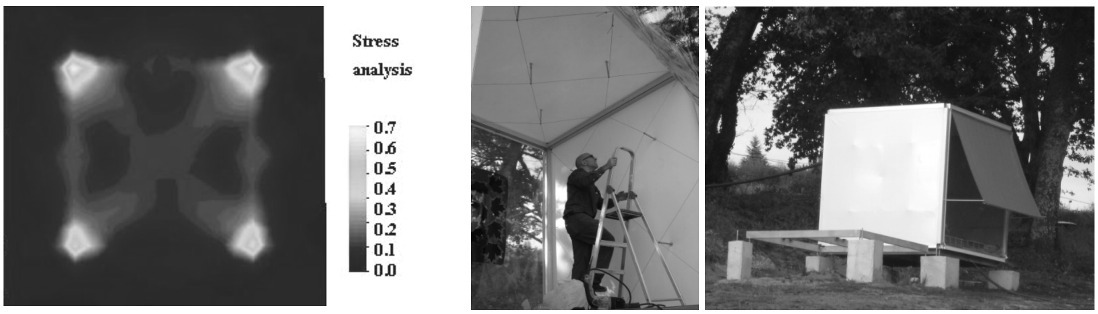
(a) (b) (c) (d)

Figure 4: Membrane Test cell prototype details: a) aluminium frame profiles section, b) fixing the membrane on the frame, c) fixing the steel joint connection to the frames on corners; and (d) profile corner with stretched Polyester/PVC membrane and inflatable PVC foil.

3.3.Structural weight optimization

The growing need to save means and resources, associated to ecological concerns, has been impelling a new minimalist aesthetic which, taken to an extreme, implies the reduction to the minimum expression of the building components. This current, called "Light-tech" [5] or also “Eco-tech” by other authors, bets on the introduction of more efficient constructive systems, especially in terms of structural performance. Most of the examples are apparently difficult to associate with sustainability, as materials used (steel, aluminum, glass) have high embodied energy and economical costs, but in many examples the structural systems used are extremely optimized in terms of the relation between weight and mechanical properties, what makes them competitive, but this is especially truth when new materials are used, such as membranes. An example can be given when comparing greenhouses from the 19th century in casted iron and glass, and a contemporary example, such as the Eden Project in Cornwall, from Architect Nicholas Grimshaw. In this project each ETFE (ethylene tetra fluoro ethylene) foil pillow weight approximately 2 - 3.5kg/m^2, what means less than 2% of equivalent glass cladding, while the entire pillow system including aluminum connection and steel frame support weighs between 10% and 50% of conventional glass-façade structure [7].

The prototype main structure is made of aluminium profiles of 70x70mm. The west and east façades, as well as the roof are made of an opaque white polyester/PVC membrane of 2,5 x 2,5m attached to aluminium profiles. Its structural stability (Figure 5(a)) is assured by four poles of steel with 20 cm long tensioned against the membrane by two crossed steel cables fixed to the corners (Figure 5(b)), that also assure the cross stabilization of the panels. Its detailed structural concept is described in detail in a previous publication by the author [8].



(a) (b)

Figure 5: Opaque membrane façade of the membrane test cell - computer stress analysis for form-finding optimization (a) [8], internal view during the assembling process exterior and view of the prototype (b).

4. CONCLUSIONS

A tensioned membrane building evolves a complex design process, since the selection of the membrane support structure, passing through form-finding, structural calculation and functional optimization, and finally the construction. The goal is to find the most efficient structure, considering all aspects of the design process. There are several ways to accomplish this: till a few decades ago it was only possible through physical models and manual calculation; nowadays relying almost only on computer aided design and calculation tools. There are nowadys many software tools that help on the design and fabrication of membranes structures in all the development stages. These allow calculating the amount of necessary fabric, defining the cutting patterns and the dimensions of other structural components. The programs can be more dedicated to display and form-finding, or for structural calculation, and more recently even to support automated fabrication. This paper shows the concepts behind the design of a modular housing prototype, built in Campus de Azurém of the University of Minho, where some of the advantages associated with the use of textile membranes and the design methodologies referred in this paper, were integrated and optimized. It can be concluded that there are good potentialities associated with the use of textile membrane materials that allow achieving a good environmental profile in innovative conceptions for modular housing.

5. ACKNOWLEDGEMENTS

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6. REFERENCES

[1]. Vandenberg, M. (1996). *Soft Canopies, Detail in Building.* Academy Editions; ISBN: 185490440 X, London.

[2]. Knippers, J., Cremers, J., Glaber, M. & Lienhard, J. (2010). *Construction Manual for Polymers and membranes – Materials, semi-finished products, form finding, design.* Detail Editions and Birkäuser; ISBN: 978-3-0346-0726-1,Germany.

[3]. Macieira, M. (2012). *Architectural Membranes: Potencial application in the interior of buildings.* (in Portuguese), Master Thesis in Architecture (Construction & technology), University of Minho.
[4]. Shaeffer, R. E. (1996). *Tensioned Fabric Structures: a Practical Introduction*. American Society of Civil Engineers. ISBN: 978-0784401569, New York.
[5]. Mendonca, P. (2005). *Living under a second skin – strategies for the environmental impact reduction of Solar Passive Constructions in temperate climates.* (in Portuguese) Ph.D. Thesis, Civil Engineering Department, University of Minho, Guimarães, Portugal.
[6]. Horden, R. (1995). *Light Tech: Towards a light Architecture*. Birkhäuser, ISBN: 978-3764352202, Basel, Boston, and Berlin.
[7]. Robinson, L. (2005). *Structural Opportunities of ETFE*. Master Thesis Submitted to the Department of Civil and Environmental Engineering, MIT. June.
[8]. Mendonça, P. (2010). *Low-span lightweight membranes in housing - environmental and structural potentialities*, Proceedings of the *ICSA Conference*, CRC Press, Guimarães, 21-23 July.

ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

RESEARCHES REGARDING DOCUMENTS USED FOR QUALITY CONTROL DURING THE TEXTILE PRODUCTS MANUFACTURING PROCESSES

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Abstract: To satisfy customer needs, industry specialists should consider the following issues:
• what are the priorities of consumers with aesthetic requirements, performance and value?
• what are the main aspects of the performance of a product are important for consumer-comfort, durability, functional utility.
• on what type of concepts (intrinsic or extrinsic) focuses buyers when purchasing a product.
The answers to these questions create priorities for the development of the line, of the product, for production and marketing.
Analysis clothing products and processes include the following objectives:
• products are examined in terms of economic activity to meet consumer.
• decisions are taken in the context of product line and the company strategy.
• products are developed and presented so as to match consumer preferences considered in the style, fitness, fashion, quality and value.
• in order to determine the performance of a product is required strong technical knowledge of materials and assemblies.
• must be assessed and alternative ideas for development, production and / or marketing processes.
• the lower level, the potential profitability of the product should always be considered when alternatives are evaluated.
• quality standards are based on firm perceptions on consumer demand.

Key words: performance, cost, quality product, line development, costs.

1. INTRODUCTION

Specialists from knitwear and garment industry are constantly confronted with reducing costs for labor and raw materials. These costs are often dependent on each other, so that one can reduce other costs increase. The choice of cheaper raw materials can lead to more defects or poor handling, which will raise the cost of glabrous operations, cutting and assembly. The selection of countries with cheaper labor can increase the risks non performances to specifications, low quality products, higher transport costs and failure to delivery. Production costs provide the basis for the lowest price to produce a profit[1].

The analysis involves the use of intrinsic and / or extrinsic factors depending on the scope of the analysis. Tangible characteristics, intrinsic to the apparel product include materials, assembly methods, style, matching and finishing. Extrinsic aspects are foreign product and refer to price, brand, reputation manufacturer or store that sells the product, and advertising merchendasing visual techniques. Development of intrinsic quality and product performance requires investment in materials, equipment, skills and time.

2. GENERAL INFORMATION

2.1 Technical quality design of the product

The chain to achieve a quality product starts on board and ends at the end when starting the chain manufacturing operations, which requires compliance with reliability and maintenance designed. To control the quality must be considered, the quality of manufacture and product quality, given that both elements contribute to quality assurance. They are interrelated and difficult to separate. For instance, two products being used, but were made in different ways that can be found to the quality of the design. That is why there is no difference in terms of its ability - as such for making full use of the product. Quality achievement is given to the quality specifications made at the design stage. From another point of view, the construction quality is a measure of correspondence indicated product quality requirements specifications with the product itself.

In knitwear and garment industry there are many product features that can not be measured only approximating, which can induce a certain degree of error from the product design stage, hence the major role that it is this stage making products[2].

2.2. Factors influencing the quality of products

After studying the clothing and knitted fabric there was a problem - a finding as a form general overview of the factors that influence product quality and specifications of the items included usually to profile of companies.

Thus, we analyzed the influence of materials, construction and technological solution especially on the aesthetic quality of products [1] [3]. Since the categories of features expressing the quality of a product is very different, continue to making a thorough analysis of how to use them in the specifications.

In this regard, it was considered necessary following steps:

- quality assessment based on criteria level:
    - textile materials;
    - constructive solution;
    - technological solution;
    - determining the factors influencing the quality of products;
    - determining the important characteristics for the chosen factors;
    - their transposition into product and process specifications.

Conceptual applications results obtained for the first 3 stages of this route are presented in table format (Table 1), which benefits by:

- ■ full assessment criteria and influence factors at each level;
- ■ identify the correlation factors and criteria of different levels;
- ■ referral factors influence;
- ■ reducing the speed of response decision-making referring to remedies;
- ■ materialize planning and continuous quality improvement in the quality documentation.

This analysis, in fact, allows the passage of specific characteristics that determine the aesthetic quality of the product specification for these quality levels.

2.3. Preliminary analysis of of clothing products in order to transpose into specifications

The purpose of the analysis is to determine the methods of analysis and control complexity of these products. There are three methods of analysis [4]:

- visual inspection;
- increased visual inspection, supplemented by simple tests, using simple tools and measuring magnification and / or household washing machines;
- laboratory analysis using standardized test methods, specialized test equipment, high power magnification tools and precision measuring instruments.

Visual inspection is the least complex method of analysis of clothing products. It is effective in the overall assessment of the appearance and aesthetics of a product, the quality of materials used in identifying the type of seams and mesh density determination. A qualified person can make a quick assessment by visual inspection and sufficiently accurate product. Experience in the analysis of products developed ability to "feel" the quality of the product. Skills are developed by comparing the features and similar performance for a wide variety of products.

Analysis products using **increased visual inspection** provide more information and increase the credibility of the conclusions. Less experienced personnel in situations where more detailed data are needed requires the use of powerful analytical methods. For example, the simple test of combustion or dissolution can be used to determine fiber content. Using a microscope or magnifying glass increases the volume and accuracy of the details of the structure of materials, type wires, twisting them, the process of painting, etc. Washing machines can provide information on latent defects, such as fixing the dye on the fiber or shrink in the wash. Both visual inspection and increased visual inspection can be made without destroying the product. Using standardized methods and test equipment costs increase performance analysis, but also the amount of obtained information [5].

Laboratory tests for materials and products are the scientific method analysis. Testing laboratories using methods recognized by professional organizations provide the most accurate and reliable results [6]. Laboratory analysis can be especially useful when considering characteristics such as dimensional stability, strength, abrasion resistance, air permeability,the degree of fixation of the dyestuffs. The results of the analysis can be used to determine the suitability of materials and the degree to which fulfill a specific purpose. Tests are often damaging. Firms can make their own laboratory tests or you can order some laboratories. The time required to achieve test may prove prohibitive in view of the intense activity in the apparel industry [2].

Table 1. Factors influencing the aesthetic quality

Analized aspect	Influencing fators:	Characteristics:
Presentation and characteristics of materials	Materials	Fiber composition Structural constitution of the material Thickness of the material Finishing character Thickness of the material
Presentation and characteristics of yarns connecting the elements of the product	Materials	Fiber composition Linear density
Presentation and characteristics of product marks	Constructive solution	Dimensional proportional characteristics of marks Consistency dimensional marks with features and form of the human body The coverage degree of body by the product
Presentation and characteristics of product marks	Constructive solution	The type of material from which it is made Consistency of form element with the product Concordance contours decorative elements with the silhouette of the product Concordance chromatic of main materials with the product form
Structural characteristics of of joints: bonding joints	Technological solution	Type of adhesive Adherence Flexing rigidity
Seam connection: structure and implementation of stitching	Technological solution	Form stitching - the bobbin case, the chain The structure of stitching Visibility of stitching Seam line
Characteristics of stitching	Technological solution	Number of layers Width, thickness Number of stitches

2.4. The stages of clothing product quality analysis and specification development

The analysis of clothing product quality requires extensive knowledge on certain aspects of the garment industry. For example, the cost analysis of a product requires a deep understanding of raw material and production. Analysis of clothing products is conducted in the following stages (Figure 1).

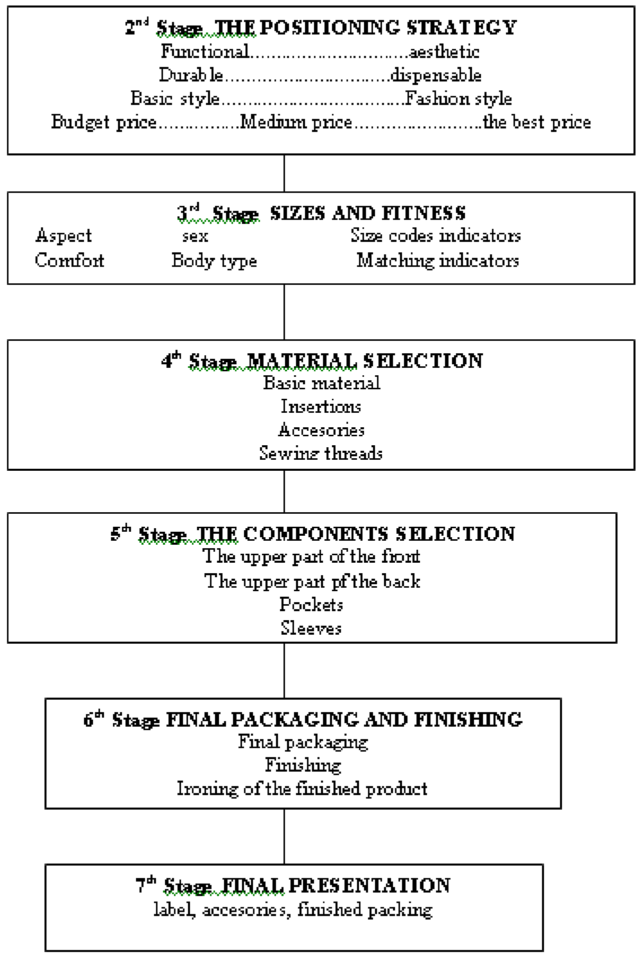

Figure 1. Stage analysis of a model for the preparation quality specifications

3. CONCLUSIONS

As is clear from the figure, industry specialists have to choose the best alternative options resulting from the firm's strategy: product lines, cost structure and quality standards so that company to be both cost effective and a good image market.
It is noteworthy in this context that the permanent improvement of the control of products is based on controlling these process steps actively transposing all the changes which interferes specifications.

4. REFERENCES

[1]. Oană, I.P., Oană, D.*,(*2004) - *Asigurarea calității zonelor critice ale produselor de îmbrăcăminte, din punct de vedere estetic*Analele Universității din Oradea - Fascicula Textile-Pielărie, vol.IV, Editura Universității din Oradea, ISSN 1582-5590
[2]. Florea, A. *(2001)* - *Controlul calității produselor*Editura "Gh. Asachi" laşi, 2001
[3]. Oana, I. P., Oana, D., (2008)– *Contribuții practice la studiul asamblărilor cu structuri textile*, Ed Univ. Oradea,
[4]. Comandar, C. *(*2000) - *Structura şi proiectarea tricoturilor- Tricoturi din bătătură* Editura Cermi, laşi
[5]. Dodu, A., şi alții, (2005)- *Manualul inginerului textilist,* vol II, Editura AGIR, Bucureşti,
[6]. Preda, C.(1996). *Metode şi aparate pentru controlul calității materialelor textile destinate confecționării produselor de îmbrăcăminte*, Ed. BIT Iaşi

STUDY ANALYSIS ON SLIDING CHARACTERISTIC OF STITCHES IN CASE WARP KNITTED FABRIC MADE ON FAST CARS WITH FONTS

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Abstract: Sliding stitches represented by removing seam elements under the action of a load, displacement caused by the removal of material assembled edges. This phenomenon may occur during the product behavior, causing an aesthetically unpleasant. Dragging causes of concern:
The type and characteristics of the materials assembled by stitching: a use for the realization of the assembly materials of wires with a very low coefficient of friction to facilitate its movement to the starting position; a degree of complexity of the structure of materials assembled directly influence the phenomenon of sliding as the structure is simple, the more risk there will be movement into seam yarns; a density material also has an influence on the slides forward - low density material will slide easier in stitching.
The technological process of sewing. Parameters of the sewing operation have direct and significant influence on the phenomenon of sliding stitching: a stitch type - the stitching is more rigid, the greater risk of developing slides forward; a stitch density - a density as high as possible to allow better establishment of yarn materials, given an approximation as possible of the ideal situation, the pace is so small that each strand of material is trapped into the mesh stitching individually.
Using a higher value for the sewing needle thread tension reduces the risk of sliding materials with the into seam.

Key words: stitch type, sliding, testing, knitted fabrics, knitting machines.

1. INTRODUCTION

From the current classification results the phenomenon of the sliding mode can be avoided, namely by proper selection of the raw material and stitching the structure of the materials used, as well as to the parameters of operation for achieving the materials and assembly by stitching. At the same time, the phenomenon of sliding of the seam may also be controlled by chemical treatments during finishing, which increase the friction on the yarn thread into the sewing material. It must be stressed that such treatments have a negative impact on the feel and should be avoided if possible.

2. GENERAL INFORMATION

2.1. The method used to determine the stitch dragging

Nowadays using mainly two methods for determining dragging material in the seam, each with advantages and disadvantages. The samples used can be obtained either from two separate pieces of material, or by folding and sewing a single piece. [1], [2]

The first method is based on determining the dragging which shows the application of a predetermined force. Bona [3], [4] mentions French method defined by AFNOR standard NF G07.117, which provides for the use of force within 4-8 daN, according to the characteristics of the test material. Testing [5], [6] can be done using a tensile testing machine (type dynamometer) or use a special built as CETIH used by French standards. Dragging is evaluated in terms of quality and not quantity, determining whether into seam material deformation occurs by the use of force and to what degree (without sliding, gliding and sliding slightly stronger).

The size of removal into stitches can be expressed quantitatively by measuring it with a ruler, while the sample is held slightly tensioned (250 gf).

In the case of the second principle of the test, to determine the force required to produce a departure from a given value, commonly mentioned into the literature as one of 6 mm. The method is defined by the British Standard BS 3220 1988 and American standard ASTM D434 - 42. Both standards are based on the comparison of curves - extension recorded for a sample of material assembled by stitching material and one assembly. The differences between the two curves are due solely to the presence of the stitching. By using the two graphs are determined value of the force corresponding to a distance of 6.4 mm between the curves, plus the distance between the curves recorded at a predetermined power (2 to 4.45 N).

Saville mentions a third principle test, which does not use samples assembled by sewing and specific fabrics. Under this method the force required to determine a set of needles to penetrate the test material to be tested.

3. CONCLUSIONS

Dragging the stitch is a phenomenon encountered in practice, but little studied in knitted fabrics. An experimental study on this feature can show how the degree to which the phenomenon is influenced by the structure of the assembled materials, raw material type and the stitch. The specific structure of knitted fabrics based on sliding causes looping yarns to be different fabrics, yarns in the fabric where the layout geometry simplifies the process of sliding.

However, it is natural to consider the case dragging the stitch in the case of knitted fabrics. If the conditions related to the raw material the stitch parameters and the complexity of the structure favors the appearance of fabric dragging, as the case of knitted fabrics studied, it is important to determine and rank the influencing factors.

Dragging the stitch in the case of knitted fabrics was studied in the case of the warp knitted fabrics made with two loops on the knitting machine with fonts. As raw materials were used mono-and poly filament yarn and polyamide and polyester filament yarn poles, which due to thread the thread friction coefficient low favors the onset and intensity of dragging phenomenon the materials into seam.

4. REFERENCES

[1]. Oana Ioan Pavel, Oana Dorina, (2008)– Contribuții practice la studiul asamblărilor cu structuri textile, Ed Univ. Oradea,

[2]. Oană I.P., Oană D. - *Asigurarea calității zonelor critice ale produselor de îmbrăcăminte, din punct de vedere estetic,* Analele Universității din Oradea - Fascicula Textile-Pielărie, vol.IV, Editura Universității din Oradea, 2004; ISSN 1582-5590

[3]. Bona, M. (1993) -*Psihical Testing and Quality Control,* The Textile Institute, Manchester,

[4]. Bona, M.(1994) - *Textile Quality,* Textilia, Italia,

[5]. Florea, A. *(2001)* - *Controlul calității produselor*Editura "Gh. Asachi" laşi,

[6]. Preda C. (1983). *Controlul calității produselor*, Ed. Rotaprint Iaşi

UNCONVENTIONAL ASSAMBLY

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Abstract: In this paper was exposed some research institute from important specialists in textile domain, concerning an unconventional assembly method – ultrasonic weld. An alternative to the classic sewing assembly, with thread and needles is ultrasonic seaming. In ultrasonic welding, there are no connective bolts, nails, soldering materials, or adhesives necessary to bind the materials together. Ultrasonic is defined as acoustic frequencies above the range audible to the human ear. Ultrasonic frequencies are administered to the fabric from the sonotrode of bonding machine. The high frequency and powerful energy produced, when is release in one special environment, the ultrasound heating this environment. The ability to ultrasonic weld textiles and films depend on their thermoplastic contents and the desired end results. The paper defines the weld ability of more common textiles and films. The welding refers to all types of bonding and sealing, as in point bonding of fabric, or continuous sealing of film. With the whole environment gone highly technical and specialized, industrial fabrics are used widely today for making many products such as inflatable boats, sewn technical clothing, tents, awnings, truck tarpaulins, filter bags, airships, bag & luggage, inflatable toys, advertising banners etc. Sewing, seam taping, gluing etc. have gone obsolete for sealing such fabrics that have to be ultra safe and efficient. This welding technology may be an alternative method of manufacturing cloth and is gently with the environment because there are produced less wastes.

Key words: ultrasonic weld, ultrasonic sealing technology, fabric welding, ultrasonic bonding, ultrasonic plastic welding machines

1. INTRODUCTION

1.1. Ultrasonic welding technology

It is an industrial technique where high-frequency ultrasonic acoustic vibrations are locally applied to work pieces being held together under pressure to create a solid-state weld. It is commonly used for plastics, and especially for joining dissimilar materials. In ultrasonic welding, there are no connective bolts, nails, soldering materials, or adhesives necessary to bind the materials together. For joining complex injection molded thermoplastic parts, ultrasonic welding equipment can be easily customized to fit the exact specifications of the parts being welded. The parts are sandwiched between a fixed shaped nest (anvil) and a sonotrode (horn) connected to a transducer, and a ~20 kHz low-amplitude acoustic vibration is emitted. When welding plastics, the interface of the two parts is specially designed to concentrate the melting process. One of the materials usually has a spiked energy director which contacts the second plastic part. The ultrasonic energy melts the point contact between the parts, creating a joint. This process is a good automated alternative to glue, screws or snap-fit designs. It is typically used with small parts, but it can be used on parts as large as automotive instrument clusters. Ultrasonic welding of thermoplastics causes local melting of the plastic due to absorption of vibration energy. The vibrations are introduced across the joint to be welded. [1, 2, 3] This type of welding is often used to build assemblies that are too small, too complex, or too delicate for more common welding techniques.

2. GENERAL INFORMATION

2.1. Components

All ultrasonic welding systems are composed of the same basic elements:

- A press to put the two parts to be assembled under pressure
- A nest or anvil where the parts are placed and allowing the high frequency vibration to be directed to the interfaces
- An ultrasonic stack composed of a converter or piezoelectric transducer, an optional booster and a sonotrode (horn). All three elements of the stack are specifically tuned to resonate at the same exact ultrasonic frequency (Typically 20, 30, 35 or 40 kHz)

Ultrasonic welding is a bonding method that uses high frequency mechanical sound waves to create molecular bonds between thermoplastic materials such as nonwovens, films or injection-molded plastic parts. During the ultrasonic welding process, mechanical vibrations are introduced into the material at a high frequency of 20,000 or more cycles per second with specific amplitude in the magnitude of the diameter of a human hair and a certain weld force. [4].

An ultrasonic generator electronically converts line voltage into a high voltage/high frequency signal and delivers it to a converter. In the converter, piezoelectric crystals are sandwiched between two titanium discs and vibrate (expand and contract) at the frequency of the applied electrical signal.

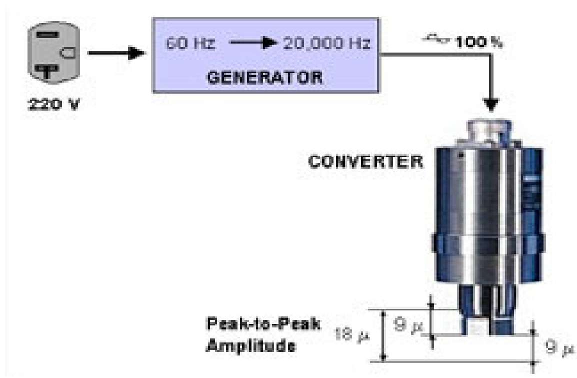

Figure 1. Electrical system with generator and converter [4]

Converter: Converts the electrical signal into a mechanical vibration

Booster: Modifies the amplitude of the vibration. It is also used in standard systems to clamp the stack in the press.

Sonotrode: Applies the mechanical vibration to the parts to be welded.

» An electronic ultrasonic generator (power supply) delivering a high power signal with frequency matching the resonance frequency of the stack.

» A controller controlling the movement of the press and the delivery of the ultrasonic energy.[1]

2.2. Fabric Welding Characteristics

With the whole environment being highly technical and specialized, industrial fabrics are used widely today for making many products such as inflatable boats, sewn technical clothing, tents, awnings, truck tarpaulins, filter bags, airships, bag & luggage, inflatable toys, advertising banners etc. Sewing, seam taping, gluing etc. have gone obsolete for sealing such fabrics that have to be ultra safe and efficient. Thus, for producing these specialized textile products, heat and pressure are applied to the seams of pattern pieces to fuse them together, thus making an airtight and watertight seal. This work of fabric welding is done with the help of a variety of heat sealing machines. [5]

Figure2. Thermoplastic PVC [5]

Figure 3. Technical cloth specialized with highly functional effects [5]

Fabric welding is the process of joining pieces of fabrics using heat and pressure. Thermoplastic coatings, such as polyvinylchloride (PVC), polyurethane (PU), polyethylene fabric (PE) and polypropylene (PP) are used for heat sealing.

Fabric welding is not required for the usual daily cloth or products. Only when the product needs to be specialized with highly functional aspects, then only fabric welding is done. Such requirements arise when the product has to get-

» Water resistant
» Pressurized
» Abrasion resistant at the seam
» Resistant to thread decay
» Fine appearance

Once done, fabric welding reduces maintenance cost as there is no need of threads, sewing machines, seam tapes or any other such material.[5]

2.3. Categories of Welding Fabric

There are basically two types of fabric welding- Dielectric Welding and Rotary Welding. Ultrasonic welding is generally categorized as rotary welding. In this type, the fabric moves continuously through the machine while it is being welded.

Dielectric Welding is the older of the two types of welding. In this method, a die is lowered on to the two fabric pieces that are supported by an underlying base plate. A timed pulse of radio frequency energy is sent between the die and the base plate. The fabric between the die and base plate gets heated enough so as to melt the thermoplastic coating on a temporary basis. With the melting of this coating, both pieces of fabric are fused together. The die is then lifted and new pieces of fabric move into position, and the whole process is repeated again.

Rotary welding is a continuous process where the fabric pieces move continuously through the welding area, usually pulled along by a pair of drive wheels. Heat is sent through any of the sources like a heated metal wedge or hot air, just before the fabric passes between the drive wheels. On the drive wheels, the welding pressure is applied which seals the fabric permanently.[5]

Rotary welding is faster than dielectric welding. The speed increases with the length of the products and seams. Welding speeds of up to 6 meters/ per minute and even higher can be achieved through it. However, rotary heat sealing requires a skilled and well trained operator to achieve full speed and flexibility. It is also capable of producing three dimensional finished products (products that do not lie flat) like garments, inflatable boats, bags, and luggage. As dielectric welding uses flat base plate, it restricts its application to the products whose seams must lie flat during the sealing process. However, nowadays, certain specialized dielectric welders have three dimensional dies, base plates and vacuum systems for holding the fabric pieces in position while the dies are applied but they are very costly.[5]

The ability to ultrasonically weld textiles and films depends on their thermoplastic content (minimum 65%) and the desired end result. [6] The major categories of material construction of thermoplastic textiles and films are:

Table 1. The major categories of material construction of thermoplastic textiles [6]

Nr.crt.	Material	Material Construction	Factors Influencing Weldability
1.	Wovens	Textile formed by regular interweaving of filaments or yarns.	Yarn density, thermoplastic content, tightness of weave, uniformity of material thickness. Weld strength, may vary according to the orientation of yarns or filaments.
2.	Nonwovens	Textiles formed by bonding and/or interlocking fibers, yarns, or filaments by mechanical, thermal, or chemical means.	Uniformity of material thickness and thermoplastic content. Random orientation of fibers gives nonwovens excellent strength.
3.	Knits	Textiles formed by interconnecting continuous loops of filaments or yarns.	Style of knit, thermoplastic content, and elasticity of construction.
4.	Films	Thermoplastic material that has been cast, extruded or blown into a film, generally under 0.254 mm thick.	Film thickness (at least 0.013 mm thick), density, and thermoplastic type.
5.	Coated Materials	Textiles and films covered with a layer of thermoplastic, such as polyethylene or urethane. Base material need not be thermoplastic	Coating material, thickness, and substrate characteristics.
6.	Laminates	Textiles and films consisting of two or more layers in a sandwich form.	Thermoplastic type and content.

They are many bonding machines producers, specially in Asia. In Europe the most important producer is Pfaff Company and in U.S.A. the most important is Branson Company.

3. CONCLUSIONS

The applications of ultrasonic welding are extensive and are found in many industries including electrical and IT, automotive and aerospace, medical, business, consumer, medical, toys and packaging. Whether two items can be ultrasonically welded is determined by their thickness. Ultrasonic welding is a very popular technique for bonding thermoplastics. It is fast and easily automated with weld times often below one second and there is no ventilation system required to remove heat or exhaust. This welding technology may be an alternative method of manufacturing cloth and is gentle with the environment because less waste is produced. The method presents the advantage that no yarn, needles, adhesives are need and holes in fabric are not necessary and in consequence less waste is produced.

4. REFERENCES

[1]. Wikipedia Free Encyclopedia. Available from: en.wikipedia.org/wiki/Ultrasonic Welding Accessed 16/04/2013

[2]. Dodu A & colaboratorii (2003) Vol. II . Partea B. Secțiunea VII. Confecții textile *Manualul inginerului textilist,* ED. AGIR, page number 1419 – 1423, ISBN 973-8466-10-5, 973-8466-96-2 Bucureşti

[3]. Mitu S. & Mitu M. (2005), Vol. II *Bazele tehnologiei confecțiilor textile* ED. Gh. Asachi, page number number 109 - 117 , ISBN 973-730-025-4; 973-730-027-0, Iaşi, România

[4]. Herman T. (2005), *Ultrasonic Bonding Of Nonwovens, Films And Textiles; A cost – effective alternative to adhesive bonding* , Available from: w.w.w.bilian.com, Accessed 10/ 04/ 2013

[5]. Knowledge Center > Academic reports, *Fabric Welding*, Available from: w.w.w.teonline.com, Accesed 10/04/2013

[6]. Branson , *Ultrasonic Welding Characteristics of Textile and Films* , Available from :
w.w.w. Branson- PlasticsJoin.com, Accessed 11/04/2013

USING THERMOGRAPHY TO IDENTIFY FLAWS IN THE SUNSTAR BUTTONHOLE SEWING MACHINE

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Abstract: The goal of this paper is to identify potential defects in sewing machines, by using infrared thermography. Thermographic measurements were conducted at the Clothing laboratory of the Department of Engineering and Management for Industrial Leatherworking and Textiles of the University of Oradea. The equipment used was a Flir E60 thermal imaging camera. Measurements were conducted on the SUNSTAR buttonhole sewing machine, in order to trace the temperature transfer from needle and thread to the fabric on which the buttonholes were sewn. Buttonholes were sewn on the following fabrics: polyester, wool and cotton, with an 0.8 mm needle, made by Schmetz company. The thermal images were analyzed using the Flir Tools software which was installed on a computer and it was observed that due to the small time interval required to sew a buttonhole, the temperature transfer conditions vary. An amount of thermal energy accumulates in the needle and the thread that was used assimilates the heat. It was noted that in the first 12-14 of operation the needle's temperature increased by a large amount, slowing down afterwards. Following the completion of several buttonholes on fabrics with a lower resistance to penetration, it was found that the needle temperature recorded much lower values, even in higher operating modes.

Key words: thermographic measurements, thermal image analysis, Flir Tools application, thermal degradation, needle, thread, polyester, wool, cotton.

1. INTRODUCTION

Any object with a temperature above absolute zero emits energy. If the temperature raises, so does the energy emitted. Infrared thermography is a technique that produces a thermographic image of the thermal energy emitted by objects.

The method is very effective for non-destructive testing, because it reveals any lack of uniformity in the conveyance of a thermal impulse due to discontinuity in the structure of the studied object. Non-destructive testing of composite materials such as carbon fibers, honeycomb structures used in the aerospace industry, and some monolithic materials such as aluminium, rubber and certain resins, is often difficult to carry out with conventional methods. On the other hand, infrared technology provides a basis for testing methods based exclusively on detecting the object's thermal radiation and, in principle, does not interfere with the object. Infrared thermography shows the “invisible” – heat and its distribution on the body surface. Modern thermographic devices can “see” temperatures ranging from -40 degrees Celsius to +1500-2000 degrees Celsius and can detect differences in temperature as low as 0.04 degrees Celsius [1].

This technology can find practical use in any field where heat occurs or changes its distribution as a result of a chemical, physical (mechanical, electrical etc.) or biological process, or other types of processes. Virtually any technical or biological process involving energy conversion to heat or which consumes or generates heat can become the object of a thermographic study.

The short time required to record thermograms, to process and interpret data, and the relatively low costs involved, make infrared thermography an often used method in investigating industrial, and even civil structures [2].

Advantages:

- infrared thermography allows remote, non-contact measurement of temperatures, which is essential, for example, in the case of parts or materials which are at high temperature or are inaccessible;
- infrared thermography does not influence in any way the examined material, object or process;
- the technique does not involve dangerous actions; moreover, it can be used in hazarduos areas, for example, while machines are being operated;
- it is an ultrasensitive technique, able to detect temperature variations in the tenths of a degree range, in space (from one image point to another), as well as in time (transitions taking place in time intervals ranging from seconds to hours and days)
- because it provides instant information, the thermography system allows a fast and accurate identification of the points that represent potential flaws;
- data can be collected and stored in digital format
- the technology allows validation of normal operations and, more importantly, locates thermal anomalies which indicate possible errors, flaws or inefficiencies in an industrial system. For example, insufficient lubrication of the sewing machine hook can produce heat by friction, which can be detected by thermography.
- by using infrared thermography in machine maintenance in the textile industry, incipient flaws could be detected and corrected long before failures occur, thus reducing the outage periods of sewing or embroidery machines by eliminating unplanned stops and optimizing the scheduling of planned maintenance and repair operations. This has the immediate effect of reducing costs (savings with the electrical energy, machine repairs), and reducing the duration of periodic checks and inspections. It also increases the periods during which the machines are operational, and improves work safety conditions.

2. THE EXPERIMENTAL PART

The machine used for the measurements is a professional SunStar buttonhole sewing machine, with the following technical specifications:

- " Direct Drive " drive (servo – motor embedded in the sewing head)
- electronic programming
– maximum 99 models
- buttonhole length: 10 mm - 38 mm
- buttonhole width: 1.5 mm – 3.2 mm
- maximum sewing speed : 2,200 stitches/min
- stitch : 0.5 – 2 mm
- transport mechanism – dual stepper motor (x, y)
- automatic thread cutting
- automatic lubrication
- can sew normal head, round head, keyhole buttonholes
- can be programmed for cutting the fabric before or after stitching, or for cancelling cutting (for ornamental buttonholes)
- has an electronic control panel for changing buttonhole model and size, for sewing speed adjustment, for setting the distance between stitches etc.[3]

A Flir E60 camera was used for thermographic measurements, camera made by Flir Commercial Systems B.V., with the following technical characteristics [4]:

IR infrared resolution:	320 x 240 pixels
Thermal sensitivity:	< 0.05ºC
Temperature domain:	-20ºC la 650ºC
Accuracy:	± 2ºC
Zoom:	1-4x
Lens:	Standard 25º x 19º
LCD Touchsreen Color:	3.5" (320 x 240)
Video Camera:	3MP with Flash
Picture-in-Picture:	Scalable

Frequency: 60 Hz

For thermal image analysis, the Flir Tools application was used.

Figure 1. Thermographic camera Flir E60 [4]

The measurements were conducted at the Clothing laboratory of the Department of Engineering and Management for Industrial Leatherworking and Textiles of the University of Oradea. Buttonholes were sewn on the following fabrics: polyester, wool and cotton with a 0.8 mm Schmetz needle. [5]

Determining the optimal operating mode for the SUNSTAR sewing machine by using the vibration measurement technique was described by the authors in a previous paper.[6] Vibration measurements were used to diagnose the causes for halts in the SunStar buttonhole sewing machine. These were done in every measurement point on the three directions of the Cartesian coordinate system: axial (X), horizontal (Y), vertical (Z). Data from the sewing machine was collected for the following vibration parameters: velocity, displacement and acceleration, and it was determined that on the three measurement directions, the optimal operating mode for the SunStar buttonhole sewing machine is at 2000cpm. [6] After determining the optimal operating mode, thermographic measurements were carried out.

Figure 2 shows the thermal image of the SunStar buttonhole sewing machine.

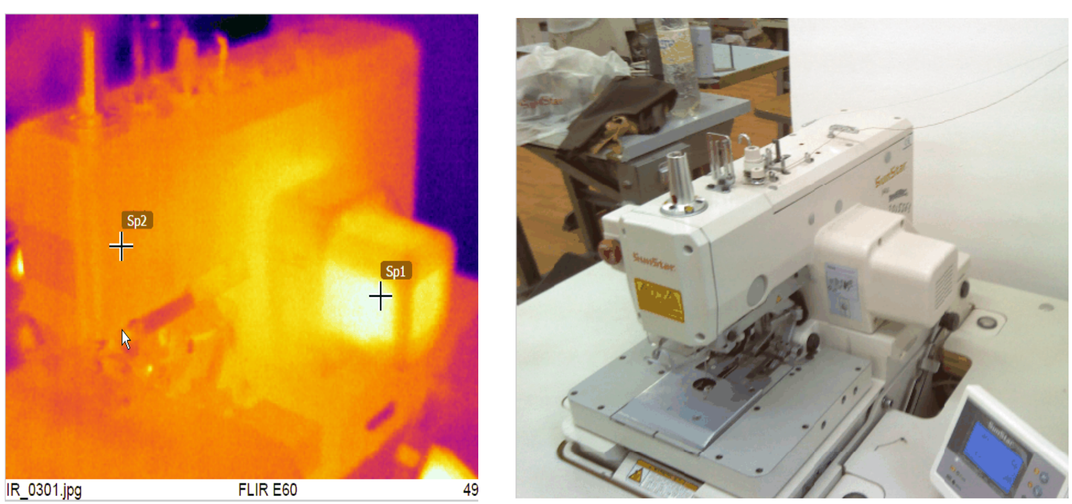

Figure 2. Images of the SunStar buttonhole sewing machine in IR and in visible spectrum

Thermographic measurements of the needle were carried out in order to verify the heat transfer from the needle to the fabric.

The thermographic measurements were done after the first 5-6 seconds after buttonhole sewing started, with the first position of the graphic cursor Sp1 on the needle rod, which built up a temperature of 31.4°C, and the second position of the graphic cursor Sp2 on the needle, which built up a temperature of 28.2°C, as Figure 3 shows.

Measurements	
Sp1	31.4
Sp2	28.2

Parameters	
Emissivity	0.95
Refl. temp.	20 °C
Distance	1 m
Atmospheric temp.	20 °C
Ext. optics temp.	20 °C
Ext. optics trans.	1
Relative humidity	50 %

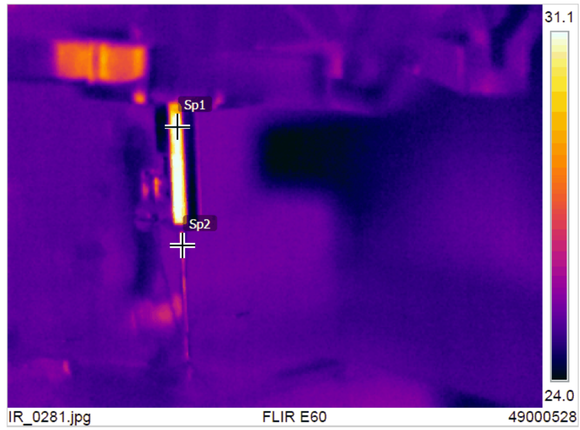

Figure 3. The buttonhole sewing machine image in IR and visible spectrum, after the first measurements

The measurements were done from a distance of 1m between the measuring device and the buttonhole sewing machine, with an environment temperature of 20°C, and a relative humidity of 50%.

A rather fast increase in temperature can be observed after sewing several buttonholes, the Sp2 graphic cursor showing a temperature of 46.8°C on the needle rod, and the Sp1 graphic cursor positioned on the needle shows a raise in temperature from 28.4°C, the temperature when sewing started, to 51.3°C, as Figure 4 shows.

Measurements	
Sp1	51.3
Sp2	46.8

Parameters	
Emissivity	0.95
Refl. temp.	20 °C
Distance	1 m
Atmospheric temp.	20 °C
Ext. optics temp.	20 °C
Ext. optics trans.	1
Relative humidity	50 %

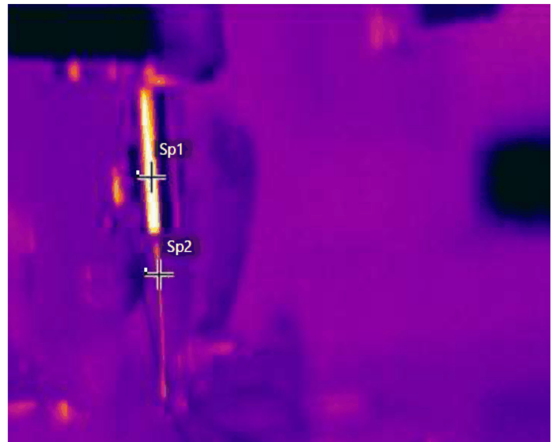

Figure 4. The buttonhole sewing machine image in IR and visible spectrum after sewing several buttonholes

After approximately one hour of operating, both the needle rod and the needle did not show major raises in temperature, which indicates a slowdown in temperature increase.

3. CONCLUSIONS

Due to the small interval needed to sew a buttonhole, the heat transfer conditions vary. The thread assimilates the heat and changes its internal energy.

It was noted that in the first 12-14 seconds the needle temperature increases by a rather large amount, after which it slows down. The needle temperature increases at a slower rate when operating in slower modes and the risk for heat damage to the three fabrics on which the sewing is done is lower.

After sewing several buttonholes on fabrics with a low resistance to penetration (polyester), it was observed that the needle temperature is registering much lower values, even when operating in faster modes.

The authors consider that the heating of the needle during the sewing process does not directly affect the wear of the needle's tip.

4. REFERENCES

[1]. *** http://www.valconsulting.info/#!termografie/cw8z, Accessed: 07/04/2013.
[2]. *** Marks' *Standard Handbook of Mechanical Engineers*, edited by Baumeister, T., et. Al, McGraw Hill Book Company, Eight Edition, 1988
[3] *** http://www.sunstar-romania.ro/ Accessed: 05/04/2013.
[4]. *** http://www.flir.com/ Accessed: 08/04/2013.

[5]. Şuteu, M., „Raport de cercetare Nr. 3: *Cercetări şi rezultate experimentale privind asigurarea fiabilității proceselor tehnologice din industria textilă"*, Universitatea din Oradea, Februarie 2012.
[6] Suteu, M., Indrie, L., Ganea, M.**, "***Determination of optimum performance regime for SunStar buttonhole machine by vibrations measuring technique. Processing the data measured with Data Explorer Software",* Annals of the University of Oradea, Fascicle of Textiles-Leatherwork, Oradea, vol XII, nr. 1, 2011 pp. 146-157.
[7] Porav V., **"***Dimensional stability during thermic soldering of the doubled assembly for short time heat treatements",* Annals of the University of Oradea, Fascicle of Textiles-Leatherwork, Oradea, vol IX, nr. 1, 2008, pp. 119-126.

INNOVATIVE MATERIAL-TECHNOLOGY SYSTEM WITH CONTRIBUTION TO INCREASESING ECO-EFFICIENCY OF INDUSTRIAL LEATHER PROCESSING

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Abstract: This paper presents the results of testing an innovative material-technology system for reduction of environmental pollution with salts in wet finishing leather processing phases. This presents the results of testing an innovative material-technology system for reduction of environmental pollution with salts in wet leather processing phases. Wet finishing experiments on leather were performed using new compact (retanning blends) materials with effects on reduction of sulphates from waste waters Designing new products is based on the latest knowledge on compatible materials with good stability over time, ability to penetrate the porous dermis structure and to interact with functional groups of collagen. Wet multifunctional materials were obtained and tested for wet finishing of hides with retanning, fatliquoring and dyeing properties reduction of sulphates in the effluents from compact retanning was min.45% and reduction of chloride 50%, chromium salts from effluents are completely reduced in the case of compact FOC (free of chrome) leather, reduction of ash content in the effluents from compact retanning was min. 40%.
The leather wet finishing with newly multifunctional materials gave comparable physical properties to classical retanning.
The economic effects to applying compact materials and technologies of bovine leather wet finishing are significant and refer to reducing processing time by 45%, water consumption by 30%, labour by 40%, auxiliary materials by 30%.

Key words: wet leather processing, salt reduction, bovine hides, free of chrome leather, compact wet finishing.

1. INTRODUCTION

The term salt in the tanning industry is typically used to refer to the two commonly used salts, namely sodium chloride and sodium sulfate. It is quite typical in the tanning industry to consider both of these inorganic salts together using the simple term salt. These two inorganic salts in the effluent are clearly the most difficult form of pollution to be dealt with in the leather industry. Both are very soluble in water and chemically stable, making it effectively impossible to remove them from a mixed effluent in waste water treatment plants by typical processes such as: sedimentation, oxidation, precipitation or flocculation like most other pollutants.

The salts used in leather processing (inorganic) and the salts formed during this process constitute over 60% of the total chemical substances used in leather processing, which is enough to justify research for rationalization of chemical processes for the purpose of reducing environmental pollution with salts [1].

This paper presents the results of testing an innovative material-technology system for reduction of environmental pollution with salts in wet finishing leather processing phases.

2. EXPERIMENTAL

Leather retaining is a key multistep operation in leather processing which requires the use of chemically complex auxiliary materials difficult to biodegrade and which contain large amounts of salts [2]. Most products are wet finishing powders and may contain significant amounts of sodium sulfate as inert salt standards. As an alternative to classical retaining a series of blend type materials with dyeing fatliquoring and retanning function have been developed are used in one dose, after hide neutralization [3, 4, 5].

Designing new products is based on the latest knowledge on compatible materials with good stability over time, ability to penetrate the porous dermis structure and to interact with functional groups of collagen.

The skins were classified into three groups and retanned (wet finishing) according to the experimental design given in Figure 1 and Table 1 [6].

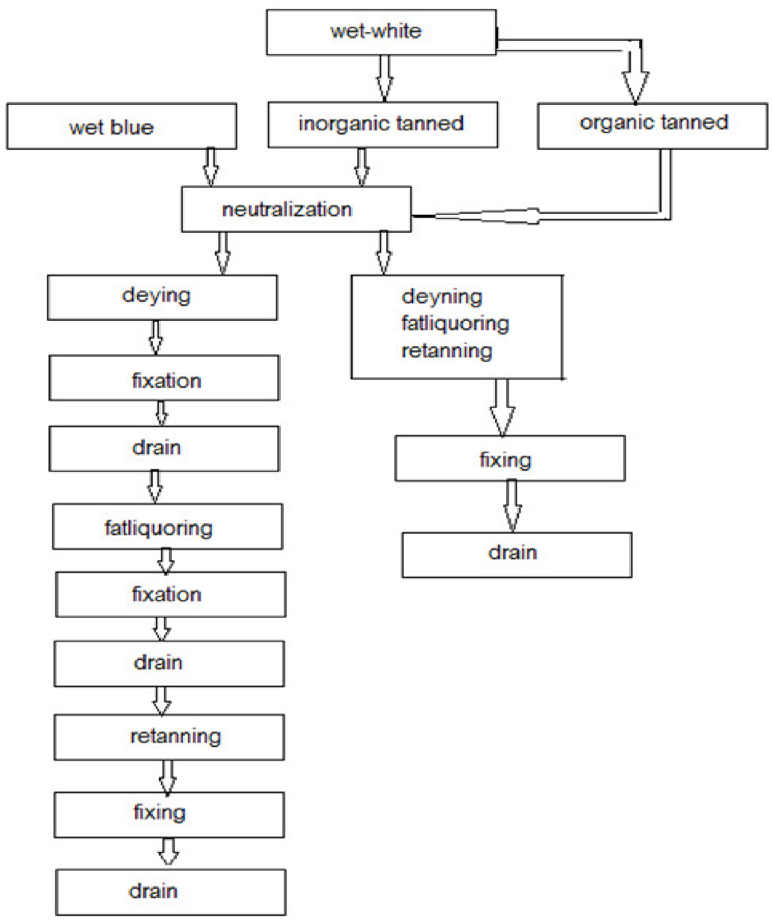

Figure1. Experimental design of the retanning processes

Table 1. Experimental design of the retanning (wet finishing) processes

Trial no.		Type of treatment
M	M_M	Wet blue classical retanned
	MB_P	Wet blue compact retanned with wet finishing product
PO	MO_M	Organic wet white classical retanned
	MO_P	Organic wet white compact retanned with wet finishing product
PI	MI_M	Inorganic wet white classical retanned
	MI_P	Inorganic wet white classical compact retanned with wet finishing product

The classic multistep retanning chrome bovine hides (or free chrome tanned) were processed according to Table 2.

Table 2. Classic multistep retanning chrome bovine hides

Process	Parameters		
Dyeing	100% water	55^{o}C	
	2% days		20-60'
Fixation	+1% formic acid	(1:10)	15-20'
	control		
Draining			
Fatliquoring	100% water	55-60^{o}C	
	10% fatliquors compound		40-60'
	control		
Draining			
Retanning	100% water	35^{o}C	
	3% synthetic resins		20-30'
	8% natural tanning (mimosa,		40-50'
	quebracho	control	
Fixation	1% formic acid	1:10	15-20'
		Control	
			pH=3.8-4.2
Draining			

The new compact retanning hides with new composite blends were processed according to Table 3.

Table 3. Compact retanning with new composite products

Process	Parameters		
Compact retanning (dyeing, fatliquoring, retanning)	100% water	35-38^{o}C	
	10 % compact		60'
Fixing	+ 1% formic acid		15'
		control pH=4.2	
Draining			

Bovine hides chrome tanned without chrome finished wet frequently used technology and compact product variants proposed are shown in figure 2.

Figure 2. Bovine hides chrome tanned without chrome finished wet frequently used technology and compact product variants proposed

3. RESULTS AND DISCUSSIONS

Physical test results of the leather samples after retanning processes are given in Table 4.

Table 4. Physical test results of leather after compact retanning process

Trial no.	Tensile strength (N/mm^2)	Amounts required under the standard	Elongation at (break %)	Amounts required under the standard	Tear strength (N/mm)	Amounts required under the standard
MB_M	19.20	Min.16	61.50	Max.79	52.10	Min.27
MB_P	22.31		67.20		53.20	
PO_M	19.05		51.30		31.04	
PO_P	21.15		56.20		35.21	
PI_M	23.10		53.40		30.05	
PI_P	28.80		58.00		29.40	

Results of chemical analysis performed on retanned samples are given in Table 5.

Table 5. Results of chemical analysis

Trial no.	Fat %	pH	Ash %	Cr_2O_3 %	Shrinkage temperature ^oC
MB_M	7.3	3.95	5.9	3.8	101
MB_P	7.5	4.16	5.8	3.5	98
PO_M	7.4	4.21	2.8	-	84
PO_P	4.3	2.5	7.6	-	85
PI_M	3.62	7.9	7.4	-	89
PI_P	4.01	6.9	7.9	-	92

Results of salt content in the leather wet finishing effluents are given in Table 6.

Table 6. Salt content in the effluent

Trial no.	Salt content mg/dm^3			
	Chloride	Sulphates	Cr_2O_3	Ash
MB_M	1418	11324	607	6900
MB_P	567	6151	580	2800
PO_M	920	4020	-	950
PO_P	405	1005	-	502
PI_M	1030	12500	-	6500
PI_P	460	5800	-	2600

Balance of salts in effluents from compact retanning of bovine hides chrome tanned compared to the classical multistep process is presented in Figure 3.

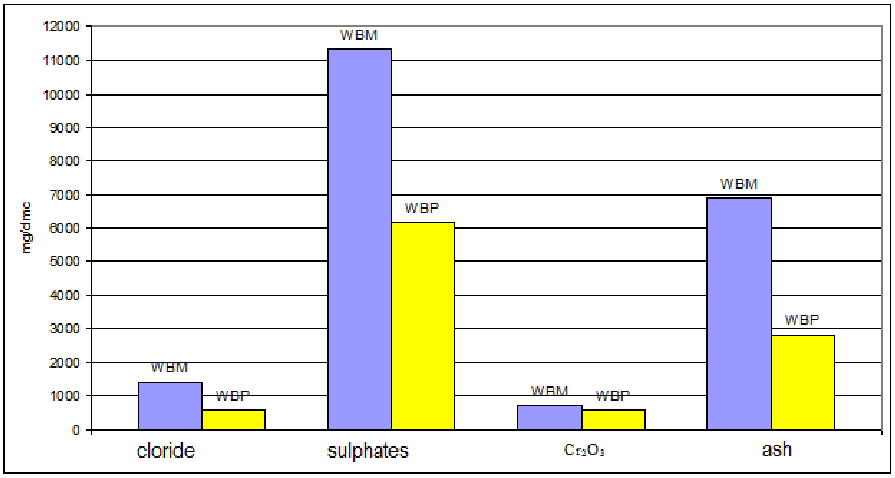

Figure 3. Reduction of salts and chromium content in retanning effluents from bovine hide chrome tanned

Reduction of 60% chloride and 45% sulphates was achieved. Chromium salts from effluents are completely reduced in the case of compact retanning of free of chrome leather.

Balance of salts in effluents from compact retanning of bovine hides free of chrome tanned (organic and inorganic) compared to the classical multistep process is presented in Figure 4.

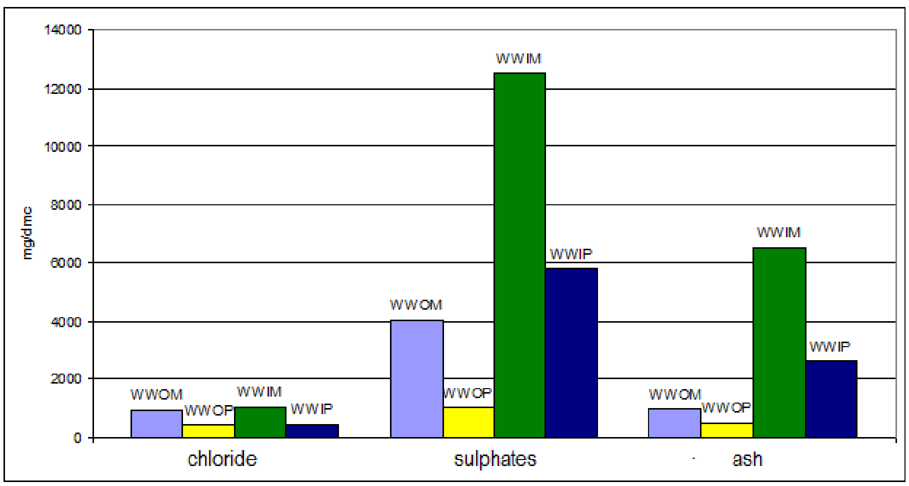

Figure 4. Balance of salts in effluents from compact retanning of bovine hides free of chrome tanned

5. CONCLUSIONS

- Wet multifunctional materials were obtained and tested for wet finishing of hides with retanning, fatliquoring and dyeing properties;
- Reduction of sulphates in the effluents from compact retanning was 45%-75% and reduction of chloride 55%-60%;
- Chromium salts from effluents are completely reduced in the case of compact FOC (free of chrome) leather;
- Reduction of ash content in the effluents from compact retanning was 47%-60%;
- The leather wet finishing with newly multifunctional materials gave comparable physical properties to classical retanning.
- The economic effects to applying compact materials and technologies of bovine leather wet finishing are significant and refer to reducing processing time by 45%, water consumption by 30%, labour by 40%, auxiliary materials by 30%.

6.REFERENCES

[1]. TFL Eco Guidelines (2011), Salt & Nitrogen Reduction in the Leather Making Process, ecology@tfl.com.

[2]. Rajamani, S. and Ramasami, T. (2007), "Salinity-related Issues in India", *World Leather*, May, 37-39.

[3]. Csnaka, H. (1995), UNIDO, Ljubljana

[4]. Papa Konstantinou, D. (2001), "Salt Free High Stability Organic Tanning for the Production of High-Tech Upperleather", *Tecnologie Conciane*, March-April, 83-85.

[5]. Munz, K.H. (1993), XXII IULTCS Congress, Brasil, 363.

[6]. Crudu M., Gaidau C., Crudu A., Popescu M., Ionescu M., Valeika V., Plavan V. "INNOVATIVE MATERIAL- TECHNOLOGY SYSTEM FOR REDUCTION OF ENVIRONMENTAL POLLUTION WITH SALTS" Conference Chemistry and Chemical Technology, 25-27 apr.2012, Kaunas, Lithuania

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PERSONALIZING THE SHAPE OF THE SHOE LAST

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Abstract: The paper presents various techniques for modelling the last, using **Last Maker**, a component of the **Delcam Crispin 3D**, several techniques for parameter varying and for result visualizing.
Using the specific tools of **CRISPIN Dynamics CAD SUITE** software, **ModelTracer** and **Last Maker** modules, a method for creating new shoe lasts has been developed in this paper. The method can be useful for creating lasts for a variety of footwear. **LastMaker** - a program providing the means to design and modify lasts width outputs to various 3D file formats. This system offers new solutions for shoemakers. This application offers functions for creating new shoe lasts using function **Last>Adjust**. There are also facilities to re-centre front and back guide lines, change foot (no need to re-digitize). Set the correct heel height and grading shoe last for obtaining shoe lasts for inferior and superior sizes. We can study the new shoe last by comparing it using this function application.
The method for creating new lasts that is useful for footwear manufacturers who can always find the shoe last according to their product or can create a new last, similar in shape with the first last - same heel height, same shape of the tip and creating a new last, with heel height and different shape from the original one.

Key words: last, parameter, new last, heel height, toe spring, stick lenght, bottom length

1. INTRODUCTION

The last is the most complex spatial form and is indispensable in the manufacture of footwear. Even the most experienced manufacturers of footwear products mentioned the last to be the "soul "of the footwear. Without the last there would be no footwear, no footwear industry and no footwear fashion [1]. At the same time, they claim that the design and execution of the last is the most complex and elaborated process of the entire shoe manufacturing business, the launch pad of its manufacture[2], [3].

There are no straight lines on the last. The last made of a continuous flow of contours and configurations. In this respect, it is considered "a masterpiece of engineering and a work of art".

However, while taking into account fashion and the characteristics of each style, the contours must meet precise standards of measurement and sizing.

But the process of defining the geometry of the last is complex. Specialists in computerized design of spatial forms, state that computer-aided design of a last includes the most advanced design techniques: from defining the 3D geometry of the last to obtaining its numerical form. This enables manufacturers to make patterns and prototypes using Numerical-Command-Machines (NCM) such as computer-aided design techniques currently used in industries of aerospace and car manufacturing and a number of applications requiring processing of spatial coordinates in three-dimensional shapes [2], [4], [5].

With this purpose in mind, there have been developed a series of specialized CAD/CAM software products to design lasts, with interfaces for pattern production. In the following there are presented some advanced methods available for **CRISPIN Dynamics CAD Suite** for footwear, regarding the last modelling with their specific advantages. Using this method, there has been created a searchable database of shoe lasts, characterized by the main geometric parameters, and a sequence of it, is attached to this paper.

In order to create the database it was required to build the spatial shape of the last in computer-assisted sessions, to analyse the last from all points of view and to determine the main parameters that characterize it.

2. INFORMATION

Increasing and tougher competition between footwear producers makes market adaptability a must, one which is increasingly difficult to attain. Pricing must be carefully controlled, while the quality of the products must remain the same or even continuously improved. These requirements can be reached only by using computer-aided production. To this end, both footwear production and software companies joined forces to develop CAD/CAM shoe design software.

The design of the last influences not how comfortably a shoe fits the foot, but also how stylish it looks. Footwear must be designed so that it perfectly fits the foot and also be comfortable. These aspects are influenced by the shape of the last, the properties of the materials, the shape of the legs, the thermal comfort of the shoe and even the shape and the color and the shape of the upper.

Using CAD/ CAM systems, the producers can easily modify the shape of the lasts they already have, so that they can create new models.

A last that was produced by using a certain set of basic measurements can be digitized and then introduced in specialized software, where scaling and sizing tools are applied so that other sizes could be obtained.

Existing CAD CAM systems allow sizing, scaling and modelling the design of the last, allowing for a personalized design, a perfect fit of the shoe or varying the style of the last by introducing different parameters for the design. Moreover, the software takes into account the whole shape of the foot and produces parameters that allow a better fit.

This is how new lasts can be created, facilitating an increase in the quality and design of the shoewear.

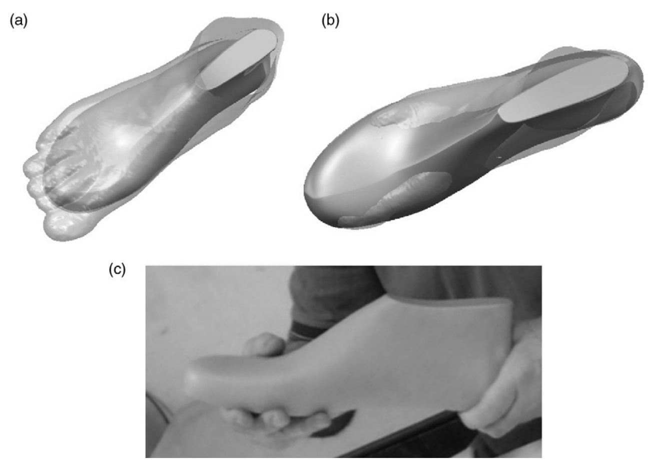


Figure 1: Personalizing the shape of the last

The paper presents various techniques for modelling the last, using Last Maker, a component of the **Delcam Crispin 3D**, several techniques for parameter varying and for result visualizing.

The lasts resulting from the process can be later produced using standard numerical command equipment - CNC.

3. CRISPIN DYNAMICS - CAD SUITE

This application has functions for creating and modifying the shoe last, making realistic designs of footwear products, flatten and transferring the base lines of the 3D model for development in 2D [3], [4]. The software facilitates the digitization of shoe last, re-centre front and back guide lines, change foot (left/right) and set the correct heel height and. One can create guidelines to save with the last and extend the last for a boot design [3]. The last type can also be changed to a type that allows the entire last surface to be used for a design. The application is modular as following:

- **LastMaker** - a program providing the means to design and modify lasts width outputs to various 3D file formats.
- **ShoeDesign** - a program for designing uppers on 3D lasts provided by **ModelTracer** or **LastMaker.**

There are presented the most advanced methods offered by **CRISPIN Dynamics CAD Suite system** for footwear concerning the modelling process for the shoe last shape with the specific advantages.

3.1 About for Last Maker

LastMaker - a program providing the means to design and modify lasts width outputs in various 3D file formats. This system offers new solutions for shoemakers. This application offers functions for creating new shoe last using the function **Last>Adjust** for development in 2D. There are also facilities to re-centre front and back guide lines, change foot (no need to re-digitize). Set the correct heel height and grading shoe last for obtain shoe lasts for inferior and superior sizes. The new shoe last is studied in comparison by using the function of this application [3], [5].

There are also facilities to re-centre front and back guide lines, change foot (no need to re-digitize). Set the correct base dimensions of the shoe last:

Toe Spring

Heel Height

Stick Length

Bottom Length

Girth

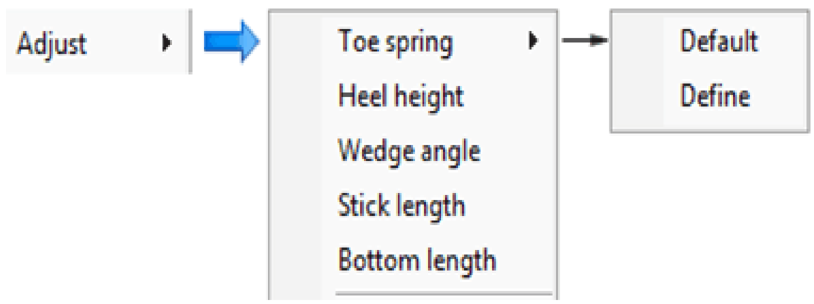


Figure 2: The menu of the function Last>Adjust and the functions

Geometric parameter	Signification
Toe Spring	
Heel Height	
Stick Length	
Bottom Length	
Girth	

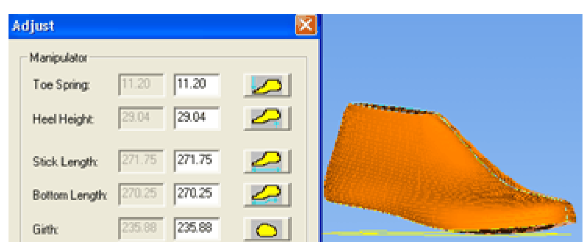


Figure 3: The base geometric parameter of the function Adjust

The new shoe last in comparison for a study using the function of this application [5].

3.2. Functions for modifying the base dimension of the shoe last

The function for modifying the base dimension of the shoe last is found in table nr.1.

Table 1: The function for modifying the base dimensions of the shoe last

FUNCTION	COMMAND	INSTRUMENT
The function for modifying the Toe Spring	**Menu>Edit>Last>Adjust>Toe Spring**	
The function for modifying the Heel Height	**Menu>Edit>Last>Adjust>Heel Height**	
The function for modifying the Stick Length	**Menu>Edit>Last>Adjust>Stick Length**	
The function for modifying the Girth	**Menu>Edit>Last>Adjust>Girth**	

NOTE

In cassette of the function to inscribe a new value (figure 4) for each parameter:

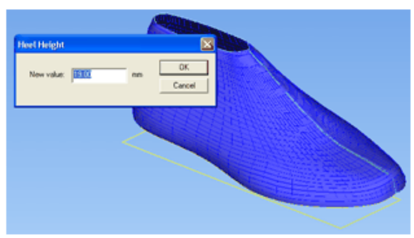


Figure 4: The form of the window for either base function

3.3. Comparing and analyzing the new Shoe Lasts

The comparing function allows the possibility of comparing two different lasts; the result can be measured or displayed as a solid last [3], [6]. First it is opened the last needed to be compared; it is possible to have open a number of lasts and any of them can be compared. It can easily be checked, if one selects cascade view, using function **Window > Cascade**.

Now, from the main menu select: **Verify > Compare > Alignment** and the list of all the open files names is bringing up (fig.5). Select desired last and the last is opened and positioned similarly as the original last. Last positioning is the next step and the various translations and rotations are required in order to properly position the toe with the back part.

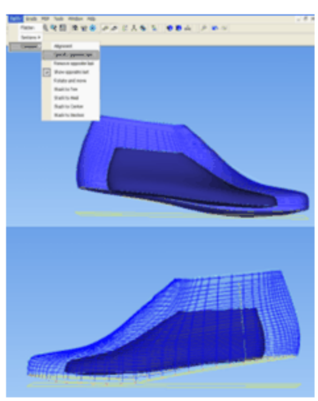


Figure 5: The result for comparing two lasts

4. EXPERIMENTAL EVALUATION OF THE PERFORMANCE OF THE SOFTWARE

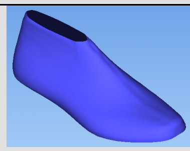
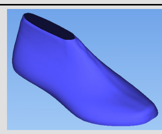
To experimentally evaluate the work method, two different scenarios are taken into account:

- Creating a new last, similar in shape with the first last - same heel height, same shape of the tip.
- Creating a new last, with heel height and different shape from the original one

4.1 Creating a new last, similar with the original

Let us consider two lasts of the same shape, but different dimensions - respectively Last 1 and Last 2. The dimensions for the two last are in table 2:

Table 2: The results for creating a new last, similar with the original

Lasts	Toe Spring	Heel Height	Stick Length	Bottom Length	Girth
 Last 1	**11.20**	**29.04**	**271.25**	**270.25**	**235.88**
 Last 2	**7**	**35.82**	**199.62**	**195.96**	**135.18**

The comparative results for modifying the dimension of one last in order to obtain a last with dimensions of last2 are:

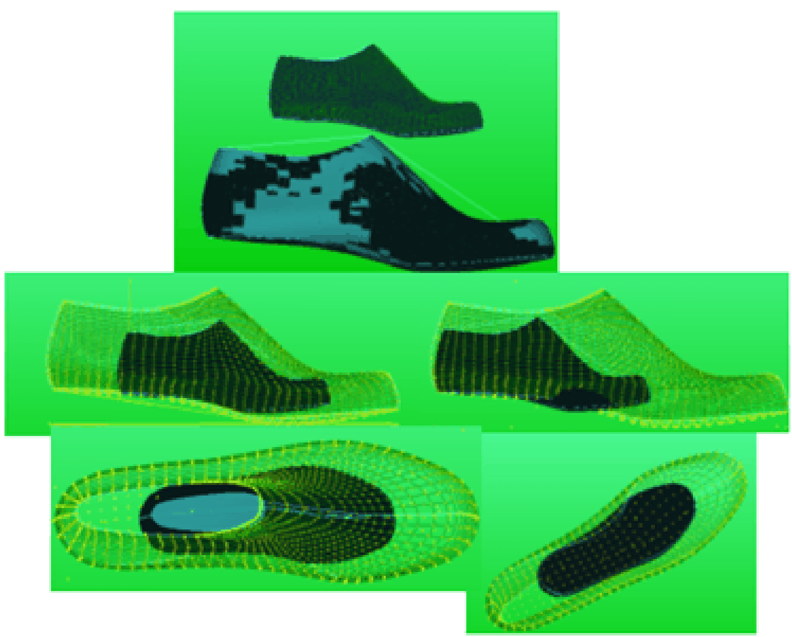
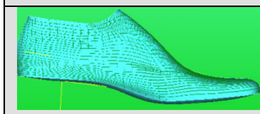
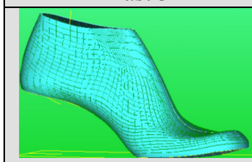


Figure 6: The results for comparing LAST1 with LAST2 after modifying the parameters of the last 1 with parameters of the last2

4.2 Creating a new last, with heel height and different shape from the original one

Let us consider two lasts of the same shape, but different dimensions - respectively Last 3 and Last 4.

Lasts	Toe Spring	Heel Height	Stick Length	Bottom Length	Girth
 Last 3	**0.14**	**29.**	**281**	**281.56**	**225**
 Last 4	**9.**	**82**	**242**	**238**	**209**

The comparative results for modifying the dimension of one last for obtaining a last with dimensions of last4 are:

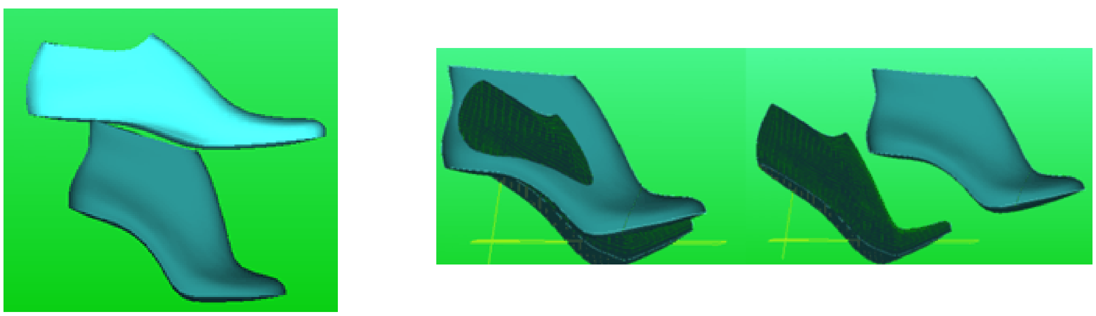


Figure 7: The two lasts, last3 and last4 for discusion

5. CONCLUSION

Using the specific tools of **CRISPIN Dynamics CAD SUITE** software, **ModelTracer** and **Last Maker** modules, a method for creating new shoe lasts has been developed in this paper. The method can be useful for creating last for a variety of footwear.

The method for creating new lasts is useful for footwear manufacturers who can always find the shoe last according to their product.

6. REFERENCES

[1] Costea M., Drişcu M, *Crispin Dynamics 3D –New solution for shoemakers creating and modification of the shoe last*, Leather and Footwear Journal 11 (2011), pg 109-120, ISSN 1583-4433
[2] Mihai Aura, Costea M ş.a. *Customized footwear insers for high arched foot – one case study*, Proceedings of the 3nd International Conference on Advanced Materials and Systems 2010- ICAMS 2010 Bucuresti
[3] Drişcu Mariana, *Modelarea formelor plane şi spaţiale ale încălţămintei,* Ed Pim, Iaşi, 2008
[4] Drişcu M., *Reconstruction and flattening of the surface shoe last*, Proceedings of The 14th Internaţional Conference, Iaşi&Chişinău ModTech2010, May, 2010, Romania, ISSN:2006-391
[5]***http://www.google.ro/search?q=shoe+size&hl=ro&prmd=imvns&tbm=isch&tbo=u&source=univ&sa=X&ei=KlpTT4DwNaik4ATx7rGzDQ&sqi=2&ved=0CEkQsAQ&biw=1024&bih=515, Acessed on 08.04.2013
[6] *** http://www.footwear-cadcam.com/languages/fr/general/cadsuite.asp, Acessed on 08.04.2013

ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

CONTRIBUTIONS TO THE DEVELOPMENT OF PATTERNS ORTHOPEDIC FOOTWEAR CHILDREN'S PART I

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Abstract: The study presented in this paper was conducted within the Republican Experimental Center, Prosthetics, Orthopaedics and Rehabilitation (CREPOR) which is the only specialized institution in Moldova and provides disabled people with technical aids. Currently orthopedic shoes made in CREPOR only partially meet the requirements of the beneficiaries from the fact that these requirements are constantly increasing. In particular this refers to footwear design, the materials used and the quality of implementation. Disrupting the normal functioning of the foot, often accompanied by changing its form, is the result of multiple causes, which can be conventionally divided into external and internal. Among the *external causes* mentioned overuse acting on foot, stress dependent nature activity of human and a wrong footwear. Of *internal causes* hereditary predisposition to recall the occurrence of diseases and weakening of muscles. Children's orthopedic problems (mainly lower limb abnormalities, dysplasia of the hip, spine deviations) are part of the conditions that require early detection and should be a constant concern of the family doctor. To identify the most frequently occurring anomaly analysis was performed to 115 sheets of custom developed based on appeals to the CREPOR in september-november 2009, orthopedic footwear for children with various problems documented in the lower limbs.

Key words: abnormality, leg, children, requirements, collection, questions

1. INTRODUCTION

Orthopedic shoes as well as the usual serves as clothing leg and in addition bears a auxiliary and sometimes base to treat certain diseases. Orthopedic footwear indicated orthopedic doctor that determine the construction analysis is required stage anomaly [1].

Republican Centre for Prosthesis, Orthopedics and Rehabilitation (CREPOR) is the only specialized institution in Moldova, which provides disabled people with technical aids.

Analyzing the period 2003-2010 crepe activity was found in 2003 were comandate11865 pairs of orthopedic shoes, but they were made and offered beneficiaries only 5830 pairs. In 2004 were ordered 14224 pairs, of shoes but released 6066 pairs. In 2005 they were ordered 4562 pairs, that just released 3406 pairs. In 2010 were comandate14013 perechi and issued 12186 pairs of shoes [2].

Shows in figure 1 the dynamics of addressing people at this center demand.

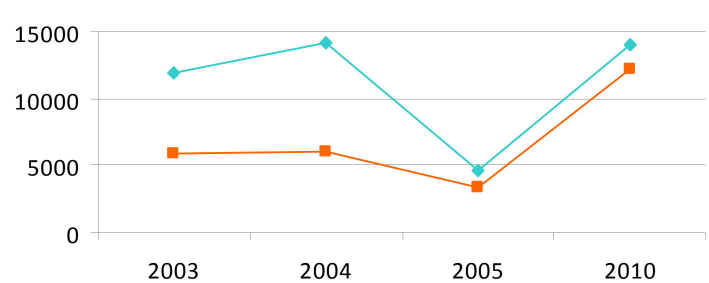

Figure 1. Diman addressing people at CREPOR demand

It is important to note that this information reflects only partially the situation in the country, because not all people with abnormalities foot are addressed at this center. To obtain a true picture of the situation is necessary to make anthropometric measurements on representative selection of subjects of different age groups and sex, which could lead to finding new people to abnormalities leg.

Currently orthopedic shoes made in CREPOR only partially meet the requirements of the beneficiaries from the fact that these requirements are constantly increasing. In particular this refers to footwear design, the materials used and the quality of implementation. For these reasons, the majority of young people declines wearing such shoes, leading to worsening anomalies and the occurrence of others, treatment which need further.

2. STATIC AND FUNCTIONAL ANOMALIES OF FEET CHILDREN

Disrupting the normal functioning of the foot, often accompanied by changing its form, is the result of multiple causes, which can be conventionally divided into external and internal [3].

Among the *external causes* mentioned overuse acting on foot, stress dependent nature activity of human and an inadequate footwear [3].

Of *internal causes* to recall hereditary predisposition the occurrence of diseases and weakening of muscle [3].

As a result of excessive static load, the leg can be damaged by static deformation of a number of functional drawbacks. Frequent **static deformations** are: flat foot longitudinal / transverse; foot bony prominences; hollow foot; varus equinus; clubfoot; fingers vicious positions; etc. Among the **functional impairments** of the foot reads: fatigue rapid leg; illness leg and calf; joint instability tasks being put on foot during walking and runners; increasing secretion of sweat; legs asymmetry. The **morphological** abnormalities relate disproportionate legs (very long or very short) length asymmetrical legs, no fingers or joints, finger segments overly large or small.

Children's orthopedic problems (mainly lower limb abnormalities, dysplasia of the hip, spine deviations) are part of the conditions that require early detection and should be a constant concern of the family doctor [1].

Flat foot or fallen arches is defined as the absence of arches longitudinal and transverse of the foot [3]. To 4 years, 96% of children have flat feet [4, 5]. We can even say that is physiologically fallen arches. After 4 years of age in most children at this level extra fat is reabsorbed.

There are three stages of evolution of flat foot [3, 5] degree is flat feet reducible, grade II - flat foot contracted, grade III - flat foot rigid.

1. Reducible flat foot is when patient experiences fatigue pain at the end of the day or after walking longer.
2. Flat foot contracted is when a patient has pain that radiates to the legs, knees, hips, lower back, which walking feel embarrassed and makes it impossible to standing long rule.
3. Rigid flat foot deformity occurs when the foot is rigid and fixed in one position, so the going is slow, making support on the outer edge of the foot.

Curative treatment use of equipment orthopedic, physiotherapy, physiotherapy and massage. Usually inside shoe insert with plantar supporter role to maintain plantar arch, reducing pain, preventing emphasizing deformation and installation phenomena of osteoarthritis.

Opposite foot flat is ***foot scooped***. Maximum legs hollow occurs in children aged 10 years, in girls being more frequently than boys. At the first deformation is flexible (reducible) and in some cases may remain so for a long time. Usually, as time passes, the deformation becomes rigid, it is becoming increasingly difficult to reduce orthopedic and tends, however, to stress the retraction of all the soft tissues (achilean tendon, extensor tendons) [5].

Orthopedic treatment and the recovery are used in early cases and reducible, allowing temporary halt of evolution. For recovery planting vault using orthopedic shoes, inserts, massage and medical gymnastics. In this case orthopedic shoes and inserts serve to "calm" area affected by broadening the previous surface support and reduction pressure in termination metatarsals and correct the varus position of the calcaneus is made by the addition of base on the outdoor footwear. Also use footwear of a insole formed and made of a material with a properties very high plastic to the surface of contact between the foot and the plane of the support to be as high.

Congenital club foot is one of the most common malformations of the newborn. Its frequency is estimated to be 1 case per 1000 live births [6]. Term congenital club foot corresponds malformations that changes the orientation of the foot in relation to the leg. From the point of view of the position of the foot in relation to leg distinguish the following cases [3]:

- *varus* – foot rests on the external, surface plantar supine;
- *valgus* – foot rests on the internal, surface plantar pronation;
- *equin* – axle the foot is extended shaft calf, support antipicior or fingers;
- *calcaneus* – leg supports on the heel, not running flexion-extension, the fingers facing upwards.

Rarely has a club foot one direction then the shaft is deflected. The most common type of foot calico is the foot varus-equinus, representing 80-90% of all cases of congenital club foot, other types are extremely rare [6].

Foot affected by cerebral palsy (ICP). The term "general" cerebral palsy includes a group of neurological disorder non-progressive, characterized by control inadequate of movement and posture, due to a defect or lesion of the immature brain (central nervous system). Cerebral palsy are considered disease non-progressive, but in a continuous dynamic process influenced by growth and development, so that clinical manifestations may change over time [6].

The legs may be affected in several ways: muscles poorly developed, flat feet, shortening, varus foot or the presence of multiple faults.

Fingers in vicious positions (straddle) usually presents in flexion deformities of fingers 3 and 4 finger 2 below them. Position can not be changed by pressing. In most cases, children adapt to the anomaly and require no treatment. If the deformation is emphasized wearing shoes becomes difficult, intervention can be surgical release affected finger flexor tendon. In other cases, is affected finger 5 extensor tendon, being raised over finger 4. Surgical correction in this case it practice when wearing shoes is difficult to.

Walking on the peaks is often met in the first two years running (1-3 years), and is often a habit that does not require treatment or special attention [6]. This however should not be confused with walking fingers of children with cerebral palsy.

To identify the most frequently encountered anomaly analysis was performed of 115 sheets of custom developed based on appeals to the Republican Center for Prosthetics, Orthopaedics and Rehabilitation (CREPOR) in september-november 2009, orthopedic footwear for children with various problems certified to the lower limbs. Analysis of patients by age and sex allowed concluding that they aged 1-7 years of which 65 are boys and 50 girls. The maximum share (80,9%) of the 115 petitions was born in 2008 children (21,7%), 2007 (27,8%) and 2006 (31,3%), so the age of 3, 4 and 5 years.

In the analyzed sample the most common abnormalities were (figure 2):

a) bilateral valgus flat foot in adduction – 57,39%;
b) leg, infantile cerebral paralezie – 17,39%;
c) flat foot adducted – 10,43%;
d) shortening of one leg – 5,21%;
e) congenital club foot – 4,34%;
f) foot varus – 2,60%;
g) foot valgus – 1,73%;
h) elephantiasis – 0,86%.

The same study showed that boys are more affected than girls.

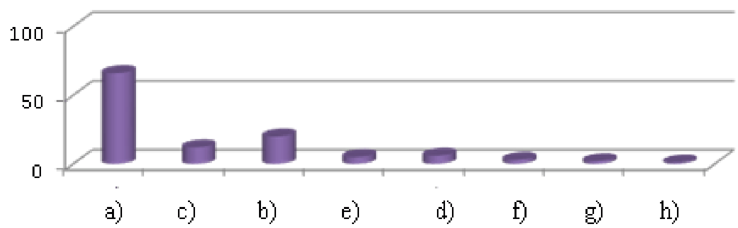

Figure 2. Frequency of meeting pathologies foot children who received orthopedic shoes made from CREPOR

3. CONCLUSIONS

Based on theoretical and experimental research conducted in this paper the following conclusions can be drawn and guidelines:

Anomaly flat foot valgus is confirmed with a maximum weight children. This is due to several causes, including wearing unsuitable footwear due to massive imports of cheap low quality shoes.

To prevent deformation of the lower limbs and not only is proposed: the use of age-appropriate footwear and foot shape, informing parents about the risk of using worn or improper footwear, footwear proper maintenance, compliance with medical prescriptions on the use of special footwear or role prophylaxis.

4. REFERENCES

[1]. Domnița, S., Condor, M., Oprea, S. (2007). *Detection of abnormalities in the lower limbs in infants and children.* The journal practice.

[2]. Ischimji, N., Mironiuc, T., Bulgaru, V., Malcoci, M. (2007). *Providing native population with orthopedic shoes.* Materials Technical-Scientific Conference of the employees, graduates and students, UTM Chisinau, page 312, ISBN 978-9975-45-068-3.

[3]. Mălureanu, G., Mihai, A. (2003). *Basics shoes design.* Publishing Performance, Iasi, ISBN 973-8075-88-2.

[4]. Research Project 07.420.16. INDA. *Anthropometric studies on improving the manufacturing technology of therapeutic footwear.* From 2007 to 2008.

[5].http://www.kudika.ro/articol/frumusete~wellness/3814/piciorul-plat-platfus.html, Acessed on 03.11.2012.

[6]. http://www.medicina.ro/catalin/picior.htm, Acessed on 03.11.2012.

CONTRIBUTIONS TO THE DEVELOPMENT OF PATTERNS ORTHOPEDIC FOOTWEAR CHILDREN'S

PART II

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Abstract: The study presented in this paper was conducted within the Republican Experimental Center, Prosthetics, Orthopaedics and Rehabilitation (CREPOR) which is the only specialized institution in Moldova and provides disabled people with technical aids. Prior to collection development models have been studied both medical and technical requirements from orthopedic shoes for children and consumer requirements. Based on theoretical and experimental research conducted in this paper can be the following conclusions drawn and guidelines: most people who go to the center are not satisfied with models of orthopedic shoes the existing there, the preferred range boots for season the cold of because it is difficult to find a pair of shoes for the winter than for summer; is chosen more closure system lace as it is a closure more secure, durable and breaks down harder, most people surveyed in terms sliced want a soles prefabricated shoe ordered, but not all anomalies allow it; also is desirable for orthopedic shoes are of many colors, and the elements of beauty to decorative stitches. The results obtained were compiled two collections of models of orthopedic shoes for children with ergonomic properties, aesthetic and functional improvement for children with anomalies: bilateral valgus flat foot and shortening a member.

Key words: abnormality, leg, children, requirements, collection, questions

3. REQUIREMENTS TECHNICAL - MEDICAL TO FOOTWEAR ORTHOPEDIC CHILD

An orthopedic shoes the requirements imposed orthopedic shoes for children [1-6]:
1. To provide ability effective support legs.
2. To keep the foot in place.
3. For prevention of progression deformity after treatment or prophylaxis.
4. To compensate for shortening leg.
5. To reimburse pressures in different regions of the surface of the foot, to increase the bearing surface.
6. To defuse the painful side.
7. To overcome the shortage of spring leg.
8. To ensure smooth transitions foot phase of impact propulsion, even when using devices fixing.
9. The liquidation of cosmetic defects of the foot.
• compliance with medical instructions;
• compliance interior shape of the shoe with as the foot, closely as possible;
• making proper technique;
• undifferentiated as far as possible from ordinary shoes;
• ensuring comfort and functionality foot in the shoe.
10. Easy to use special items constituting orthopedic footwear.
11. Using lightweight materials for not to increase mass orthopedic footwear.

4. IDENTIFICATION REQUIREMENTS FOR CONSUMERS

For determining the composition of a collection of types is required research permanent market and study user requirements. With surveys can study user requirements, learning the views and wishes of potential users of the products. We developed a survey containing nine questions. Number of people surveyed is 50 people, sex of woman and boys aged 1-7 years who responded parents with kids.

The presents questions survey and answers obtained.

1. Know pathology that you are diagnosed ?
- 22% of the total number of respondents do not know pathology which is diagnostic;
- 78% know pathology that are diagnosed.

2. We ask you to CREPOR orthopedic footwear ?
- 98% of number of respondents want to be made footwear;
- 2% do not want orthopedic shoes.

3. Wear shoes orthopedic recommended doctor the CREPOR ?
- 96% of the total respondent wearing shoes recommended orthopedic doctor;
- 4% not wearing shoes recommended orthopedic doctor.

4. Are you satisfied with the models that are at the center?
- 18% are satisfied with the models that are at the center;
- 54% are not satisfied with the models that are at the center;
- 28% are less satisfied.

5. What assortment prefer to be made to the center?
- 4% prefer sandals;
- 70% prefer boots;
- 10% prefer shoes;
- 16% prefer boots.

6. What closure is present in footwear?
- 44% with braid;
- 24% velcro tape;
- 16% with zipper;
- 16% with buckle.

7. What is the preferred material for sole shoe order?
- 26% prefer foam rubber;
- 20% " kozhvalon " PVC;
- 54% prefer prefabricated foot.

8. From the point of view of color range you prefer?
- 52% want orthopedic shoes in several colors;
- 48% of a single color.

9. What kind of decorations you want to be present in footwear order?
- 46% decorative stitches;
- 12% perforations;
- 24% metallic elements;
- 18% of other elements.

The survey results allowed the following conclusions:

- most people who go to the center are not satisfied with models orthopedic footwear existing out there;

- preferred assortment boots cold seasons of the year, it is more complicated to find a pair of shoes for the winter, than for summer;

- is chosen more closure system lace as it is a closure more secure, durable and breaks down difficult;
- the majority of people surveyed in aesthetically want a soles prefabricated shoe ordered, but not all anomalies allow it;
- it is also desirable for orthopedic shoes are of different colors, and the element of beauty to decorative stitches.

5. DEVELOP MODELS - PROPOSALS ORTHOPEDIC FOOTWEAR BY PROBLEM CHILD

Figures 3-4 presents models proposals for abnormalities: shorten one states and bilateral valgus flat foot adducted to have been met requirements for these anomalies taking into account consumer preferences.

Figure 3. Models proposals for fault shortening foot

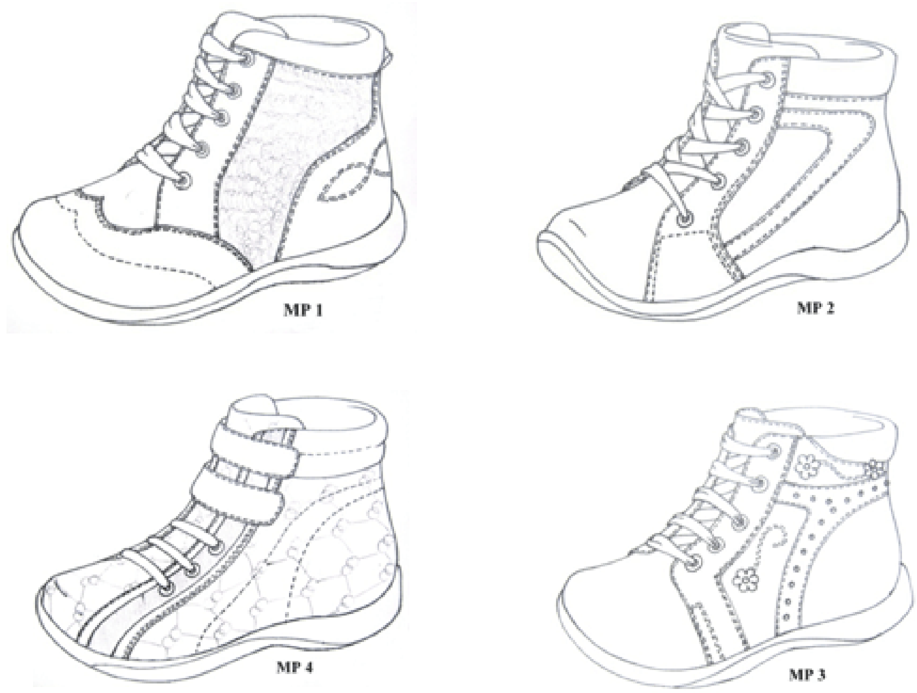

Figure 4. Models proposals fault valgus flat foot

6. CONCLUSIONS

Based on theoretical and experimental research conducted in this paper can be the following conclusions drawn and guidelines:

- for determining the composition of a collection of types is required research permanent market; the study of user requirements; study requirements technical-medical from orthopedic shoes for children;
- the results obtained were compiled two collections of models of orthopedic shoes for children with ergonomic properties, aesthetic and functional improvement for children with anomalies: bilateral valgus flat foot and shortening a member.

7. REFERENCES

[1]. Domnița, S., Condor, M., Oprea, S. (2007). *Detection of abnormalities in the lower limbs in infants and children.* The journal practice.

[2]. Ischimji, N., Mironiuc, T., Bulgaru, V., Malcoci, M. (2007). *Providing native population with orthopedic shoes.* Materials Technical-Scientific Conference of the employees, graduates and students, UTM Chisinau, page 312, ISBN 978-9975-45-068-3.

[3]. Mălureanu, G., Mihai, A. (2003). *Basics shoes design.* Publishing Performance, Iasi, ISBN 973-8075-88-2.

[4]. Research Project 07.420.16. INDA. *Anthropometric studies on improving the manufacturing technology of therapeutic footwear.* From 2007 to 2008.

[5].http://www.kudika.ro/articol/frumusete~wellness/3814/piciorul-plat-platfus.html, Acessed on 03.11.2012.

[6]. http://www.medicina.ro/catalin/picior.htm, Acessed on 03.11.2012.

ORTHOPEDIC AND BIOMECHANICAL FEATURES FOR RUNNING SHOES FOR SPRINTS, MEDIUM AND LONG DISTANCES

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Abstract: Athletics is the sport discipline that has 3 simple event types and 2 multiple events competitions. The simple events are: running, jumps, and throws and the multiple events competitions are: decathlon and heptathlon. The running events are 100 m, 200 m and 400 m dash and 800 m, 1500 m, 5000 m and 10000 m; 100m, 400 m and 3000 m hurdles; marathon, 20 km and 50 km march and cross-country. Different athletics events will require different types of sport shoes, designed for the specific events. Because of the high number of the athletic events and implicitly the number of different kind of shoes used in these events, we will refer to the general features of shoes for short, medium and long distances.Athletics shoes are different as structure and design depending on the events they are intended for. Running for short distances is different than running for medium or long distances, because of the biomechanical features of the movement. This paper will present: particularities of the foot biomechanics while running on short, medium and long distances, general aspects about the running biomechanics; features of the athlete's leg biomechanics during sprint and long-distance running events and orthopedic and biomechanical features for running shoes for sprints, medium and long distances of the specific shoes for these events.

Key words: athletics, running biomechanics, track and field shoes

1. INTRODUCTION

Athletics (tracks and field) is the sport discipline that has 3 simple event types and 2 multiple events competitions. Different athletics events will require different types of sport shoes, designed for the specific events.

This paper will present some of the biomechanical particularities that are specific to the athlete's foot while running on short, medium and long distances and the particularities of the specific shoes for these events.

2. PARTICULARITIES OF THE FOOT BIOMECHANICS WHILE RUNNING ON SHORT, MEDIUM AND LONG DISTANCES

2.1 General aspects about the running biomechanics

Movement may be considered as a motor activity that supports the human body's mobility or it can also be defined as a sequence of steps. The human body's movement is the result of different forces interaction determined by the gravitational force, air drag when moving, reactions to leaning against surfaces and some interior forces because of contracting muscle tensions. Contracting muscles determine one of the legs to lift up, away from the support plane and by swiveling in the pelvis-femur joint, it advances in front of the body in the general movement direction, while the other leg is still in contact with the support plane and behind the body. There can be identified two distinct positions for the legs while walking: standing and swiveling. Running, as an athletic event, is based on the natural movement of running, but improved to reach the maximum output. Unlike walking, running has a "flight" phase, which replaces the bilateral support experienced when walking. While running is highly demanding for one's legs, it actually puts in motion the entire loco motor apparatus. The basic cyclical unit while running is the running step. The complete cycle of the movement unit while running is represented by the double running step which includes two support stages and 2 “flight” ones. For the double running step, the movements executed by one leg, have two different stages: support and swivel. The support stage, itself, comprises the impact(amortization) phase, the vertical phase and the propulsion one. The swiveling time has a posterior oscillation or the behind step, the vertical moment and the anterior swiveling or forward step.

The most important of all these phases is the impulse which represents the main motoric factor for running. The impulse is executed by the leg during the support stage. The motoric action of the leg during the support stage is comprised of a traction phase, which turns in propulsion, both stages being essential for running. The support stage, the body’s center of mass is perpendicular to the support surface only towards the end of the traction period; after that it should always be in front of the sprinter. This translates into a continuous tendency to fall head-first, because of a constant unbalance, kept willingly and accelerated, which causes the runner to move. During the support stage, the center of mass goes through a convex curve trajectory, and while flying a concave curve. The strong and fast support leg extension during the propulsion phase together with the swiveling leg during the anterior oscillation phase, acts on the center of mass as one of the most important factors which causes obtaining an optimal performance for dash running.

During the “flight” stage, after the leg has left the ground, it is accelerated while flexing. This acceleration makes the hip move in a complex way; this is evident especially during sprints. The up and forward hip movement and its acceleration increase the propulsion force if the ground and as a result, the speed that the center of mass is moving away from the propulsion leg with. Unlike walking, where the body has the biggest height while the support leg is standing up straight, during running, the biggest height is achieved in the middle of the flight. The faster the running, the faster the body and the pelvis get closer to a linear trajectory, having smaller amplitude oscillations. The body’s sideways oscillations reach their maximum during the support stage: it coincides with shortest body mass. People with bigger pelvis and short legs have difficulties running because of the high sideways oscillations.

The torsion movements of the upper body and the pelvis are greater while running than while walking and it diminishes with the speed increase. The calf flexion against the thigh is, in some cases, more accentuated, sometimes touching the buttocks with the heels: its role is to ease the forward projection of the leg for the following phase, which is very fast and energetic. The leg pressure on the ground is accentuated at the beginning of the vertical phase, and then decreases again during the vertical and increases again, reaching the maximum at the end of the impulse. The normal leg foot pressure on the ground [1], Fig.1, follows a unique curve, which goes over the body weight line the faster the run. The tangent pressure of the foot on the ground is negative at the beginning, showing that during the amortization, the leg pressures in the opposite direction than the running direction. After going through the vertical stage, the pressure curve becomes positive: the pressure curve on the ground grows proportional with the speed.

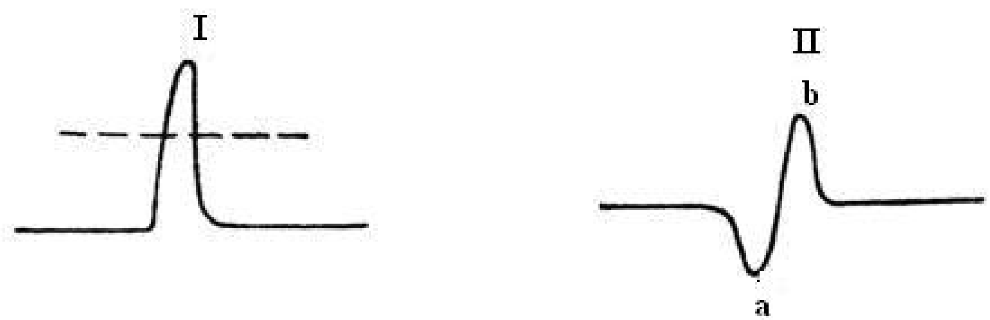

Figure 1: The pressure dynamographic, normal (I) and tangent(II) on the ground while running

Regarding the step while running [2], the step’s length gets bigger as the frequency increases. The running gets faster with the frequency and converges to a 10m/s maximum. While running, the step is longer than while walking, and time wise, it’s shorter. The length of the running step is not only dependant on stretching the legs, like during walking, but also the length of the leap during the flight stage. It also depends on the leg’s length, the length of the foot and if it completely roles on the ground. Taller runners have a longer stretch while running, for the same opening angle between their legs. Air drag is a serious obstacle for running. Its effect is minimized by the runner leaning forward, which reduces the frontal surface.

2.2. Features of the athlete's leg biomechanics during sprint and long-distance running events

The optimal frequency for long-distance running is 105-115 steps a minute. For sprints, the current results show us that the physiological limit is over 10-14m/s for professional athletes, and the step length is approx. 2-2.5m, depending on the complete extension of the impulse leg. The length of the step is also dependant on the contact with the ground [3]; for example, when the contact is made with the tip of the sole, the step is shorter than for heel impact, and the sole completely roles on the ground. When coming into contact with the ground, passively setting the foot on the ground creates drag. An active contact with the ground is ideal when the backward leg speed is equal to the overall running speed. During the impulse, the phase that causes movement in space, the kinetic energy that is being developed is dependant on its mass and the square of its speed.

The double step for sprints and long-distance running has some features [4] : during the amortization phase, the foot's contact with the ground is made with a short planting flexion, on the tips of the metatarsal and toes, on the tip of the sole, accentuated flexion, the faster the run. For long-distances the contact is made with the entire sole. The knee and coccyx joints should be very flexed to increase speed. Because of this, the angle between the calf and the ground is smaller for long-distance and more open for sprint [5]. On long-distances, runners try to maintain high speeds, but they save their strength by reducing the effort and step frequency.

The specific biomechanics elements are identified during the start. In sports, by starting, one understands getting ready fro starting, and the start itself. Getting ready to start refers to adopting a position that is favorable for running. These positions are assumed as responses to the commands "Get ready!" and "Set!".

By the launch during the start, one implies the runner moving from the "Go!" signal to free running. For professional sprinters, that length interval can be as short as 20-35m after the start. Starting from the crouch position [1] Fig. 2, is used for all sprints, 400m included, because it offers the best possibility of ramping up to speed fastest, while starting from a stand still.

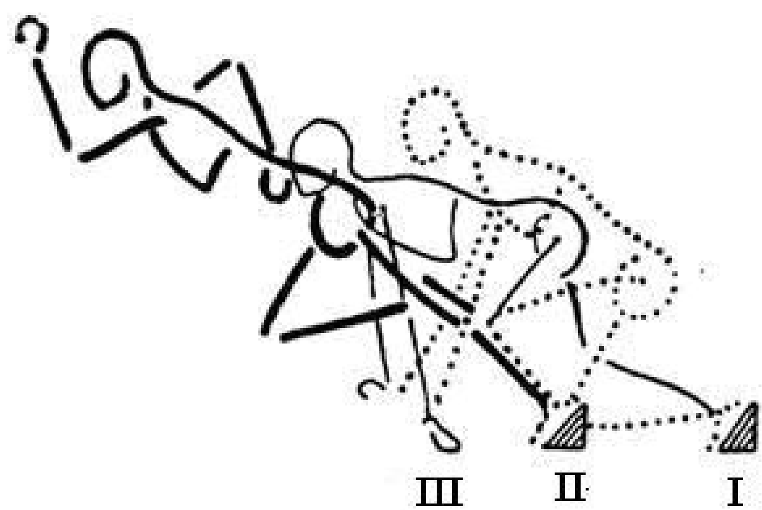

Figure 2: The successive staring phases for sprints: I "Ready", II –"Get set!"and III-"Go!"

From a biomechanical standpoint, the position that the runner assumes for the "Get set!" position is essential. One should not forget that, the actual start, the launch speed depends on the technique and its efficacy but, first of all, on the motor capacity of the runner. The optimal manifestation of the runner's force is directly influenced by the position he adopts during the "Ready!" stage. According to the laws of biomechanics, the whole attitude of the runner on the "Get ready!" command must allow a strong initial impulse and relatively long applied to both feet, which we'll act on the center of mass.

The position that the runner takes during the "Set!" stage is determined by the following elements: where the support points are, the upper torso position, the pelvis height.

When the “Set!” command is issued the soles are strongly fixed against the block-starters and only touch the running track with their tips. When the “Go!” signal is given, the gun fire, the runner has to act instantly with a sudden impulse effort. The hands will come off the ground, while the legs push against the block-starters.

A great importance for picking up speed on a short distance is wearing the right shoes, which have to provide: equal weight distribution on the 4 support points, arms and legs, a balanced and relaxed demeanor, an optimum motor angle in the knee joints, the possibility of a strong impulse for relatively small angle.

As part of the sprint events, the hurdles events set themselves apart with specific elements. Biomechanically, the difference is made by the dynamic effort required by the muscle groups which help the athlete jump the hurdle. Lifting the center of mass is realized, primarily, by the forward force of the attack leg and the arms oscillation. The leg that creates the impulse is put in motion by the muscle chain of the triple extension by contracting to “defeat”, which causes the body’s center of mass to move forward and. If using an appropriate technique, the maximum height must be achieved over the hurdle and the jump has to be as close to it as possible. While attacking the hurdle, the muscles that come into play are the thigh flexors which deploy a strong “defeat” contraction by lifting the entire leg [1,6,7], Fig.3.

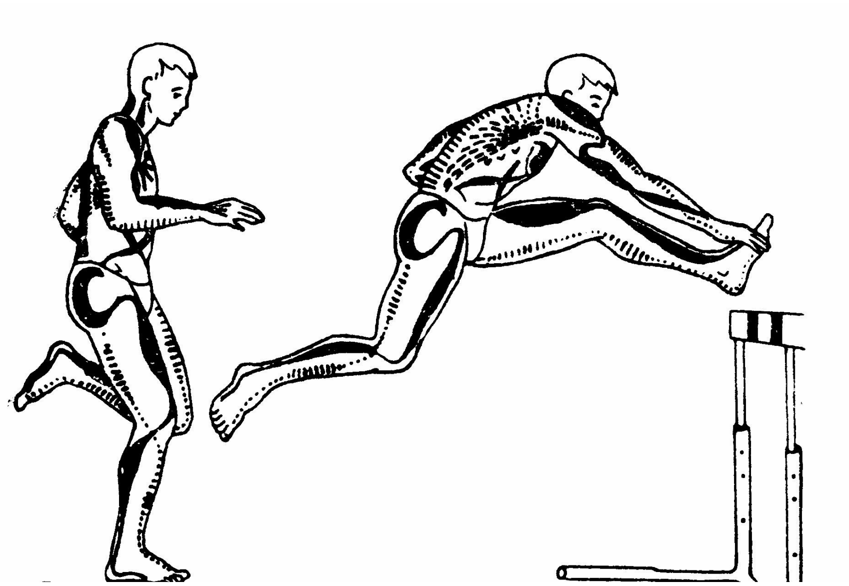

Figure 3: The hurdles event and the muscular chains that are involved

While jumping the hurdle, the impulse leg has to execute a combined movement of flexing the knee and lifting the thigh, followed by the flexing the thigh against the pelvis, to avoid the pelvis and to move the leg over it.

3. ORTHOPEDIC AND BIOMECHANICAL FEATURES FOR RUNNING SHOES FOR SPRINTS, MEDIUM AND LONG DISTANCES

Because of the high number of the athletic events and implicitly the number of different kind of shoes used in these events, we will refer to the general features of shoes for short, medium and long distances.

Staring with the start and then during running, a very important role is played by the functional features of shoes for running, the reasoning behind the different parameters and the shape of the shoe tree, the optimal construction of the shoe outside, a good wrap around the foot and easing the stress that’s being transmitted to the leg. Therefore, overall, running shoes for all distances have to be soft but enduring, to preserve its shape over time and be light. Athletics shoes are different as structure and design depending on the events they are intended for. Running for short distances is different than running for medium or long distances, because of the biomechanical features of the movement. More specific, the “flight” stage is shorter and ground contact is faster, while switching legs. Of great importance to getting good sprint results is, biomechanically speaking, the correct position of the starting leg, therefore the shoes the athlete is using.

That's why running shoes [3,4,5] should be made of elastic, light leather, 0.9-1.2 width for women and no more than 1.4mm for men. It's usually indicated to use cattle leather or goat leather, which are more resistant and more comfortable to wear. For some cases, there are being produced athletics shoes that are made of textile fabrics combined with leather or synthetic materials, but they are not meant for professional levels [5]. Compared to just normal shoes, running shoes the height of the top of the boot is 25mm to 40mm taller [4]. Running shoes shouldn't have a rigid tip, but the buttress is made of vinyl polychlorine, using die press forging, to make sure the shape of the heel is maintain during running. Classical velvet shoes, with the inside of leather, with the round instep, without a toe cap, and with a narrow buttress made of plastic is made on shoe trees that are 40mm tall at the heel. The height if the back top of the boot for medium and long distances must be less than for short distances running shoes [3]. The outside is the made same for all distances running shoes.

Particularly, the sole part of the shoe is very important, as it needs to insure the optimal conditions for the sole of the foot to move, especially metatarsals and toes, allowing it to move away from the support surface and cushion the landing after the "flight" stage. Running shoes must be flexible around the toes joints; this is done by specifically designing the soles for running. While running, the foot is mainly supported by the metatarsals and by the toes, that's why the shoes have to allow for the toes to flex freely. Considering the foot biomechanics while running, we reached the conclusion that the sole for running has to have two distinct parts [5]: a flexible part behind the toes joints (the heel and ankle) to allow for them to flex easily and a rigid sole in the front of the toes joints, which should help with the propulsion before the "flight". The flexible sole is made of leather and rubber micro porous, with good resistance and amortization. The front of the sole or the rigid soles are made of synthetic materials (vinyl polychlorine, polyamide, thermoplastic rubber) which are resistant to multiple bending, good amortizations and friction properties. The top of the sole will be covered in nails which insure a good adherence to the ground. This is what allows for a good start, makes it less likely for the shoes to slip and makes the running faster. The rigid part on the front of the shoe, must have the following characteristics [3,4]: good resistance to multiple shocks, very good friction properties, good anchoring in the block starters. The rigid sole on the front of the sole, is made through polyamide injection. The plastics used for special soles are vinyl ployclorine, thermoplastic rubber, polyamide and they offer optimal properties to the rigid soles for running. It's very important for the top of the sole to be very light.

A very big importance when designing rigid soles, the tops of the soles and athletics shoes has the anti slipping drawing and the way the nails are arranged. They have to make sure the foot is strongly planted on the support surface and also allow for the runner to accelerate. Also, the screws and the screw nuts play an important role. The shape the way the nails are built, their number and the way they are placed are the results of research studies and are enforced by rules; the way the nails are fixed must ensure adequate resistance and the possibility to be easily changed. Different examples are illustrated in Fig.4.

The international rule books ask for the use of only certain types of shoes, depending on the event. For example, the shoes for medium and long distance have to only have 7 nails, while the sprint shoes will only have 4 nails. In that regard, the sole is designed with nuts for mobile screws.

Among the different shoe makers the quality differences are determined by: the physical-chemical properties of the blends that make the soles, the screws, the quality of the materials used for screws and nuts and how light and resistant they are.

Considering that, after the flight stage, the foot comes in contact with the support surface, for a better cushioning if the shock, the back of the shoe will have a rubber detail with low density and 4-5mm thick.

Figure 4. Nail arrangement on the soles for running shoes

The tip and the toes part of the shoe for sprint shoes will have a plastic cover with 4 pins, and the ankle and heel part a sole with friction and cushioning properties, 4-5mm thick.

Considering that, by shortening the contact after the flight stage, there is a force that acts especially in the heel, the medium and long distance running shoes will have a rubber and plastic sole applied, thus insuring they will not break while running or during the start.

The heel portion is like a shim 8-10 mm thick. A great importance is placed on the shape of the stripes on the surface of the sole, which insures for good friction and nail support.

3.CONCLUSION

- Overall, running shoes for short, medium and long distances must be soft, enduring, the preserve its shape and as light as possible.
- The outside of the shoe is usually made of soft and elastic leather. The most used are cattle skins with velvet and goatskin. Sometimes, for intermediate performance levels, textile materials may be used.
- Running shoes should not have rigid tip, but the buttress is made of vinyl polychlorine using die press forging, to make sure the heel shape is preserved. Unlike normal shoes, the top of the boot is up to 25mm to 40mm taller.
- Running shoes must be very flexible around the toes; that's why the sole has two parts: a rigid and a flexible part, made of different materials.
- The number of nails, their placement and the way the nuts are placed id also very important.

5. REFERENCES

[1]. Iliescu A..(1975). Biomecanica exercitiilor fizice si sportului, Ed. Sport Turism.
[2]. Budescu E, Mihai E, Iacob R. (2004). *Determination of return coefficient in impact biomechanics with applications in sport*. Proceedings of 12-th International Congress on Physical Education and Sports, Komotini, Greece.
[3]. Komi P.V., Hyvarinen T.(2003). *Considerente biomecanice asupra forțelor de impact şi stabilitatea piciorului în alergare*, Rev. Sportverl-Sportschad Nr. 7, Berlin, p.23.
[4]. Haris C,Debeliss M,Adams K.J.(2003).*The effects of running apeed on the metabolic and mechanical energy costs of running.* Journal of Exercise Physiology, vol.6,nr.3-2003.
[5].Iatridis J.C., Iatridis C., Gwynn I.(2004).*Mechanisms for mechanical damage in the intervertebral disc annulus fibrosus*. Journal of Biomechanics, vol.37,nr.8-2004
[6]. Chan CW, Rudins A. (1994). *Foot biomechanics during walking and running*, Mayo Clinic Proc, 69 (5).
[7]. Shanthikeinnas S, Low Z, Falvey E. (2010).*The eefect of gait velocity on calcaneal balance at heelstrike;implications for orthotic prescription in injury prevention.* Gait Posture, 31 (1), 2010.

STUDY ON FOOT TYPOLOGY IN ORDER TO DESIGN SPORT SOCKS

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Abstract: This paper presents an identification of the foot typology and the distribution of the plantar pressure specific to each of its zones. Foot typology and plantar pressure distribution are achieved by plantar surface recording by means of a device that generates the sole print in a 2D format. The sole print provides useful information to improve sport sock sole. During motion, the foot shape changes and various areas are stressed at certain intensities. The pressure peaks are risk areas on the sole surface. These areas need protection to avoid the emergence of problems on the plantar surface. The sock protects the feet. Based on this information, the sport sock will be designed in such a way as to provide an optimal support to the foot type and to reduce the plantar pressure in risk areas. The intelligent design is to provide the sock sole with special areas that observe the anatomic characteristics of the foot and the specific stresses to which each area is submitted. Sport socks should ensure protection and the best conditions of physiological effort in order to improve athlete's performances. This foot measurement method enables an intelligent design of the sport sock. The aim of this design is to improve the construction and the functionality of the sport sock.

Key words: food typology, plantar pressure, design, sport sock.

1. INTRODUCTION

Athletes' feet are subject to great mechanical stresses that may cause various traumas. The sock acts as a barrier between foot and shoe, which provides protection by: motion control, foot temperature and fluid exchange optimization. Athletes should choose carefully shoes and socks, as an improper combination may be conducive to numerous problems.

During motion, feet are subject to friction and pressure. The foot is the support surface of the human body that absorbs shocks during physical activity. It needs higher protection mostly in the most stressed areas. The protection of these areas is made by means of socks with an intelligent design.

This design should be tailored to the foot typology and the plantar pressure distribution on various areas. The intelligent design of the sock should enable feet to breath and to eliminate sweat.

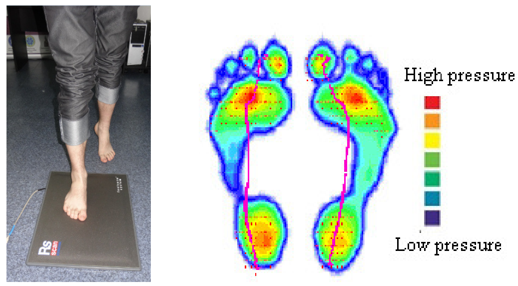
2. PLANTAR PRESSURE RECORDING

The determination of the foot typology and the distribution of the plantar pressure are achieved using a system called RSscan, which comprises a plate, a signal transformer connected to a PC and a special program called Footscan 7 Gait-2nd Generation. Using the program Footscan 7 Gait-2nd Generation a database is built comprising the subject's identification data and the performed measurements. After measurements, the plantar print results. This is a map with differentiated pressure values. For the analysis of the plantar pressure, the sole print may be achieved in dynamic condition (fig.1a).

The foot is divided into 10 significant areas on which various pressure values are recorded. The intensity of the plantar pressures is marked in a chromatic map (fig.1b).

Maximal pressure values are represented by orange and red, marking the risk areas. These areas are the most stressed areas of the plantar surface and require protection.

By scanning the plantar surface, the aim is to obtain an image of the plantar surface and the foot pressure values per areas. This foot measurement method serves as a basis for an intelligent design of the sock sole. The sock sole will be designed with special areas that would help reducing the plantar pressure by choosing accordingly the raw materials and the knitting structure for each area.

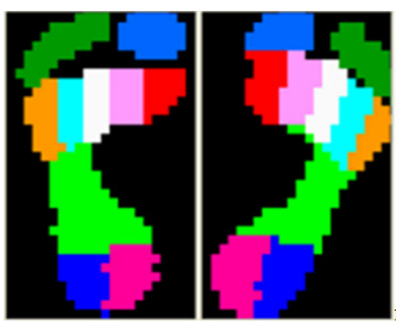


a) b)

Figure 1: Plantar pressures recorded conditions in: a) static; b) dinamyc; c) chromatic map

In order to determine the foot typology and the distribution of the plantar pressures, prints from 52 subjects were taken, out of whom 26 were female and 26 male, at ages from 20 to 30, and weights from 45 to 100 kg. The subjects' bare feet were measured in dynamic conditions, to obtain the plantar print. They were asked to walk at a normal pace on the plate, recording two separate measurements for the left foot and for the right foot, respectively. We made three pair of measurements for each subject. The plantar pressures were recorded for each foot area and the print was taken and exported at a real scale of 1:1.

The Footscan 7 Gait-2nd Generation system calculates automatically the pressure values for each foot area. The foot is divided into 10 areas (fig.2).



Z_1- toe 1
Z_2- from toe 2 to toe 5
Z_3- metatarsal 1
Z_4- metatarsal 2
Z_5- metatarsal 3
Z_6- metatarsal 4
Z_7- metatarsal 5
Z_8- median area of the foot
Z_9- outer heel area
Z_{10}- inner heel area

Figure 2: Planting zoning footprint

On these areas different pressure values are distributed, the means were calculated for each area, for males and females (tab.1).

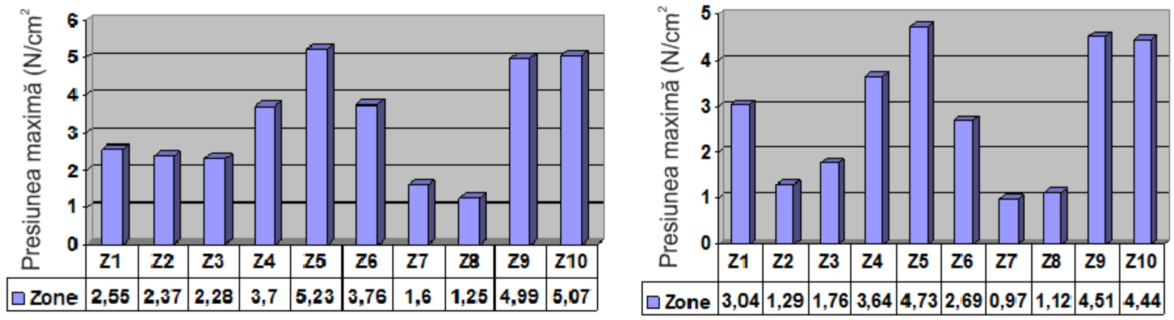
Tabel 1. Average values of maximal pressures for each foot area

Areas	Maximal pressure (N/cm^2)	
	Males	Females
Z_1	2.55	3.04
Z_2	2.37	1.29
Z_3	2.28	1.76
Z_4	3.70	3.64
Z_5	5.23	4.73
Z_6	3.76	2.69
Z_7	1.60	0.97
Z_8	1.25	1.12
Z_9	4.99	4.51
Z_{10}	5.07	4.44

Table 1 shows that the maximal pressure recorded for males is identified in the areas:
- metatarsals 2, 3,4: Z_4 = 3,70 N/cm^2, Z_5 =5,23 N/cm^2 şi Z_6 = 3,76 N/cm^2;
-: Z_9 = 4,99 N/cm^2 and Z_{10} =5,07 N/cm^2;

In females, the maximal recorded pressure is identified in the areas:
- great toe; Z_1 =3,04 N/cm^2 ;
- metatarsal area 2 and 3: Z_4=3,64 N/cm^2 and Z_5=4,73 N/cm^2;
- outer and inner heel area: Z_9 = 4,51N/cm^2 şi Z_{10} =4,44N/cm^2 ;

The plantar distribution in males and females is illustrated in the following charts:



a b

Figure 3: Distribution of mean values of plantar pressure on foot areas: a) males; b) females.

The maximal pressure recorded by the RSscan plate in motion is manifest both in males and females in the area of the 3rd metatarsal and on the entire heel. These areas are the most stressed and at risk.

3. FOOT TYPOLOGY

3.1. Calculation of the IB foot arch index

Socks should fit perfectly on the foot, observing its typology. Food typology is obtained based on the plantar print exported at a real scale 1:1 and manually processed by drawing the reference line. In the specialized literature, there are presented several calculation methods of the foot arch index. [1, 2] For the purposes of this study, we used the method of Udaya Bhaskara Rao and Benjamin Joseph (fig.4). [3] It presents the following particularity: the median of the plantar print coincides with the median of the foot arch. Plantar print in adults does not show this particularity.

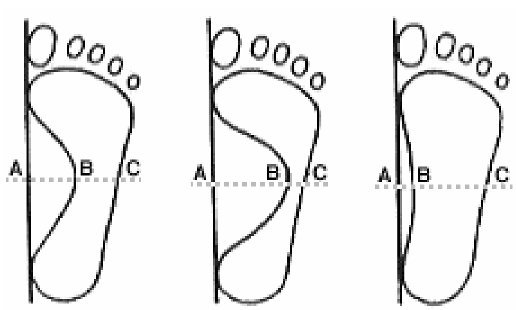


Figure 4: Method of Udaya Bhaskaro Rao and Benjamin Loseph [4]

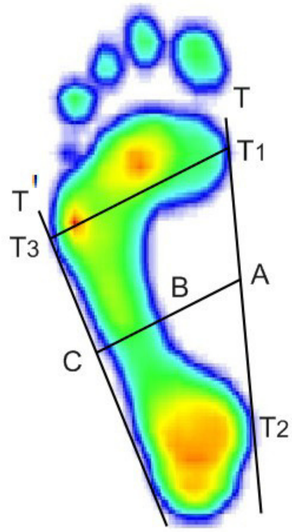
3.2. Method of graphic construction

3.2.1. Method I

Two tangents to the sole print sideways (T, T') were constructed, then the tangency points $\overline{T_1T_3}$ were united in the fore print area (fig.5). The mid line segment $\overline{T_1T_2}$ is given by point A, from which a parallel is driven to the line segment $\overline{T_1T_3}$. From the intersection of this parallel with the inner outline of the plantar print results the B point and the intersection with the outer outline the C point results. The line segment $\overline{BC}$ is located in the print median area.

The foot typology is given by the $\overline{BC}$ line segment length. The indices of the IB arch are calculated using the following relation:

IB= BC/AC*100%. **(1)**



where, $\overline{BC}$ - the line segment that intersects the outer outline of the print and the print outline in the arch area;

$\overline{AC}$ – line segment that intersects the outer print outline with the mid line segment $\overline{T_1T_2}$.

Figure 5: Method I. Plantar print – reference lines

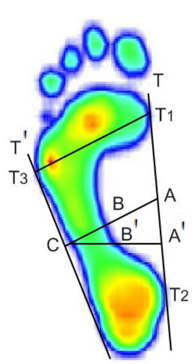
Based on this construction (method I), feet are classified according to the value of the IB arch index within a certain limit range:

- IB□ 40%, high-arched foot (PS);
- IB=[40-60]%, normal foot (PN);
- IB□60%, flatfoot (PP). [4]

3.1.1 Method II

The method II coincides with the method I up to drawing the $\overline{AC}$ line segment. According to this method from point C (fig.6) a perpendicular was drawn to the tangent T, which it intersects in point A'. The intersection of the perpendicular with the inner plantar print outline is the point B'. This construction enables the calculation of the IB plantar arch index calculation, as follows:

IB= B'C/AC'*100%, **(2)**



where, $\overline{B'C}$ - the line segment that intersects the outer print outline and the arch print outline;

$\overline{A'C}$ – line segment that intersects the outer print outline and the mid line segment $\overline{T_1T_2}$.

Figure 6: Method II. Plant print – reference lines

Likewise, in the case of the construction according to method II, the typological classification of foot depending on IB is made respecting the same limits as in method I.

4. RESULTS AND DISCUSSIONS

The achieved results by both methods are centralized in table 2.

Tabel 2. Classification of the foot type depending on the value of the IB arch index value, for males and females, using both methods

Foot type	CSI index variation (%)	Method I				Method I			
		Males		Females		Males		Females	
		Left foot	Right foot	Left foot	Right foot	Left foot	Right foot	Left foot	Right foot
High-arch (PS)	□ [0, 40]	17	18	12	14	8	9	7	6
Normal (PN)	[40-60]	8	8	8	7	17	16	10	8
Flat (PP)	□ [60]	1	0	6	5	1	1	9	12

Each table is numbered and table captions are in TNR 10 pt, placed above the table, centered and has the following style.

The values of the IB arch index in both methods differ. This difference is justified by the position of the point B' from method II (fig.6) compared to the position of point B from method I (fig. 5). The more the point B' is closer to the heel, the larger the IB arch index. This deviation does not affect in a major way the classification of the sole print according to foot type.

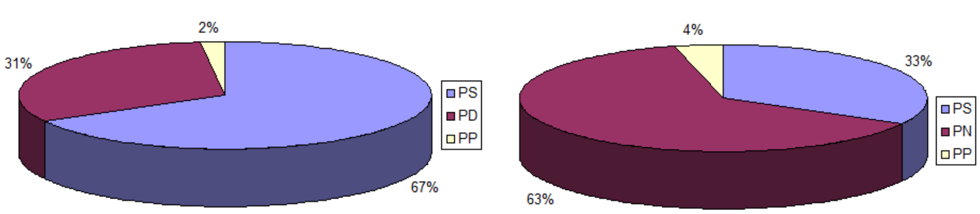
According to table 2, there are differences between the left foot and the right one for each group of subjects, and they are within the normal limits.

In table 3 the total number of feet of each group of subjects for both methods are centralized.

Table 3: Centralized total number of feet of each group of subjects for both methods

Foot type	Method I		Method II	
	Males (SD)	Females (SD)	Males (SD)	Females (SD)
High-arch (PS)	**35**	**17**	**26**	**13**
Normal (PN)	**16**	**33**	**15**	**18**
Flat (PP)	**1**	**2**	**11**	**21**

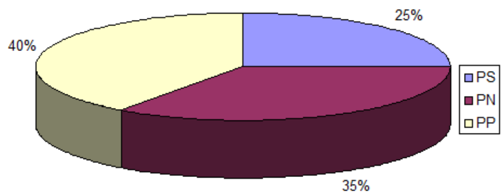
At the calculation method I of the IB arch index for the male group, there are found: 67% high-arch foot subjects, 31% normal foot subjects, 2% flatfoot subjects, and for the female group: 33% high-arch foot subjects, 63% normal foot subjects, 4% flatfoot subjects.



a b

Figure 7: Percentual distribution of the foot type depending on the value of the IB arch index value - males and females (method I)

At the calculation method II of the IB arch index for the male group, there are found: 50% high-arch foot subjects, 29% normal foot subjects, 21% flatfoot subjects, and for the female group: 25% high-arch foot subjects, 35% normal foot subjects, 40% flatfoot subjects.



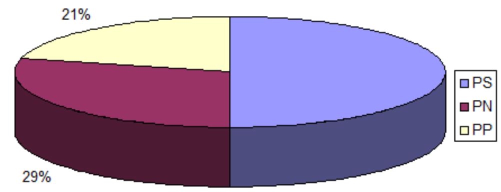


Figure 7: Percentual distribution of the foot type depending on the value of the IB arch index value (method II)

Further to the calculation of the food arch index by the two methods, the foot typology was obtained. This information is necessary to design sport socks. In males, between the two calculation methods of the foot arch index, there is a percentual difference between flat and high-arch feet and in females between normal and flatfeet. This difference does not concern the sock design, but is used for the purposes of obtaining the foot typology.

5.CONCLUSIONS

By recording the plantar surface, our aim is to obtain the distribution of the plantar pressures and the foot typology. This information is needed as a basis in designing appropriate sport socks for each type of foot. The socks will have special areas in which raw materials and the knitting structure will be appropiate for each sole area. The role of these areas is to help reducing the sole plantar pressure.

This foot measurement method enables an intelligent design of the sport sock. The aim of this design is to improve the construction and the functionality of the sport sock.

Acknowledgement
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6. REFERENCES

[1]. Pinto, A., Sainto, E., etc. (2011). Footprint study in children during the jack test, Acta Ortop Bras Vol. 19(3), ISSN 125-8.
[2]. Thesis: Paştină, M.(2012). Contrinuții la modelarea 3D și prototiparea rapidă a încălțămintei profilactice destinate persoanelor cu nevoi speciale.
[3]. Bhaskara, R., U., Joseph, B., The influence of footwear on the prelevance of flat foot, British Editorial Society of Bone and Joint Surgery, Vol. 74-B, Nr. 4 Jully, 1992, Kastura Medical College, Manipal, India, ISSN 525-7.
[4]. Mihai, A., Paştină, M. Classification of foot types, based ou plantar foot prints, Proccedings *of the 47h International conference ICAMS 2012*, Advanced materials and systems, pp. 347-352, ISSN: 2068-0783, September 27th-29th 2012, Bucharest, România.
[5]. Ciobanu,C., Penciuc,M. and Budulan C.: ATHLETIC SOCKS*,* vol. *CORTEP 2012,* Ed. Performantica, pag. 314-319, ISBN 978-973-730-962-4, *International Conference CORTEP 2012 - 14th Romanian Textiles and Leather,* Sinaia, România.
[6]. Mălureanu, G., & Mihai, A. *Bazele proiectării încălțămintei,* ISBN Ed. Performantica, Iaşi, 2006

THE ALTERNATIVE CORELDRAWINGS AN IDEAL SOLUTION FOR DESIGNERS, IN EMBROIDERY

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Abstract: The machine beaded appearance coincides with the first sewing machine mechanical America sold out in the best-known company of sewing machines in the world: The singer Company in the year 1863. [1] The first machine beaded computer-assisted has been constructed by Wilcom in 1980. After 1990, developments in microprocessors allowed that all types of mechanical machines beaded to turn to digital machines beaded. These machines use digital designs. [2] Developments in digital beaded machines allowed customization industrial products made in series. The raw material that is most important is a digital drawing. List of most important brands is high. [3] Taking into account the number of large editors for embroidery it is almost impossible for a designer to know CAD design for all text editors. This is a problem both for designers but also for producers. A practical solution for designers is CorelDrawings what offers the convenience of design specific vector graphic-designers. [4] Automatic conversion of the vector, the library with textures, simulate embroideries and save specific formats great brands make CorelDrawings a practical alternative. Designer can focus on specific problems without using a large number of editors for each brand. We approached a drawing of the logo to demonstrate practical capabilities. [5] Drawing digital was saved in a format and open industrial professional editor Wilcom Designer. [6] Export to grid format may allow analysis and discussions with the customer before it has been transposed into production.

Key words: embroidery, Corel Drawings, software, design, draws

1. INTRODUCTION

Almost all modern embroidery machines are computer controlled. The appearance coincides with the first embroidery machine sewing machine mechanic sold in America by Isaac Merrit Singer and Edward Clark in 1851 by company IM Singer & Co.. What is the most famous sewing machine company in the world: The Singer Company in 1863. [1] Besides lockstitch seam binding that uses 2 wire sewing machines could be used to make linear designs embroidery designs or zigzag if the material was moved manually with a tambour.

The best known example is probably the ornamental pocket with the symbol "V" of his trousers "Levi Strauss' in 1853, carry out his pants industrial with the aid of sewing machines Singer. The first machine beaded computer-assisted has been constructed by Wilcom in 1980. After 1990, developments in microprocessors allowed that all types of mechanical machines beaded to turn to digital machines, from industrial machines domestic. These machines use digital designs. [2]

2. EMBROIDERY SOFTWARE

To make us an idea on the development of the machinery and it is enough to remember the list of the most important brands: Baby Lock, Barudan, Bernina, brother, Bruda, Compucon Eos, Elna, Gross, happy, Husquarna, Inbro, Janome, Kenmore, Marco Meistergram, Melco, Pfaff, Renaisance, Schiffli, Singer, SWF, Tajima, Toyota, Ultramatic, Zangs, ZSK, Wilcom.

If we take into account the fact that each producer has developed a large number of models and versions we'll have a digital image on variety of models for which designer creates drawings. [3]

Manufacturers of beaded machines have developed software for design depending on the characteristics of machines but have occurred and software manufacturers, independent, specialized in embroidery.

The list software-remembered however for embroidery is great, and further enhanced by versions that may occur over time is growing: Wings XP, WINgs 2000, Barudan Punchant Pro, Wilcom Sirius ES-65, Compucon EOS, APS-Ethos, Pulse Signature 2000, Intellistitch, Stitch 2000, Brother BE-100, Wilcom PET, Origins, Autodigitizing, Bernina Artista, PE-Design, Janome Digitizer 2000, Melco DesignShop, Sierra Embroidery Office Suite, Husqvarna System 5, Husqvarna System VIP, Buzz Tools, Embird, SmartSizer Gold, SizeExpress, Tajima DG/ML, Pulse, Compucon EOS, Barudan TES, ApS-Ethos, Dacota, ZSK EPCWin, DELTA Embroidery Systems, Corel DRAWings.

3. ALTERNATIVE COREL DRAWINGS, A SOLUTION FOR DESIGNERS

As compared with the other techniques of decoration, and machines to produce beaded decoration of textile fibers and yarns are much more compatible with textile product. It sat intently at work technique is capable of customizing products made industrial, marking of the products with the largest producer and artistic appearance to the diversification of the product.

In any of the situations above needlework will occupy an important role but at a cost than in the price of the product. In any of the situations above needlework will occupy an important role but at a cost than in the price of the product. In the case of textile products with frequent changes of shape, color and garnishes, drawing artistic becomes raw material needs to login as a industrial techniques.

In addition to technical staff, beaded machine also needs to have a person carries in the drawings, the latter being designer. His role is to create drawings for machine beaded in accordance with the technical specifications, to contribute for the economic efficiency of production.

Taking into account the large number of the drawings linker the embroidery it is almost impossible for a designer to know CAD design for all text editors.

This is a problem for both designers but also for producers. Even if designers and producers to come to an agreement in respect of design, when it comes to a matter of transposition in a digital format always problems arise.

Having regard to the experience of working with a large number of editors in embroidery and the feeling of insecurity that I had when the program is changed depending on the machine manufacturer's we've been looking for an alternative in addressing the design in embroidery.

It is well known that the draft graphic-design are often carried out in CorelDraw, a vector graphics program. Problem known as the embroidery designers to use a large number of industrial programs, the manufacturer of dedicated software graphic-design has purchased a program of embroidery which it has adapted to the requirements designers.

An alternative proposed by the company CorelDraw for embroidery is called CorelDrawings and is a practical solution for editing designs for embroidery in a specific manner. Graphic designers and digitize designs in industrial format professional for all machine types of beaded [4]

CorelDrawings shall be installed on the computer after the program was installed CorelDraw Vector graphics. When the program is started the embroidery will be launched CorelDraw application in a specified frame and the embroidery editor in another framework.

The designer will cover drawing for embroidery under the conditions known, routine, as graphic-designer and when they want to view the drawing in specific module embroideries will change the window by Stitch mode.

Corel drawings will turn to automatically vector drawing of specific format CoreDraw embroideries. In this mode designer has access to specific tools and textures embroideries and a visual truthful simulation

The advantage of the program is sure that shall make available to a designer graphic work environment known give the latter the opportunity to focus on artistic creation. Once the design has been carried out it can be dealt with by specific technical aspects embroideries.

The purpose of this article is to propose designers and producers of alternative embroidery work effectively.

The manufacturer shall have the right to expanding the possibilities of design with CorelDraw and CorelDrawings beside the machine specific editor, featuring portability to all machine types of beaded.

4. CARRYING OUT THE EMBROIDERY DESIGN

To exemplify capabilities as well as Corel drawings, we have covered a design model of the logo, in the present case the logo University of Oradea.

The best results are obtained from the analysis of a vector-based file with Customer's logo. In the case when this format is not available the only solution is to go from an image grid logo, preferably with a resolution as high as possible.

The image is imported into grid CorelDrawings and this is not far from drawing can address the embroidery. CorelDraw is recognized for processing capabilities Vector graphics and raster, a big advantage over many editors of industrial embroidery. The Image raster logo shall be vectorized with Powertrace resulting in a vector-based drawing in sufficient detail. I recommend delete file raster after vectorize combine in as far as it will provide better results in vector mode (figure 1).

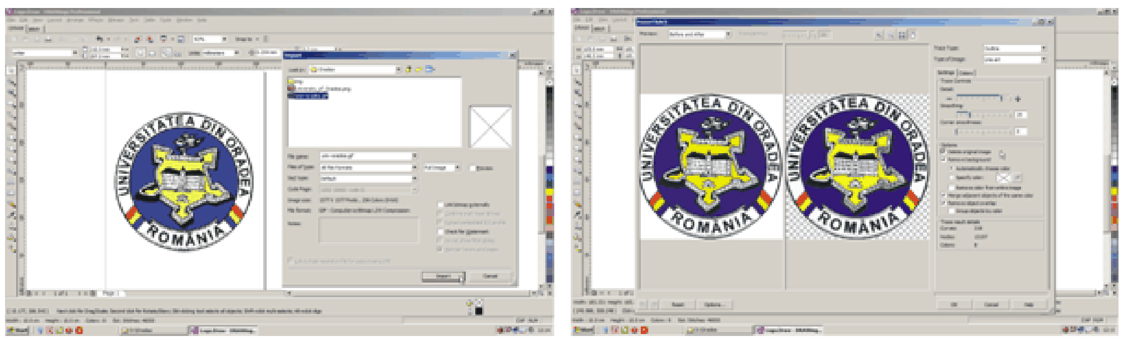

Figure 1: Import images mode grid and vector of the design

Vector Group of objects results need small changes and corrections of lines and polygons because drawing to become perfectly from the point of view graph. This step is a specific artists and is always be dealt with personally.

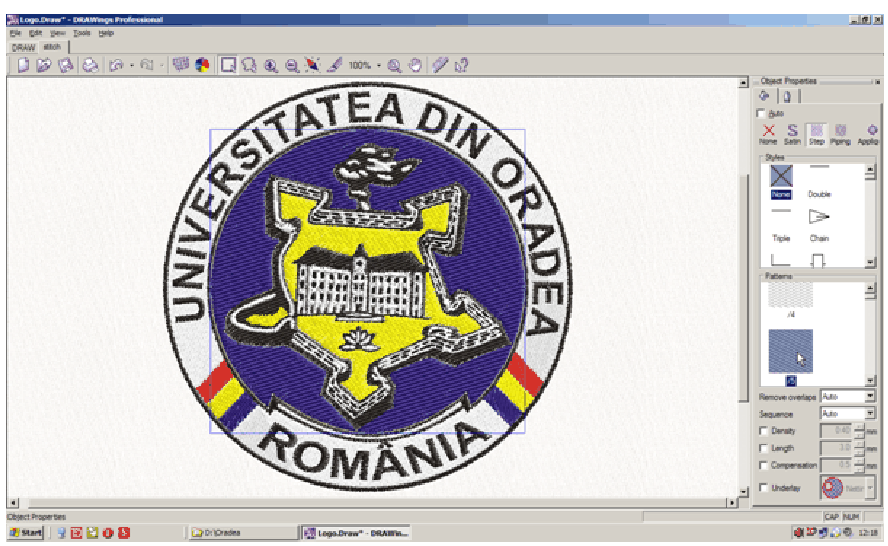

Figure 2: Simulate drawing in the framework stitch

When the vector drawing logo is ready can be used to switch to the step for simulation of the design using the window stitch. Logo will be displayed in simulation mode embroidery, to actual dimensions required by the customer (figure 2).

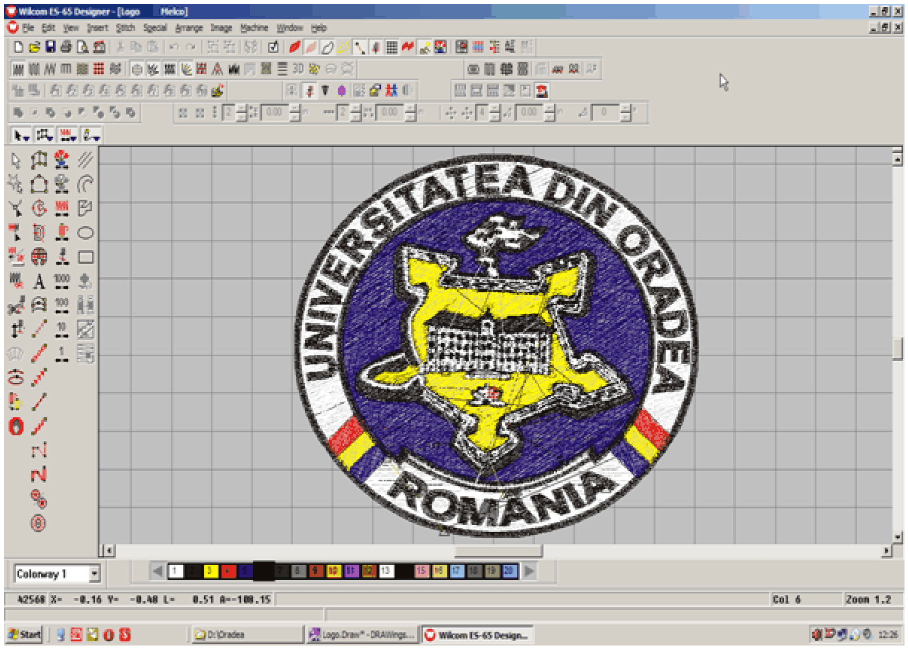

Figure 3: The drawing is open with an industrial program – Wilcom Designer

This step may determine the type of textures of the surface, the orientation models to obtain the most advantageous aspects of light and shade, the color of wire and fabric support. At this time any specification of customer may also consist in accordance with the machine's technical data of the wide-awake.

The result designer can be saved in proprietary format with the extension .draw but also in the best-known digital formats specific beaded machines: Wings Systems (.NGS), Tajima (.DST, .DSZ, .DSB), SWF (.SST), Pfaff (.KSM, .PCS, .PSM), Happy (.TAP), Melco expanded (.EXP), Brother/Baby Lock/Bernina (.PEC, .PES), Husqvarna (.HUS), Husqvarna Viking (.VIP), Viking Designer (.SHV), Janome (.JEF, . SEW), Juki (.M3), Toyota (.100), Mitshubishi HD, Barudan. [5]

The result of this digital logo has been saved in a digital format industrial and open with a program industrial, in the example Wilcom Designer. At this stage it is possible to edit various specific aspects Wilcom machinery (figure 3).[6]

Figure 4: The embroidery design simulation for discussion with the beneficiary

An advantage of this program graphic the embroidery is export to grid format that can be viewed on any computer without the embroidery software installed or it may be printed for discussions with the customer before being transposed in production (figure 4).

5. CONCLUSIONS

1. CorelDrawings is an alternative efficient designer serving digital beaded machines. The work environment specific vector CorelDraw allows better focus on design. Designer is protected by stress uses a large number of editors specific industrial beaded machines. The program does not replace industrial editors but on the contrary they are completed.

2. CorelDrawings is a shell that installs over CorelDraw graphics and exploits its resources. Tools Corel promotes artistic quality of the embroidery designs.

3. CorelDrawings is easy to use and offers compatibility with almost all digital formats of beaded machines.

4. Almost any type of image can be imported and converted to the embroidery design for any type of machine for beaded.

5. It sat intently at work by simulating designs can be analyzed before to enter into production.

6. The manufacturer may extend the work stations in the department of design to ensure a variety of drawings for any type of machine for beaded.

6. REFERENCES

[1]. Singer Corporation (2013). *Available from:* http://en.wikipedia.org/wiki/Singer_Corporation, *Accessed: 20/04/2013.*

[2]. Machine embroidery, (2013). *Available from:* http://en.wikipedia.org/wiki/Machine_embroidery, *Accessed: 20/04/2013.*

[3]. Computerized embroidery (2013). *Available from:* http://edutechwiki.unige.ch/en/Computerized_embroidery, *Accessed: 20/04/2013.*

[4]. CorelDrawings (2013). *Available from:* http://apps.corel.com/int/au/dwx3.html, *Accessed: 20/04/2013.*

[5]. Creative DRAWings 6 Embroidery Digitizing Software (2013). *Available from:* http://creativenotions.co.za/digitizing-embroidery-software/creative-drawings_6/, *Accessed: 20/04/2013.*

[6]. Wilcom (2013). *Available from:* http://www.wilcom.com/Products/EmbroideryStudio.aspx, *Accessed: 20/04/2013.*

STUDY OF THE PARTICULARITIES OF DESIGNING PRODUCTS FOR MEN WITH STRONGLY DEVELOPED MUSCULAR SYSTEM

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Abstract: This work represents the results of a study aimed at the identification of constructive particularities of a specific target group of wearers – men with strongly developed muscular system. The problem has been contoured based on the industrial production systems are aimed exclusively to the elaboration of products for standardized bodies, regulated by the applicable dimensional typology. Therefore, the study considered the aspects of anthropomorphological structure of body with a strongly developed muscular system, with identification of body areas with significant deviations from the dimensions and shape of common type body. The presence of significant deviations from the conformance types implies the identification of areas with deviations that must be taken into account for providing dimensional and shape compliance. It was proposed to adapt the contours of basic types of jackets and trousers for men to the specific deviations of wearers' bodies with strongly developed muscular system elaborated based on the etalon parameters imposed by bodybuilding. It was decided to examine the methods of harmonization in order to elaborate products capable of harmonizing the external appearance of wearers from the selected target group. The harmonization criteria were chosen so as to express the proportions of the body-builders, as well as the legalities of proportioning applied to the design of garments. In the result of the study there was elaborated a system of new suit-type products for men with strongly developed muscular system.

Key words: body-building, strongly developed muscular system, deviations from the common type body.

1. INTRODUCTION

The initial information necessary for the constructive design of new models of products is taken from the normative acts applicable for some time intervals in well-determined territories, reflecting the anthropomorphogical particularities of target population for which the garments were produced at industrial scale. The garments produced in industrial system for the wearers with deviations of posture silhouette, proportions or conformance is generally characterized by defects of on-body positioning, these being caused by incompatibility of shapes and dimensions of products with the wearers' bodies. These aspects affect the values of anthropometric compliance not only in static conditions, but in dynamics as well, lacking at the same time the aesthetic properties. For these reasons the products are transferred into the category of incompliant ones, characterized by long stagnation periods in commercial networks.

Similar problems are faced by the men practicing bodybuilding and other sports resulting in considerable growth of muscular mass all over the wearers' bodies. In this case considerable deviations from the standard dimensional characteristics occur. First of all they affect the maximum body perimeter and the perimeter of superior and inferior members. Therefore, this category of wearers is imposed to limit their wardrobe to the sports-style products manufactured of extensible materials capable of covering the oversized areas and preserving the necessary degree of adjustment narrower parts of body.

2. THEORETICAL ASPECTS

Contemporary bodybuilding is rooted deep in the ancient ages, in the times of Aristotle who promoted physical exercises aimed at development of certain muscle groups in order to outline the beauty of human body.

Bodybuilding evolved significantly by the end of 19th century when weight lifting competitions became popular.

The founder of modern bodybuilding is Eugen Sandow – the doctor who elaborated muscle system development programs promoted as body education systems.

The period of 1940 and 1970 is considered as a „golden age" of bodybuilding owing to the changes that appeared in the proclaimed physical ideals. Since that time the bodybuilders tend to increase their muscular mass, to have well-contoured, symmetric and harmonically developed muscles [1].

Nowadays one may observe the increasing interest for natural bodybuilding promoting the development of muscular system without administration of medical drugs.

The evolution of external appearance of bodybuilders is shown on the figure 1.

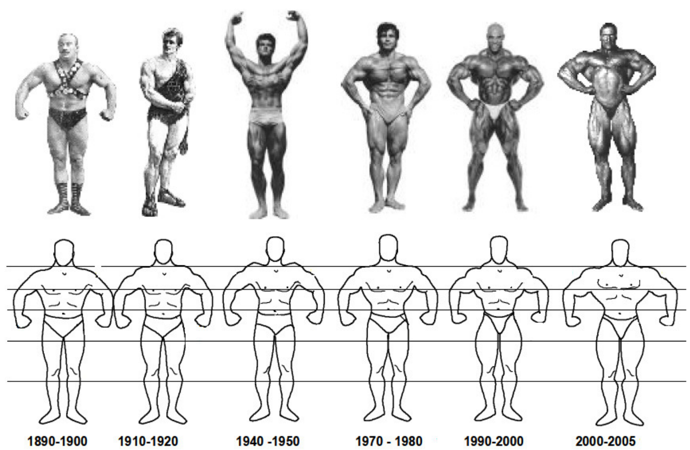

Figure 1: Historical evolution of body shapes of bodybuilders.

From the morphological point of view the body of a bodybuilder may be described by total indicators that do not fit in traditional limits. The differences of external appearance of body shape are owed to the physical effort exerted for the development of separate muscle groups. Hence, special attention is paid to the following muscle groups: forearm muscles, deltoid muscle, biceps, pectoral muscles, trapezoids, large dorsal, striated and smooth body muscles, straight abdominal muscles, anterior and posterior femoral muscles, hip muscles.

The degree of development of muscle groups that may be attained by the sportsmen depends on the heredity factors and on the morphological type of body by bone and muscular system. Three major morphological conformance types may be distinguished [2]:

- *Ectomorphic* type – characterized by thin bones, elongated muscles. The muscular mass is attained with difficulties, the relief is obtained easily, the muscle groups are easily separated and vascularized.
- Mesomorphic type – characterized by wide shoulders and back, narrow waist, the muscular system is easily developed.
- Endomorphic type – characterized by thick bones and articulations, sportsmen of this conformance type easily increase their muscular mass and are capable of withstanding significant physical efforts; the muscle groups are separated and vascularized with difficulties.

Notwithstanding the belonging to any conformance type, the bodybuilders' bodies are characterized by common external features, such as [3]:

- ✓ Wide neck, sometimes of medium to large size, with clearly outlined trapezoid muscles, with shoulder muscles in relief;
- ✓ Cone-shaped body with the small end pointing downwards, strongly developed chest muscles, abdominal muscles with relief, narrow hips without exaggerated muscular development;
- ✓ Wide back with clearly outlined muscles, especially the large dorsal muscle, long legs with proportionally developed muscles.

The specialty literature contains attempts to establish etalon values for the individual performance assessment of bodybuilders. In this work the generalized anthropometric parameters of Joe Weider are used as a reference (Table 1).

Table 1: Anthropometric parameters of proportional bodybuilders by Joe Weider [4]

Body height, cm	Body weight, kg	Axial perimeter of arm, cm	Perimeter of neck, cm	Perimeter of bust, cm	Perimeter of waist, cm	Perimeter of hip, cm	Perimeter of biceps, cm
152,5	58,5	38,0	38,0	101,0	67,5	53,0	37,0
157,0	63,5	39,5	39,0	104,5	70,0	55,5	38,0
162,5	70,5	40,5	40,5	111,0	76,0	57,0	39,5
167,0	79,0	42,0	42,0	116,5	78,5	58,5	40,0
172,0	83,5	43,0	43,0	118,0	80,0	59,5	40,5
177,0	90,0	44,0	44,0	121,5	82,5	62,2	41,5
183,0	95,0	45,0	44,5	124,0	84,0	63,5	42,5
188,0	99,0	46,0	46,0	127,0	85,0	65,0	43,0

3. EXPERIMENTAL RESEARCH

3.1 Methods of adapting the basic templates to the anthropomorphological particularities of wearers with strongly developed muscular system

In order to obtain casual products adequately positioned on bodybuilders' bodies one may use the basic templates for the common-type bodies with certain amendments introduced in accordance with their anthropomorphogical particularities [5, 6].

The experimental research included works aimed at adapting the shapes and dimensions of support surfaces of jacket-type products and trousers to the anthropomorphological particularities of wearers covered by the study. The following changes were made to the basic templates in order to comply with the particularities of wearers' bodies:

- For bodies with strongly developed muscular system in the areas of back and bust;
- For bodies with strongly developed muscular system of shoulders and neck;
- For bodies with wide back and hips and narrow waist;
- For bodies with narrow hips and waist, prominent gluteus muscles and developed thighs.

Further-on we will present the contours of main templates after adaptation to the particularities of masculine bodies with strongly developed muscular system in the back and bust zones.

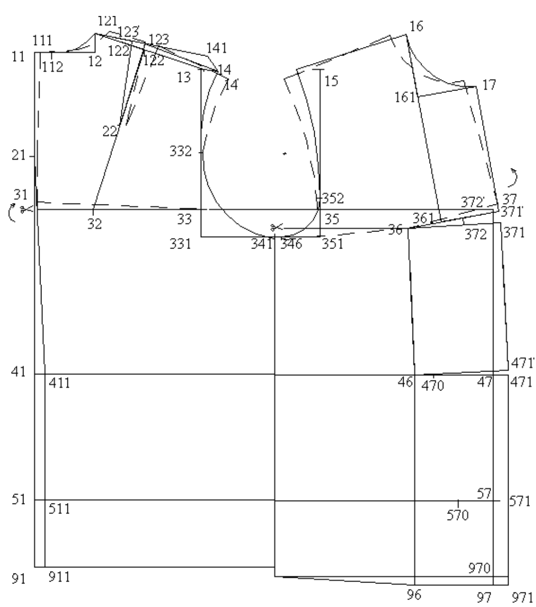

Figure 2: Main templates after adaptation to the particularities of masculine bodies with strongly developed muscular system in the back and bust zones.

3.2 Elaboration of new models of products using the procedures of harmonizing the external appearance of wearers

The masculine bodies with difference between bust and waist perimeter exceeding 20 cm is referred to the category of athletic ones. Certain procedures of harmonizing the external appearance of products are necessary for the proper elaboration of new models.

Products of semi-adjusted silhouette are recommended for balancing the dimensions of thorax and pelvis. The voluminous shoulder zone and thorax impose the use of shoulder lines of natural lengths, with pads attenuating the relief of developed muscles. Collars with wide reverses will be perceived harmonically, as well as central closing systems with one or two columns of buttons located at 2-3 levels. In such cases it is recommended to use flap pockets or applied pockets, as they visually increase the shoulder zone. The exaggerated dimensions in transversal direction of thorax may be balanced by optical illusion elements, as well as by the longitudinal division lines and fabric with vertical line pattern etc.

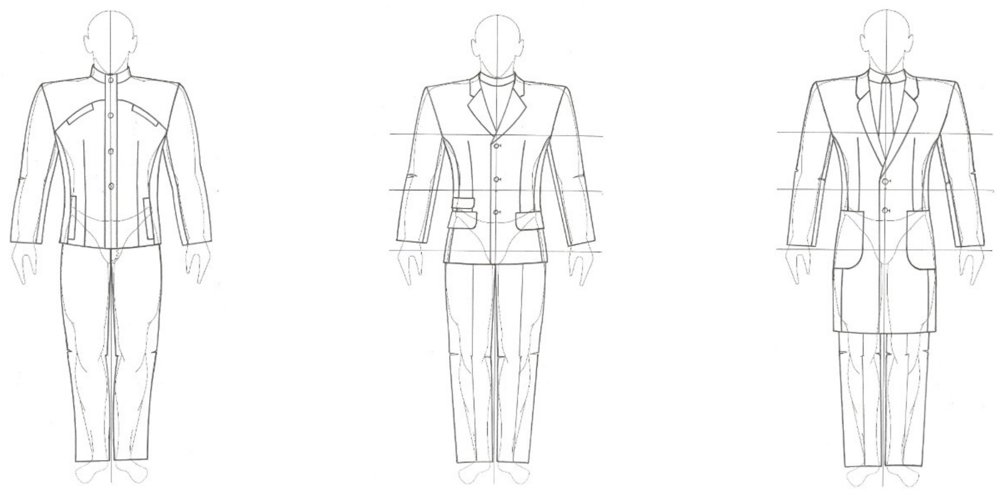

Figure 3: New models of suits for men with strongly developed muscular system

4. CONCLUSIONS

The enterprises manufacturing classical garments for men are permanently seeking for uncovered segments of wearers in order to increase production outputs. For the time being, the appearance of these groups of wearers is owed to the several social processes, such as promotion of healthy lifestyle that can not be imagined without significant physical activity resulting in significant changes to the global morphological parameters, such as proportion, posture and conformance. The anthropomorphogical transformations noticed in the bodies of bodybuilders allow to separate a target group of wearers, a new segment of consumers not yet covered by classical clothing offers.

5. REFERENCES

[1]. Dumitrescu, R. (2008). Culturism-fitness I. Fundamente teoretice şi practico-metodice. Editura Universității din Bucureşti, ISBN: 978-973-737-491-2, Bucureşti.

[2]. Антонович, С. (2012). *Титаны массы.* Издательство: АС Медиа Гранд, Москва.

[3]. Чурилин, В.А., Чурилин, Ю.А., Пимченков, М.С., Яичников, Ю.А. (1991). *Культуризм для всех.* Издательство: Полисет: Совэкспорткнига, ISBN: 5858440010, Москва.

[4]. Вейдер, Д. (1992). *Система строительства тела.* Издательство: Физкультура и спорт, Москва.

[5]. Фиш, Р.П. (1991). *Конструирование мужской одежды на фигуры с отклонениями.* Издательство: Легкая промышленность, Москва.

[6]. Воронин, М.Л. (1985). *Конструирование и изготовление мужской верхней одежды беспримерочным методом.* Издательство: Техніка, Киев.

EXTENSIVE KNOWLEDGE IN FASHION TRENDS FOR SPRING/SUMMER 2013

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Abstract: Globally there is mobility market and a manufacturers orientation to innovative products of small series or personalized. Adaptability and compliance with these fashion trends subordinate to client requirements is the key to developing big consumer brands known worldwide. Product design and development based extensive knowledge in fashion trends are extremely important capabilities for companies in the garment industry. Aligning economic agents to flexibility, mobility and speed of change in these trends and fashion orientation to custom design that meets customer requirements is the basic condition for the success of a company producing garments. Every season brings new fashion trends that make us capable to slip into different wrappers and to permanently redefine ourselves. Trend books presents new directions in fashion, specific to a given season, grouped into a several main themes. Spring/Summer 2013 trends focus on originality and functionality. We notice unexpected prints which accentuate our fantasies, exclusive silhouettes that convey an obvious simplicity, clothes influenced by technical developments, lots of colours, textured fabrics and re-adapted shapes. Spring/summer 2013 season comes with colors, prints, simple lines and new technologies resumed in four main themes: Magic Colors - a colorful casual style, Sheer Mood - a theme based on clear lines, simple shape and details that are ingeniously integrated, Print Mania - the freedom of designers in creating their own fabrics led to a trend in which prints are the main topic. The last theme is African Spirit and it is a romantic safari style with tribal elements.

Key words: Fashion, trends, knowledge, style

2. INTRODUCTION

Fashion is a general term for a popular style or practice, especially in clothing, footwear, accessories, makeup, or furniture. It refers to a distinctive, however, often-habitual trend in a look and dress up of a person, as well as to prevailing styles in behavior, and it has the power to transform an image and make a social statement. [1]

In the world of continue changing, fashion remains the constant that drives us to creativity. Fashion products are a successful mix of knowledge, talent, innovation and creativity.

"Fashion" usually is the newest creations made by designers and are bought by only a few numbers of people; however, often those "fashions" are translated into more established trends. [2] A trend is a general direction in which something is developing or changing. Research and synthesize these trends is a specialized advanced information tool, easily accessible to retail firms, necessary in support and development activities and product innovations.

Globally there is mobility market and a manufacturers orientation to innovative products of small series or personalized. [3] Adaptability and compliance with these fashion trends subordinate to client requirements is the key to developing big consumer brands known worldwide. Product design and development based extensive knowledge in fashion trends are extremely important capabilities for companies in the garment industry. Aligning economic agents to flexibility, mobility and speed of change in these trends and fashion orientation to custom design that meets customer requirements is the basic condition for the success of a company producing garments. Every season brings new fashion trends that make us capable to slip into different wrappers and to permanently redefine ourselves. [4] Trend books presents new directions in fashion, specific to a given season, grouped into a several main themes.

3. GENERAL INFORMATION

Spring/Summer 2013 trends focus on originality and functionality. The season sees a social trend become a more personal undertaking in the interpretation of surroundings which provides motivation to be artistic and fearlessly push boundaries to depart from the norm and put across a personal point of view in a world of many voices. We notice unexpected prints which accentuate our fantasies, exclusive silhouettes that convey an obvious simplicity, clothes influenced by technical developments, lots of colours, textured fabrics and re-adapted shapes.

The palette of fashionable colors spring/summer 2013 promises bright collection of clothing with a truly summer mood. The theme of modern conflict between man and nature was used as the main inspiration for its creation. A nude palette of beige and grey in contrast with bright colors: blue, red, neon, yellow, purple.

4. MAJOR THEMES

Spring/summer 2013 season comes with colors, prints, simple lines and new technologies resumed in four main themes: Magic Colors - a colorful casual style, Sheer Mood - a theme based on clear lines, simple shape and details that are ingeniously integrated, Print Mania - the freedom of designers in creating their own fabrics led to a trend in which prints are the main topic. These are floral, graphic, motifs inspired by ancient architecture, geometric shapes or even futuristic prints. The last theme is African Spirit and it is a romantic safari style with tribal elements. [5]

3.1 Major theme - Magic Colors

This is a casual style full of bright colors, a creative blend of casual elements with feminine accents, elegant, highlighted by strong colors that sparkle and are surprisingly matched. A mix of patterns and proportions is predominant, but what they all have in common is femininity. The clothes are diversified: jackets, trousers- straight or loose, short dresses, volume dresses, blouses with precise cuts, tapered or flared skirts and long evening dresses. The accessories are also in bright colors, matching the outfits. The color palette exudes freshness and youthfulness, warmth, energy, movement. Bright shades of red, orange, blue, yellow, green or fuchsia. Fabrics: veil, lycra, cotton, satin, jersey. The accessories have a bold design and are made of materials with different structures, in bright colors.

3.2 Major theme - Sheer Mood

A theme based on clean lines, simple shapes and details cleverly integrated. Every element is carefully thought through, and excessive features are completely dispensed with. The mastered composition convinces through classic and plain creations that concentrate only on the basic facts, namely on the immaculate style and the perfect fit. The light colors, the silhouettes free and easy, the flowing materials that fall and move beautifully with the wearer are in contrast with minimal shapes.

The clothes are tailored to amplify the shape and fall of the fabric: wide shirts with pockets, tunics over trousers, blouses with multiple layers, vests, jackets, high waist pants, simple dresses accessorized subtle, shorts and tops both veiled in a sheer material. Complexity is in the fabrics that are used, but also in the way that are combined: organza with cotton, silk with worsted, sheer fabrics over the dense ones for an unexpected effect. See-through sheers are a constant motif. [6]

The color palette consists of shades of white, beige, gray, contrasting with black. Accessories have a simple design with geometric shapes, in neutral colors.

4.3 Major theme – Sheer Mood

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The color palette consists of shades of white, beige, gray, contrasting with black. Accessories have a simple design with geometric shapes, in neutral colors.

Figure 1: Major theme - Magic Colors

Figure 2: Major theme- Sheer Mood

4.4 Major theme – Print Mania

This theme highlights prints. They are varied, ranging from floral prints, graphics, images of idyllic gardens, motifs inspired by ancient architecture, futuristic shapes or prints. Fantastic images are created on the computer, having as a result amazing digital prints on fabrics with different textures. Floral prints are predominant in a realistic representation or_stylized. [7] These prints are applied to some extraordinary silhouettes: overalls, slim-fit trousers, casual shirts, jackets, coats, short skirts or midi, straight or flared short dresses and long dresses loose. Printed dresses for spring and summer are nothing new, but this season's floral fancies have been given a reworking, making them more interesting than ever. Artistic combinations of shape, color and ornamentation are present on the clothes. The prints translated as well into bags and accessories.

The color palette is a mix of bright colors (red, yellow, orange, pink, green, blue, purple) with earthy tones and of course black and white contrast. Fabrics: satin, silk, veil, cotton satin.

Figure 3: Major theme- Print Mania

4.5 Major theme – African Spirit

This is a romantic safari style with tribal elements. This style combines provocative colors, exotic details and natural elements. It is noticed a play of new structures. Additional elements are lacings, fringes on trousers, dresses or jackets, crotched details and animal print. These prints are an influence of the African style in fashion and brings a touch of exotic, but very modern. The clothes are very feminine: wrap-over skirts, skinny trousers, jackets with pockets and bold seams, wide shirts, animal print dresses.

The color palette consists in a variety of nuances from light to warm beige, burnt ochre and orange, olive, kaki, yellow, gold. The fabrics are natural: linen, cotton, all kind of leather qualities, silk, chiffon. The most important accessories are bolt belts, natural embellished bags and summer boots. [8]

Figure 4: Major theme- African Spirit

4. CONCLUSIONS

Spring/Summer 2013 trends focus on originality and functionality. We notice unexpected prints which accentuate our fantasies, exclusive silhouettes that convey an obvious simplicity, clothes influenced by technical developments, lots of colours, textured fabrics and re-adapted shapes. Trends for spring-summer season 2013 are grouped into four main themes: Magic Colors, Sheer Mood, Print mania and African Spirit.

Magic Colors is a casual style full of bright colors. This is a creative blend of casual elements with feminine accents, elegant, highlighted by strong colors that sparkle and are surprisingly matched.

Sheer Mood is a theme based on clean lines, simple shapes and details cleverly integrated. Every element is carefully thought through, and excessive features are completely dispensed with. The mastered composition convinces through classic and plain creations that concentrate only on the basic facts, namely on the immaculate style and the perfect fit.

Print Mania is a theme that highlights prints. They are varied, ranging from floral prints, graphics, images of idyllic gardens, motifs inspired by ancient architecture, futuristic shapes or prints. Fantastic images are created on the computer, having as a result amazing digital prints on fabrics with different textures.

African Spirit is a romantic safari style with tribal elements. This style combines provocative colors, exotic details and natural elements. It is noticed a play of new structures. Additional elements are lacings, fringes on trousers, dresses or jackets, crotched details and animal print. These prints are an influence of the African style in fashion and brings a touch of exotic, but very modern.

5. REFERENCES

[1] www.wikipedia.org

[2] http://mashable.com/category/fashion/

[3] Sabina Olaru, Alexandra Mocenco, Mirela Teodorescu, Claudia Niculescu, Adrian Salistean, „Grupe conformaționale pentru populația feminină din România și recomandări vestimentare specifice”, revista Industria Textila, vol. 62, nr. 3, 2011, pag. 155-160

[4] www.supermoda.ro

[5] Program NUCLEU - Creşterea competitivității industriei textile şi de pielărie-încălțăminte din România – COMTEXPEL, proiect PN 09 10 02 08, Textile personalizate prin corelarea marimilor confectiilor cu designul vestimentar, conducător Institutul Național de Cercetare – Dezvoltare pentru Textile şi Pielărie

[6] www.style.com

[7] www.fashionandbeauty.ro

[8] www.ft-insite.com

DESIGNING THE BASE PATTERN OF THE CORSAGE FOR CHILDREN OF MAXIMUM AGE OF 2 YEARS

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Abstract: For designing the clothing there should be a close correlation between the size and shape of the body, and the size and shape of the clothing. Clothing has to be designed in such a way as to be able to use the methods of industrial or manual production. Clothing products for children have to be designed in function of their ages, because there are morphologic differences between the different categories of wearers. In comparison with clothing designed for older age population, the clothing for children can use as main circumference dimension, the abdominal perimeter, instead of the waist perimeter. This is due to the fact that in this life period, the waist line is not sufficiently marked. Thus, the waist line can be placed in different zones, in function of the type of clothing. The base patterns for the corsage are obtained using the calculations on longitudinal and transversal lengths of the body, with no looseness supplements on either direction. The design is made for the upper body until the hip line, for size 23, using the geometric method. Are made references about the design the other sizes in the size range (sizes 21, 22, 24, 25 and 26), according table 1.

Key words: base pattern, corsage, clothing, dimensions, anthropometry, children, textile materials.

1. INTRODUCTION

To obtain different product models, it is necessary to design the patterns for the geometrical shape of the body [1], on different categories of age [2]. Clothing for children should be designed, above all, functionally and with great imagination, considering the age and development of children [3].

This method of design has the advantage that, from the basic construction of the bodice, other basic patterns can be obtained, with different looseness supplements [4]. When using CAD methods, for which the design is done directly on the model, the basic patterns can be more precise. In this case, the dimensions on longitudinal and transversal are obtained automatically, not being necessary to use the calculations of the geometric method [5].

2. WAY OF WORKING

2.1. Dimensions taken on the body depending on age of the child

The basic patterns of the corsage are designed based on the indications in table 1, regardless of the sex of the baby [4, 6]. In Romania the standards were not established for with the dimensions of the body of children 0-6 years old. The reason for this is that the dimensional parameters could not be taken from a large number of children of various ages, the methods of taking the dimensions being long lasting.

Table 1 Sizes for children with age of maximum 2 years

Size	21	22	23	24	25	26
Height of the body (H_b)	54	60	66	72	78	84
Age (months)	1	3	6	12	18	24
Perimeter of the bust (P_b)	42	44	46	48	50	52
Perimeter of the abdomen (P_a)	42	44	46	48	50	52
Perimeter of the hips (P_h)	43	45	47	49	51	53
Perimeter of the neck (P_n)	21	21,75	22,5	23,25	24	24,75

2.2. Way of working

2.2.1. Construction of the back

2.2.1.1. Tracing the horizontal lines of the base pattern

The design of the base patterns of the corsage, made for size 23, begins by the tracing, in the upper right corner of the paper, of a vertical line corresponding to the spine. On this line the point 11 is positioned.

Length of the waist at the back ($\overline{11-41}$)

$$L_{b_w} = \frac{H_{bo}}{4} + 3\,\text{cm} = \overline{11-41} = 19{,}5\,\text{cm} \tag{1}$$

Distance waist - hips ($\overline{41-91}$)

$$\overline{41-91} = \frac{H_{bo}}{8} + 0{,}25\,\text{cm} = 8{,}5\,\text{cm} \tag{2}$$

Peculiarities:

For sizes 21, 22, 25 and 26 there is added 0.75 cm, 0.5 cm and substracted 0.25 cm, respectively 0.5 cm, and for size 24 it is just maintained the poportion with the height of the body.

From the points 11, 41 and 91, there are traced perpendicular lines which correspond to the horizontal line of the neck at the back, the waist line and the hips line.

Auxiliary point (211)

$$\overline{41-211} = \frac{H_{bo}}{3} - 5{,}5\,\text{cm} = 16{,}5\,\text{cm} \tag{3}$$

Peculiarities:

For sizes 21, 22, 24, 25 and 26 there is substracted 3.5, 4.5, 6.5, 7.5 and respectively 8.5 cm.

Legth neck - waist at the front ($L_{n\text{-}w_f}$)

$$L_{n\text{-}w_f} = \overline{41-211} = 16{,}5\,\text{cm} \tag{4}$$

From point 211 there is traced a horizontal line which corresponds to the inferior termination of the line of the neck at the front (point 271). This parameter will be marked by the distance 47 – 271. This in the length neck – waist at the back ($L_{n\text{-}w_b}$)

Distance waist - chest ($\overline{41-31}$)

$$D_{T-B} = \frac{L_{n\text{-}w_f} + L_{n-w_b}}{4} = \overline{41-31} = 8{,}25\,\text{cm} \tag{5}$$

From point 31 a horizontal line is traced, this being the line of the chest.

Auxiliary point (21)

$$\overline{31-21}=\frac{1}{2}\overline{31\text{-}211} \quad \textbf{(6)}$$

From point 21 a horizontal line is traced, corresponding to the position of the shoulder blades at the back.

2.2.1.2. Dimensioning on the bust line

The width of the back ($\overline{31 \; - \; 33}$)

$$W_b=\frac{H_{b_o}}{3}+0{,}85\,\text{cm}=\overline{31-33}=8{,}51\,\text{cm} \quad \textbf{(7)}$$

For the other sizes there is added 1 cm. Through point 33 a vertical line is traced, at the intersection with the horizontal line traced through 21 resulting the point 23; at the intersection with the waist line resulting point 43; at the intersection with the termination line resulting point 93.

The diameter of the armpit line at the back ($\overline{33-34}$)

$$D_{al_b}=\frac{P_b}{8}+0{,}5\,\text{cm}=\overline{33-34}=3{,}38\,\text{cm} \quad \textbf{(8)}$$

For size 21 there is added 0.1 cm, for size 22 there is added 0.25 cm, for size 24 there is added 0.4 cm, for size 25 there is added 0.5 cm and for size 26 there is added 0.55 cm.

From point 34 there is traced a vertical, at the intersection with the waist line resulting point 44, and at the intersection with termination line resulting point 94.

The diameter of the armpit at the front ($\overline{34-35}$)

$$D_{a_f}=\frac{P_b}{8}+0{,}75\,\text{cm}=\overline{34-35}=3{,}62\,\text{cm} \quad \textbf{(9)}$$

For size 21 there is added 0.5 cm, for size 22, 24, 25 there is added 0.6 cm and for size 26 there is added 0.65 cm.

From point 35 there is traced a vertical, at the intersection with the horizontal traced through 21 resulting point 25, at the intersection with the waist line resulting point 45, and at the intersection with the termination line resulting point 95.

Width of the front ($\overline{35 \; - \; 37}$)

$$W_f=\frac{P_b}{3}-0{,}15\,\text{cm}=\overline{35-37}=7{,}51\,\text{cm} \quad \textbf{(10)}$$

For size 21 there is added 0.15 cm, for sizes 22, 24, 25, 26 no constant is added. The points 471 and 44 are united, resulting the termination line.

Verification:

$$W_b+W_f+D_{al_b}+D_{a_f}=P_b \quad \textbf{(11)}$$

From point 37 there is traced a vertical, at the intersection with the horizontal lines traced from points 91, 41, 21, 211, 11, resulting points 97, 47, 271 and 17.

2.2.1.3. Dimensioning on the waist line

Taking into account that the perimeter of the abdomen is equal with the perimeter of the chest, the same values are adopted for the width of the patterns for the back, front and armpit.

1.4 Dimensioning on the termination line

$$\overline{94-941}=0{,}5\,\text{cm} \quad \textbf{(12)}$$

$$\overline{94-941'} = 0{,}5\,\text{cm} \tag{13}$$

These values are determined on the basis of the difference of 1 cm in plus, between the semiperimeter of the hips and the semiperimeter of the chest.

The point 44 is united with 941, the point 44 is united with 941´, resulting the side contour lines.

1.5. Tracing the superior contour lines

The width of the neck line at the back ($\overline{11\text{-}12}$)

$$W_{wl_n} = \frac{P_b}{6} + 0{,}25\,\text{cm} = \overline{11-12} = 4{,}08\,\text{cm} \tag{14}$$

From point 12 a vertical is traced, at the intersection with the horizontal traced through point 211 resulting point 221.

The height of the neck line at the back ($\overline{12-121}$)

$$H_{nl_b} = \frac{W_{wl_n}}{4} + 0{,}5\,\text{cm} = \overline{12-121} = 1{,}52\,\text{cm} \tag{15}$$

The points 12 and 121 are united resulting the line of the neck at the back.

$$\overline{221-12a} = \frac{1}{2}\overline{221-121} \tag{16}$$

From point 12a, a horizontal line is traced. From point 121 an arc is traced, with the radius equal with the length of the shoulder (5.75 cm). At the intersection with the horizontal line traced through point 12a there is obtained the point 14 which represents the lateral extremity of the shoulder line at the back. Points 14, 23 and 34 are united, resulting the line of the sleeve at the back.

2.2.2. Construction of the front

2.2.2.1. Tracing the superior contour lines

The width of the neck line at the front ($\overline{271\text{-}26}$)

$$W_{wl_f} = W_{wl_n} = \overline{271-26} = 4{,}08\,\text{cm} \tag{17}$$

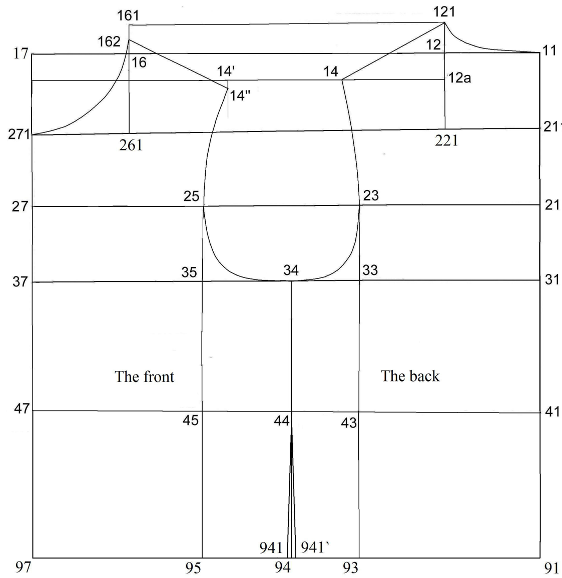

Figure 1. The design of the corsage patterns for children with age 1-24 months

From point 261 a vertical line is traced, at the intersection with the horizontal line traced through point 11 resulting point 16, and at the intersection with the horizontal line traced through point 121 resulting point 161.

Auxiliary point (161)

$$\overline{161-162} = 0{,}75\,\text{cm} \quad \textbf{(18)}$$

After the positioning of this point there is obtained constructively the height of the neck line at the front ($\overline{162-26}$). Points 162 and 271 are united, resulting the line of the neck at the front.

Verification:

$$2xSP_{nl_f} + 2xSP_{nl_b} = P_n \quad \textbf{(19)}$$

where: SP_{nl_f} represents the semiperimeter of the neck line at the front (the line between points 271 and 162), and SP_{nl_f} represents the semiperimeter of the neck at the back (the line between points 11 and 121).

From point 161 there is traced an arc with redius equal with the length of the shoulder. At the intersection with the horizontal line traced previously through point 12a, there is obtained the point 14'. From this point there is measured on vertical 0.5 cm, resulting point 14'' which represents the extremity of the shoulder line at the front. The points 161 and 14'' are united through a straight line, resulting the line of the shoulder at the front. The points 14'', 25 and 34 are also united, resulting the line of the sleeve.

The points 471 and 44 are united, resulting the termination line for the front.

3. CONCLUSIONS

The method of design used in this paper presents the advantage that, by starting from this basic contruction, there can be obtained after that basic patterns with different degrees of looseness.

In addition, the following considerations can be made:

- Indications are given for the design of other sizes, the increases being proportional from one size to the other.
- The calculation of the base dimensions is done based on the correlations between the main dimensions taken on the body on longitudinal and transversal directions.

- In the first case, the height of the body is used in a certain ratio.
- In the second case, there is used the ratio between the semiperimeter of the chest and a constant.
- Tracing the basic lines on the length and on the width of each pattern, was made following the base dimensions.
- The basic lines on the length are positioned perpendiculary on the length of the pattern, and the distance between the lines represents the base dimensions in length.
- The basic lines on the width are positioned parallel with the length of the pattern and mark the base dmensions in width.
- By tracing the contour lines of each detail, the shape of the corsage resulted.

4. REFERENCES

[1] Lin, Chin-Mei; Lin, Ching-Hui; Hsiao, Pei-Chen; et al.(2011), The Application of Geometric Form in Clothing Design, Book Series: *Advanced Materials Research*, Volume: 331, Book Editor(s): Wang, R; Liu, H.W., pp. 670-674, International Conference on Textile Engineering and Materials (ICTEM 2011), Tianjin, CHINA, SEP 23-25, 2011
[2] Roncea, A. (2012), Cresterea si dezvoltarea copilului functie de perioadele varstei, http://www.ingrijireacopilului.ro/articole/8.-cresterea-si-dezvoltarea-copilului-in-functie-de-perioadele-varstei.html
[3] Vinkovic, M. (2003), Orientation lines in artistic designing of children's clothing, *Tekstil*, Volume: 52, Issue: 8, pp. 357-367, 2003.
[4] Claire Margnier-Jean, Patti Loue-Milanese (1997), Methode de coupe – Vétements enfants, Nouvelle edition, Edité par M.P.G.L., 156 – 158, Avenue Parmentier, 75010, Paris,pp.25-29.
[5] Meng, Yuwei; Mok, P. Y.; Jin, Xiaogang (2012), Computer aided clothing pattern design with 3D editing and pattern alteration, *Computer-Aided Design* Volume: 44 Issue: 8 Pages: 721-734, aug. 2012
[6] IRS (1996), SR ISO/TR 10652 Sisteme de mărimi standard pentru îmbrăcăminte, *Colecția standarde internaționale ISO/Technical Report*, Bucureşti, 1996

USE OF MORPHOLOGICAL TRANSFORMATION PRINCIPLES IN THE DESIGN OF GARMENTS BY CONFORMANCE TYPES

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Abstract: The work considers the problem of personalized design of garments for various groups of wearers and presents the results of theoretical and experimental research of garments for women elaborated in correlation with the particularities of conformance types by applying the principles of designing products with flexible structure.
The analysis of concept of design of products with flexible structure and the determination of design principles contributed to the grounded selection of model system processes. The principle of morphological transformation has been defined as a tool for designing multifunctional products with morphological transformation elements capable of facilitating the flexibility of product, extending their functionality and active use time. Therefore, one may affirm that the implementation of flexible structure products by application of morphological transformation elements is a more efficient way to satisfy the demands of customers and to improve the quality of products, as well as to raise their commercial competitiveness on international market.
A set of recommended solutions has been analyzed and systematized, depending on the conformance type. The study of morphological particularities of main conformance types – balanced type, superior type, inferior type, as well as analysis of external shapes of representative bodies facilitated the correct choice of compositional-constructive solutions, as well as to obtain products attractive for the wearers. Using the schemes of optical proportioning and optical illusion it became possible to choose the most suitable compositional-constructive solutions of models providing for the best correlation between the proportions of used silhouette and body particularities, as well as to harmonize the external appearance of wearers by the use of morphological transformation and optical illusion elements facilitating the creation of an integer and harmonic image.
Therefore, the design of flexible structure products fits in the actual directions of recovering the garment manufacturing companies, contributing also to a wider assortment of products and being at the same time a strategic element of promoting the image of an enterprise in line with the industry innovations.

Key words: personalized design, products with flexible structure, inferior type of conformance.

1. INTRODUCTION

The actual development level of modeling techniques and methods provides a unique possibility for the transfer of results of scientific studies in industrial conditions of manufacturing garments.

At the present stage, for the assurance of maximum economic efficiency, companies, in addition to the traditional implementation of new techniques and cutting-edge methods of production, have to produce, create and assimilate new products and modernize the ones already being manufactured.

The study of efficiency parameters in the activity of any enterprise pursues as a scope the maximum output level at minimum cost and this scope may be attained by designing products with flexible structure. It determined the appearance of a study aimed at elaboration of principles of designing products with flexible structure, as well as at determining the methods and procedures of designing products with morphological transformation elements. The visual effects provided by the morphological transformation elements allowed to extend the study over the possibilities of adapting the shape and dimensions of products to the particularities of body determined by the wearer's conformance type [1].

2. PRINCIPLES OF DESIGNING PRODUCTS WITH FLEXIBLE STRUCTURE

The tendency of search for new and original solutions resulted in the appearance of products with flexible structure. Being parts of the traditional products category, they feature original constructive solutions allowing for transformation and affecting the characteristics of external appearance, destination, etc. Elaboration of such products implies the use of various design techniques and methods, both traditional and non-traditional.

In the case of application of creative methods the models traditional for classical assortments of products are considered as initial structures that may be modified with no limits for the sake of obtaining various shapes and structures for various destinations. The new shapes and lines are obtained owing to the use of transformation and creative design procedures and techniques [2].

The practice of designing new models of products contributed to the elaboration of several universal transformation techniques that allow to systematize this process, providing possibilities of applying the same on various constituent parts of structures and obtaining original transformations of shape or content. The most frequently used transformation methods are: stretching-compression, division-association, adjustment-fixation, rolling-unrolling, disappearance-appearance, substitution, permutation [3].

The development and modification of initial shapes of products in the process of traditional template design, as well as the subsequent elaboration of products with flexible structure imply the use of creative non-traditional methods, such as modular, combinatory, deconstruction, kinetic, plane cut method, etc.

The process of designing products with flexible structure is based on the following principles [4]:

- interchangeability of functional elements;
- universality of functional elements;
- multifunctionality of elements;
- morphological transformation.

In order to transfer these principles of designing products with flexible structure in the conditions of industrial production, one must bear in mind the following recommendations:

- use of materials of the same type, with homogenous physical-mechanical properties;
- elaboration of models based on the same main structure with use of unified or assimilated elements;
- the models are elaborated based on the same cut type, with preservation of number of constructive divisions;
- a homogenous structure is used, in order to preserve the complexity of processing the technological sub-assemblies and to assure the maximum use of available equipment under a stable output flow at a high rate of workplace specialization and high quality of manufactured parts;
- the diversity of external looks of versatile models is obtained owing to the changes in colors and texture of used materials, as well as changes to the geometrical and dimensional aspects of morphological transformation elements and their location; by differentiation of geometrical shapes, dimensions and location of decorative and trimming elements;
- the system models may have reference elements of different shapes and dimensions and this may determine the perception of model shapes as new ones.

The new product will be included into the category of transformable ones, as its material structure is mobile and flexible, so as to assure transformation into another product or significant change of characteristics.

Transformation itself is a morphological property of product determining its capacity to change its special characteristics and to obtain new properties and functions. The process of morphological transformation implies the existence of product in three images: initial shape, transformation into a new shape; disappearance of initial shape.

Thus, the initial shape of a product conceived as a primary element to be developed, finalized and personalized, is defined so that in the absence of any transformation it is capable of satisfying the high demands and expectations of wearers. At the first transformation the product must surprise pleasingly, while in the subsequent transformations it must provoke amazement and admiration.

As for the system of correlation of constituent parts and compositional lines of shapes, one must observe that the dialectical fight of contradictions occurs in two directions: correlation of new transformable elements within the limits of initial shape and of stable elements into the newly designed shape [5].

The principle of morphological transformation provides good results when at the model conception stage one manages to take into account the aspects characterizing the group of wearers for whom the product is intended. Specifically, one must mention the following factors:

1) modification of morphological indicators by age groups and conformance groups;
2) modification of constructive parameters of basic structures depending on the modification of morphological parameters by age and conformance groups;
3) use of constructive-compositional tools for extending the lifetime of products.

3. USE OF MORPHOLOGICAL TRANSFORMATION PROCEDURES FOR DESIGNING A WOMEN'S DRESS, AGE GROUP 45...60 YEARS, INFERIOR CONFORMANCE GROUP

Personalization of products is regarded as a perspective direction for the elaboration of assortments of products manufactured at industrial scale. In this context the design of products with flexible structure for the target groups of wearers with diverse anthropomorphological particularities is of great interest, as it allows to raise the competitiveness of new products.

The experimental study covered the women aged 45…60 years practicing an active lifestyle. This age category is characterized by morphological and physiological changes associated with the maturity degree and transition to the ageing process, such as: wrinkles on face and neck, the head and neck inclined forwards, increasing perimeters of bust and waist, the thorax is inclined forwards, the back becomes rounded, the shoulder-blades become prominent attesting non-uniform deposits of adipose tissues, the posture becomes stooped, deposits of adipose tissues appear on the arms and hips.

Following the analysis of external shape of a representative body for this group of wearers with the typical dimension of 158-96-108, aged 54 years, it became possible to identify a series of specific anthropomorphological indicators to be changed by the optical illusion and morphological transformation effects. So, in order to increase visually the body height, vertical division lines must be applied. It is recommended to use the „relief" lines on the shoulders and the front side and back side reference elements. Their shape easily follows the body contour, providing for the necessary optical illusion and conferring an aspect of femininity and elegance.

The use of horizontal division lines in the product is allowed, granted that the principle of re-evaluation illusion of vertical lines is observed. The analyzed body is referred to the large mesomorphic type. Therefore, it is recommended to use horizontal division lines at the level of waist line, preserving thus the equilibrium of proportions and visually adding some height.

Taking into consideration the age-related changes, it is good to elaborate models covering the body parts that are subjected to ageing effects most of all, as well as the body parts with significant deposits of adipose tissues, such as arms and hips. Therefore, it is recommended to use structures of small or moderate neck cut constructions. One may propose classical applied cut sleeves or raglans of various lengths, slightly narrowed at ends in order to balance the upper portion of the arm. Sleeves of lengths of three quarters and less are allowed granted that there is a collar in the product. The recommended length of products is at the knee level or a little bit higher.

The most efficient method of harmonizing the external appearance of the bodies of inferior conformance type consists in balancing the product at the hip level by increasing the volume in the upper part by large collars, large reverses, shoulder straps, additional pelerine type elements, wings for sleeves, etc.

The development degree and the location of adipose tissues in the lower part of body imposes certain restrictions in the choice of orientation directions of the pocket entry lines, only vertically positioned pockets trimmed with seams are recommended.

The dress-type products for women with flexible structure have been conceived as a combination of several variants of compositional-constructive solutions presented above. The morphological transformation elements are used for diversifying the external appearance of products, as well as for creating optical illusions for harmonizing the wearer's image. Thus, in accordance with the inferior conformance type, it is recommended to locate the morphological transformation elements on the upper side of dress, as they represent the element imitating the reverses, cuffs of decorative-constructive type. The effect of using these elements may be perceived following the application of transformation techniques and procedures by disappearance and appearance thereof in the product.

The morphological transformation elements used in the inferior part of the product must have a constructive character mainly aimed at altering the shape. For the group of wearers considered by the study the most advantageous would be the models of dresses with narrowed ends, as well as the ones with straight silhouette and moderate adjustment at the waist line level. The skirt element may be changed from narrowed to straight shape by applying the adjustment and fixation technique.

In order to balance the volume of product parts for the wearers without deviations of conformance one may use the morphological transformation elements applied by the disappearance and appearance technique. So, the pockets of lateral seams may be supplemented with the flap element that would correspond to the shape and color of other transformable elements of the product in order to preserve the compositional harmony.

In order to obtain the expected visual effect it is recommended to use materials of different colors and textures, of them one will perform the role of main material and the other will be decorative and will be used for making the morphological transformation elements. Generally, it is recommended to manufacture products with flexible structure of elastic materials with application of stretching and compression technique. This procedure allows to transform the product using the elasticity o materials and the self-adjustment principle, adapted to the dynamic and shape [6].

In continuation one may see the variants of a model with constructive flexibility with various positions and combinations of reverses, cuffs, pocket flaps, volume at ends. These variants have been classified based on the criterion of correspondence with the wearer's body shape in various conformance categories – superior, balanced and inferior (figures 1, 2 and 3).

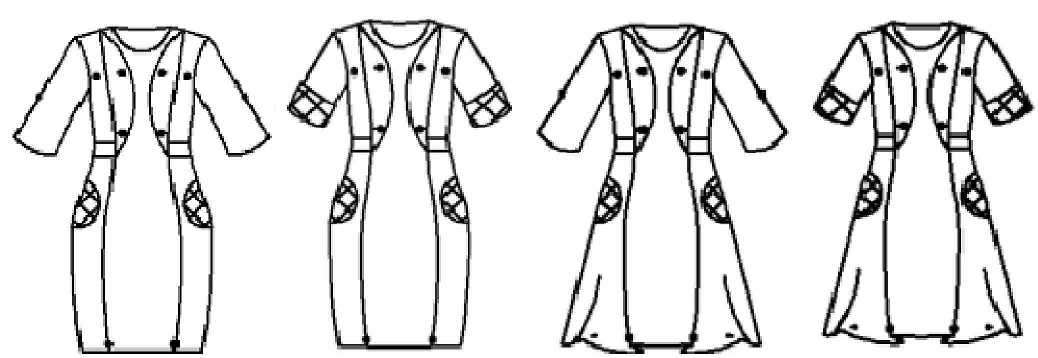

Figure 1: Variants of using the elaborated model of dress with flexible structure for the bodies of superior conformance type

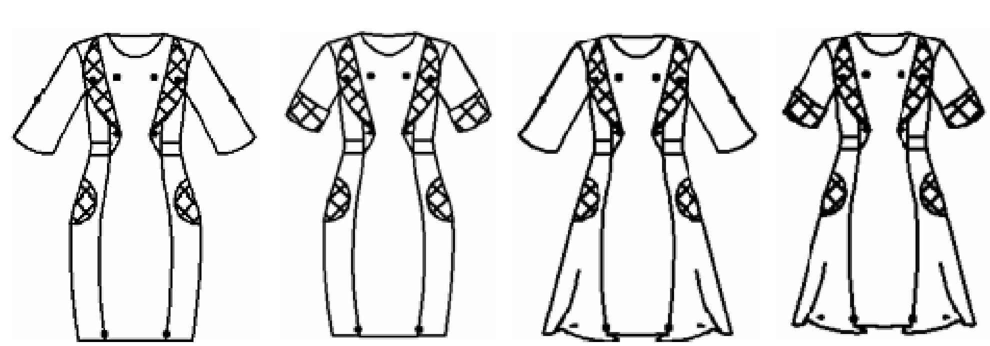

Figure 2: Variants of using the elaborated model of dress with flexible structure for the bodies of balanced conformance type

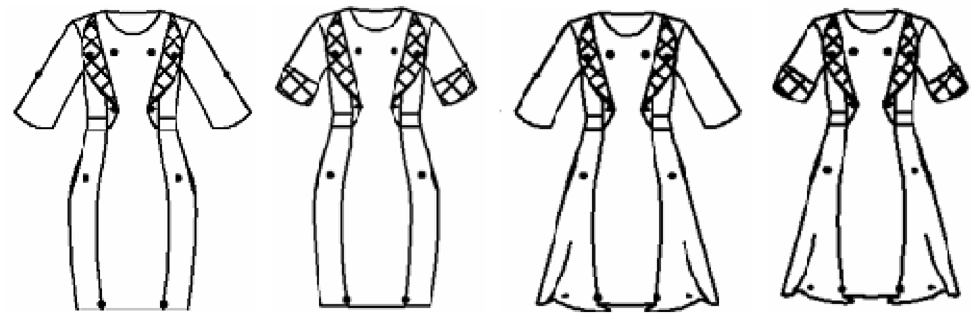

Figure 3: Variants of using the elaborated model of dress with flexible structure for the bodies of inferior conformance type

4. CONCLUSIONS

The use of morphological transformation elements in the process of designing garments influences their structural characteristics and attributes them to the category of flexible ones, providing possibilities of adapting the wearer's external appearance to the specific conformance particularities, being at the same time an efficient method of satisfying the wearers' demands and improving the quality of products.

The proportioning systems and optical illusions employed in the search for adequate compositional- constructive solutions provide for the correlation between the mobile compositional structure of product and the anthropomorphological particularities of the wearers' bodies, as well as for the harmonization of external appearance by using the morphological transformation elements.

One may affirm that the techniques and methods of transformation, principles and particularities of designing products with flexible structure determine the appearance of a series of advantages both for the wearer and for the industrial production system:

- multifuncţionality;
- flexibility;
- extension of functionality area of products and active wearing periods;
- coverage of a wider range of consumers, differing by external appearance and activities;
- possibility of transforming the products depending on consumer tastes and preferences;
- possibility to conceal the defects of wearers' bodies and to outline advantages;
- material saving opportunities for manufacturers;
- competition for traditional products;
- possibility to develop and diversify the assortment of products depending on the technological innovation and rapid evolution of consumption needs.

5. REFERENCES

[1]. Ермилова, В.В., Ермилова, Д.Ю. (2001). *Моделирование и художественное оформление одежды*, Издательский центр «Академия», ISBN 5-7695-0637-7, Москва.

[2]. Куликова, Е.Г., Теркина, С.А. (2005). Новый метод художественного проектирования одежды, *Швейная промышленность,* № 5, (сентябрь-октябрь 2005 г.), стр. 35-37, ISSN 0132-0955.

[3]. Куренова, С.В., Савальева, Н.Ю. (2003). *Конструирование одежды*, Издательство Феникс, ISBN 5-222-03617-0, Ростов на Дону.

[4]. Рачицкая, Е.И., Сидоренко, В.Л. (2002). *Моделирование и художественное оформление одежды,* Издательство Феникс, ISBN 5-222-01904-7, Ростов на Дону.

[5]. Козлова, Т.В. (1990). *Моделирование и художественное оформление женской и детской одежды*, Издательство Легпромбытиздат, ISBN 5-7088-0361-4, Москва.

[6]. Малухина, И.В. (2003). Использование принципов трансформации при разработке конструктивных решений одежды для будущих мам, *Швейная промышленность,* № 2, (март-апрель 2003 г.), стр. 44-46, ISSN 0132-0955.

RESEARCH ON APPLICATION OF BILBERRY EXTRACT IN NATURAL TEXTILE DYEING TECHNOLOGY

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Abstract: Because most of the natural dyes show positive effect as eco-safe products both for humans and environment, the present study deals with the investigation regarding the application of natural extracts in textile dyeing processes. Thus, anthocyanins which are water soluble pigments widely distributed in fruits, were the central point of this research which focused on a hydroethanolic anthocyanin extract obtained from bilberry (*Vaccinium myrtillus* L.). Their behavior and the opportunity of their application onto textile materials dyeing were investigated. The study relies on the improvement of multifunctionalities such as colour fastness by using the ability of hydrophobic MCT- β-CD's cavity to form inclusion complexes with dyes based on their selectivity. Ultrasounds dyeing with the obtained anthocyanin extract were carried out and results were compared to the standard technology. Concerning the experimental methodology, the study points out firstly a preliminary improvement of the linen substrate carried out using monochlorotriazinyl-β-cyclodextrin (MCT-β-CD). Secondly, bilberry anthocyanin extract was applied on linen material, by both exhaustion and ultrasonic dyeing procedures. The characterization of the morfology, structural and fastness properties of dyed materials was performed, by using an investigation system consisting of: scanning electron microscopy SEM, FT-IR spectroscopy, BET Surface Area Analysis, as well as dyeing fastness. The results of analysis revealed an eveness of samples, in terms of colouring by ultrasounds dyeing method. Moreover, improvements of washing and rubbing fastness were achieved (0.5-1 pints).

Key words: linen fabrics, anthocyanins, ultrasonication, inclusion complex, fastness testing

1. INTRODUCTION

The presence of natural extracts in textile fabrics is important as it highly contributes to consumer hygiene and pollution-free processes. Anthocyanins are flavonoids responsible for the orange, red, blue, purple colors of many fruits and vegetables, like apples, berries, beets and onions. Application on textile substrates of phenolic extracts from fruits has been shown to improve also other properties such as antimicrobial, antiinflammatory, anti carcinogen [1]. Starting from this point, application in textile dyeing of anthocyanins extracted from berries could be an ecological mode to improve natural dyes fastness properties. Moreover, by coupling an auxiliary used as grafting agent of fabric with natural dyes under molecular encapsulation conditions, a better stability of pigments and a possible increased bioavailability is resulted. Consequently, deposition of cyclodextrines can be used to obtain special functionality of textiles such as: absorbtion of vitamines, drugs, bioactive substances, small pollutants from waste waters, as well as dyes. Also, fastness and properties of laundering formulation can be successfully enhanced. Starting from the results provided by literature, application of cyclodextrins was tested as an inclusion complex in surface modification for improving the dyeability of textile fabrics [2, 3].

The typical dyeing process involving the use of chemicals and thermal energy was reduced, by using ultrasound energy. Meanwhile the influence of ultrasonics on the dyeing system has improved effects such as dispersion effect, breaking up of micelles and high molecular weight aggregates into uniform dispersion in the dye bath. The consequences of the ultrasonics were a dye-fibre contact and accelerating the rate of diffusion of the dye inside the fibre by breaking the boundary layers covering the fibre and accelerating the interaction between dye and fibre [4].

With regard to the experimental methodology, the present study envisages firstly a preliminary improvement of the linen substrate carried out by using the monochlorotriazinyl-β-cyclodextrin (MCT-β-CD). In the second step of the experimental protocol, bilberry anthocyanins extract was applied on linen material, by both exhaustion and ultrasonic dyeing procedures. The reason that bilberries were selected as natural pigments, is that they contain high amounts of anthocyanins of dark colour and usually appear near black with a slight shade of purple. The motivation of the research relies on the enhancement of properties such as colour fastness by using the ability of hydrophobic MCT- β-CD's cavity to form inclusion complexes with dyes based on their selectivity. Moreover, a possibility of formation of an inclusion complex (composite) between anthocyanins dye and MCT-β-CD, has been highlighted. Previous researches of the present paper authors has been extended both by using ultrasounds dyeing method and the scientific substantiation using BET analysis, which reveales the entrapping of colorant molecules inside the MCT-β-cyclodextrin.

Consequently the results of this study, including the novel experimental protocol of natural dyeing will be brought to industrial micro-scale in order to exhibit the environmental stability.

2. EXPERIMENTAL PART

2.1. Plant material and anthocyanins extraction

Extraction of anthocyanins was done in 70% ethanol solution from selected samples of *Vaccinium myrtillus* billberry (grown in Romanian region). The total anthocyanins content in the obtained extract was determined as 303.26 mg x $100g^{-1}$ fresh weight.

2.2. Pretreatment of linen textiles and dyeing experiments

Functionalization procedure is performed by padding *(impregnation-squeezing)-drying-curing*. The linen fabrics were immersed in a solution containing 50-80 g/l of monochlortriazinyl β-cyclodextrin; the pH was adjusted to 4 using acetic acid, at room temperature for 30 minutes, then padded to pickup 100%. Then, drying at room temperature for 12 hours and curing at 90÷170°C for different periods of time (1÷15 minutes) was followed. Finally, washing thoroughly with tap hot and cold distilled water, up to pH 6,5-7 and finally air drying was done.

In this work, 100% linen textile supports were dyed with anthocyanins extract by exhaustion procedure meaning an immersing of the fabric in dye bath for about 30 minutes at 60°C. Also, dyeing using ultrasonication procedure was performed. The concentration of dyeing solution, in terms of textile material tested is quantified by liquor ratio, which is 1:30 and 18.16 mg anthocyanins considered for 2% solution of natural dye.

2.3. Specifications and descriptions of the studied samples

L-Reference linen fibres support; L-MCT-ß-CD- Grafted support with MCT-ß-CD; sample 1-Non-functionalized support dyed by exhaustion procedure with 2% bilberry extract; sample 2-Functionalized support dyed by exhaustion procedure with 2% bilberry extract; sample 3-Non-functionalized support dyed by ultrasonication procedure with 2% of bilberry extract; sample 4-Functionalized support dyed by ultrasonication procedure with 2% bilberry extract.

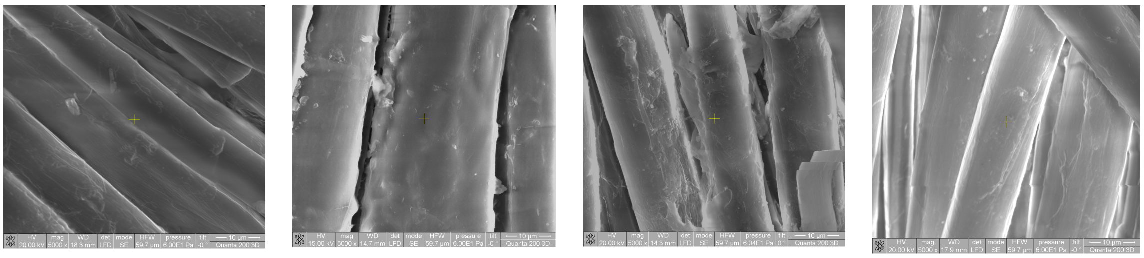
2.4. Characterization of the studied samples

The structure and properties of the bilberry extracted anthocyanins dye-MCT-β-CD-linen support composite were studied by N_2 adsorption-desorption isotherms (BET analysis), FTIR spectroscopy, and scaning electron microscopy (SEM). The characterization of textile supports, in terms of morphology and chemical attributes has been performed using scanning electron microscopy (SEM) and FT-IR spectroscopy for structural samples features, and finally the fastness testing measurements completed this study.

3. RESULTS AND DISCUSSIONS

3.1. Structural and morphologycal evaluation

The morphology of linen fibers after grafting and dyeing by the two methods was obseved. SEM results show that the fine structure of the material is quite different from the non-functionalized linen fibers and the absorbency properties of natural extract are probably due to the micro-groves otain after functionalisation with MCT-ß-CD. By ultrasonication dyeing the fibers morphology was very smooth.



L L-ß-CD Sample 2 Sample 4

Figure 1: SEM micrographs for reference and functionalized linen fibrous supports dyed by exhaustion and ultrasonication methods with 2% bilberry (*Vaccinium myrtillus*) extract inspected at ×5000 magnification

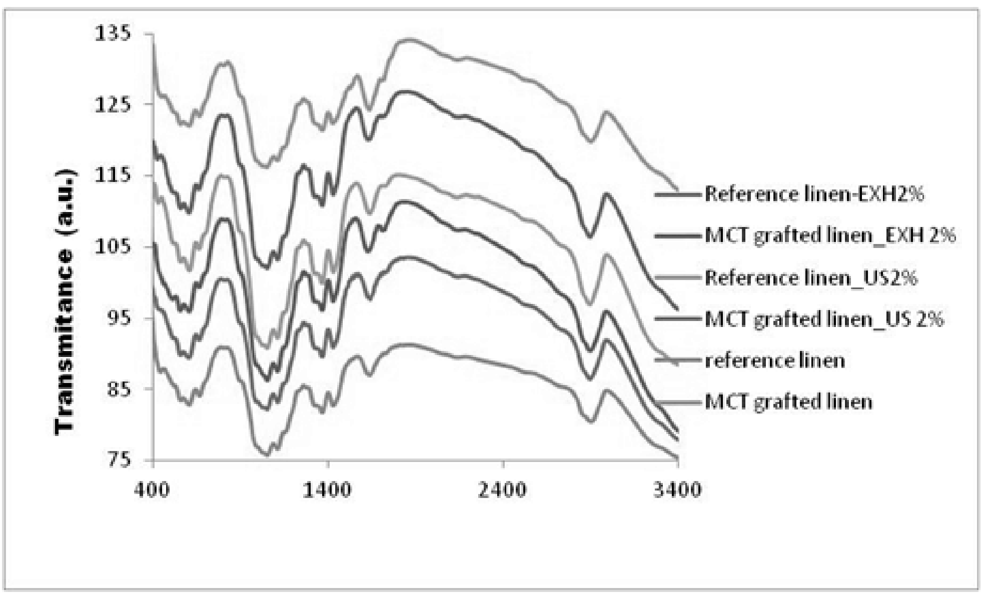


Figure 2: FT-IR spectra for linen supports dyed by exhaustion and ultrasonication procedures with 2% bilberry natural extract

According to the literature, anthocyanins dye shows intense peaks at 3400 cm^{-1} (hydroxyl group) and at 1770 cm^{-1} (carbonyl group), whereas the FTIR spectra shown in Fig. 2 depict that the dye showed less intense peaks at the aforementioned values. Therefore, it can be concluded that these changes are due to inclusion compound formation, meaning occurring of carbonyl moiety assigned to anthocyanin molecules as shown in Figure 2. Furthermore, there are some changes in IR spectra which can be seen at 1634 (aromatic –C=C-), 1180 (-O-C=O)-, 1127 (-C-C-), 900 cm^{-1}, due to bonding with MCT-ß-CD.

This statement is very well sustained by the BET analysis, revealing the entrapping of colorant molecules inside the MCT-β-cyclodextrin.

Nitrogen adsorption/desorption isotherms have been used to characterize the textural properties of the studied materials. The specific surface area has been calculated using BET method at a relative pressure ranging between 0.05-0.1 The pore radius has been calculated at a relative pressure of 0.95. The distribution of pore size has been determined from the nitrogen adsorption isotherm using Barett-Joyner-Halenda model (BJH model). Subsequently, isotherms and distributions corresponding to the pore sizes have been performed (Fig. 3).

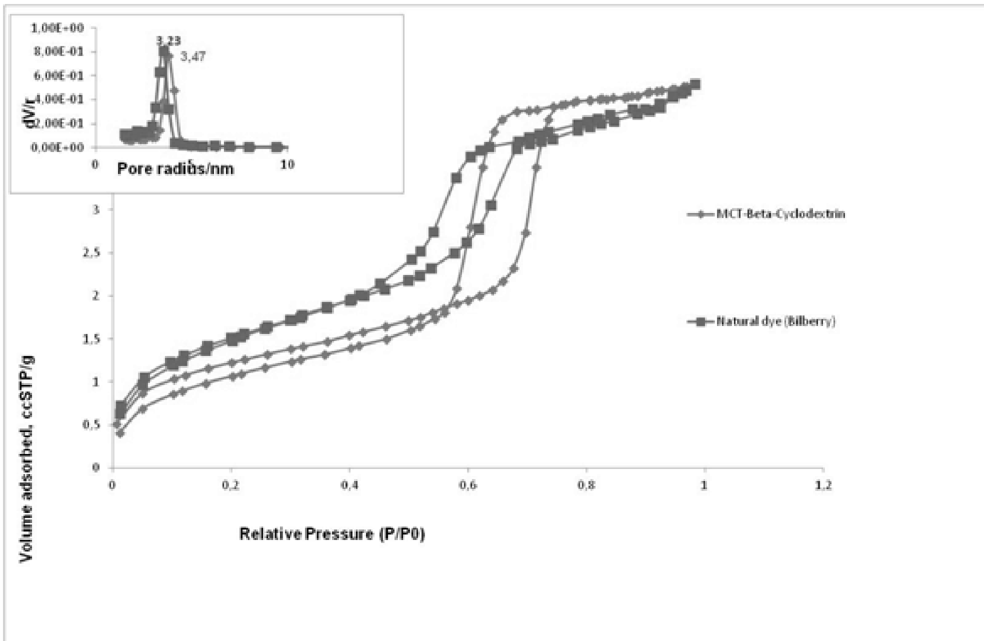


Figure 3: The N_2 adsorption/desorption isotherms of the inclusion compound (MCT-β-cyclodextrin-as host and anthocyanins natural dye as guest molecule)

According to IUPAC, the general aspect of the inclusion compound's isotherm reveals a IV type isotherm, which is characteristic to the mesoporous adsorbers, presenting the so-called capilar condensation phenomenon [5]. The results of pore distribution calculus (Fig.3) indicate the occurrence of some mesoporous with 3.23 nm radius. In the domain of partial pressures values higher than p/p_0 □0,5 the isotherm unveils the appearance of an H3 type hysteresis, indicating the existence of pores with a relative even distribution [6].

Table 1 shows thee results of washing and rubbing fastness measurements of the fabrics dyed with bilberry extract, in comparison with the reference samples (linen and linen/ MCT-ß-cyclodextrin), along with values assigned to MCT-ß-cyclodextrin nanocavity and dye radius.

Table 1: Fastness values and CD radius/Dye radius ratios for linen fabrics dyed with bilberry extract

Sample and code	**Dry rubbing fastness**	**Wet rubbing fastness**	**Washing fastness**	**CD radius/Dye radius Ratio, nm**
Linen	2	1-2	2-3	
Linen / MCT-ß-cyclodextrin	3-4	2	4-5	
1	3	3	2-3	-
2	4-5	3-4	4-5	2.17 / 2.76
3	3-4	3	4	-
4	5	4	4-5	3.23 / 3.47

The colour fastness values for samples dyed with *Vaccinium myrtillus* anthocyanins extract reveal moderate to good rub and wash fastness of the most samples, in particular for those previously functionalized and dyed by ultrasonication procedure.

The obtained results show that choosing natural dyeing of cyclodextrin grafted linen fabrics proved to be a good alternative to improve the washing and rubbing fastness of the studied specimens.

3. CONCLUSIONS

The current investigation demonstrates that bilberry can be effective as natural dye source to be applied on natural fibers, the result of the present research being a textile eco-composite. Ultrasonication proved to be a suitable method for dyeing with anthocyanins based dyestuff. The novel experimental protocol of dyeing using the natural extract will be brought to industrial micro-scale for an improved environmental stability.

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4. REFERENCES

[1]. Dai, J. & Mumper, R.J. (2010). Plant Phenolics: Extraction, Analysis and Their Antioxidant and Anticancer Properties, *Molecules*, Vol.15, 2010, p.7313-7352, ISSN 1420-3049.
[2]. Norasiha, H., Mimi Sakinah, A.M. & Rohaida, C.M.(2009). Characterization of β-cyclodextrin complexes with natural dye, *National Conference on Postgraduate Research (NCON-PGR)*, Noor, M.M., Rahman M.M., Kadirgama K.(Eds), UMP Conference Hall, Malaysia, Universiti Malaysia Pahang, pp.98-106.
[3]. Shahidi, S., Wiener, J. Ghoranneviss M.(2013). Surface Modification Methods for improving the Dyeability of Textile Fabrics, In *Eco-friendly textile dyeing and finishing*, Gűnay M.(Ed.), pp.34-52, Publisher: InTech, ISBN 978-953-51-0892-4.
[4]. Azmal Morshed, A.M..(2011).Application of Recent Developed Techniques in Textile Wet Processing, *Bangladesh Textile Today*, Vol.2, No.3, pp. 53.
[5]. Sing, K.S.W. (1985). Reporting physisorption data for gas/solid systems with special reference to the determination of surface area and porosity, Pure and Applied Chemistry, Vol. 57, No.4, pp.603-619.
[6]. LeVan M.D., Carta G. & Yon C.M., (1999). Adsorption and ion exchange, In: *Perry's chemical engineer's handbook*, Green D.W. (Ed.), 7th Edition, McGraw-Hill, New York.

APPLICATIONS OF COTTON WASTE FIBERS FOR ACTIVATED CARBON PRODUCTION

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Abstract: The activated carbon production from waste cotton fibers from weaving plants was investigated in this paper. They are waste airborne fibers that arise as a by-product in the process of weaving. Waste cotton material is used for the production of activated carbon, which is then can used for the reduction of textile dyes coloration in the solution, for example. The activated carbon used is relatively fine bulk material with heterogeneous porous particles of diverse shapes and forms. Qualitative and quantitative characterization of activated carbon shows that carbon is predominant in its chemical composition with the presence of several other elements. Textural properties of activated carbon show different parameters, which by their numeric values characterize the specific surface area, pore volume, pore diameter, etc. Pore volume according to Gurvich for p/p_0 of 0.98 was 0.0051 cm^3/g. By the BET method, we are calculated volume of gas adsorbed in the monolayer (V_m, 0.49 cm^3g^{-1}) and the constant (C_{BET}, 5.22). Specific surface area of the sample, S_{BET}, was calculated and amounted to 2.14 m^2/g. Dubinin and Radushkevich method with its equation was used to calculate the micropore volume based on adsorption isotherms. Based on the results, it can be said that the activated carbon produced from waste cotton fibers has potential as an adsorbent.

Key words: activated carbon, waste, cotton fibers, modification.

1. INTRODUCTION

Activated carbons are the most commonly used adsorbents in separation and purification processes. Lately, the efforts of scientists to find alternative adsorbent to replace the costly activated carbon have been intensified. Some of the potential low-cost adsorbents for the removal of metals and organic substances are industrial waste materials. The purpose of activation is to obtain effective low-cost adsorbent. Activation can be carried out by chemical and physical methods. In chemical activation, the basic material is impregnated by various chemical substances, and then carbonized. Physical activation involves carbonization of carbonaceous feedstock, followed by gas processing of the obtained carbonizate, or direct activation of the initial material by activating agents (such as CO_2, water vapor, N_2, H_2, O_2 ...) [1-5].

The basic structural units of active carbons are nanocrystallites consisting of planes of bonded six-membered carbon rings with many vacancies, defects and impurities in between. Heteroatom functional groups at the edges of aromatic layers break parallel plane orientation characteristic of graphite, and provide the so-called turbostratic structure characteristic of activated carbon. The most common heteroatoms in the structure are hydrogen, oxygen, nitrogen, sulfur and phosphorus, and functional groups they form determine the reactivity in the adsorption, catalytic and electrochemical processes [6-8].

This paper deals with the modeling of activated carbon produced from waste cotton fibers from the weaving plants. These airborne waste fibers are formed as a by-product in the weaving process using cotton yarns on looms. The aim is to use the waste cotton material, make it into activated carbon and use it for different purposes, such as coloration reduction, i.e. removal of textile dyes by adsorption on activated carbon.

2. EXPERIMENTAL

Activated carbon obtained by chemical and physical modification of waste cotton fibers from the weaving plants was used as an adsorbent. After the collection of waste fibers, they were washed in warm distilled water (40^oC), dried and subjected to the treatment by concentrated sulfuric acid (1 g of waste fiber: 5 g H_2SO_4) for 24 h at room temperature. The samples were then heated at 180^oC for 1 hour, followed by rinsing with distilled water and neutralization to pH=7 (with sodium bicarbonate). After drying, the obtained residue (activated carbon) was milled and then sieved to a particle size of 0.5 mm.

SEM measurements were carried out on a JEOL JSM - 6610LV device using a secondary electron detector. Also, as the SEM is equipped with EDS X-rays detector, characteristic X-rays of major elements (> 10 wt.%) were measured. EDS system enabled rapid assessment of the elemental composition of the sample - the adsorbent.

3. RESULTS AND DISCUSSION

The activated carbon used is relatively fine bulk material with heterogeneous porous particles of diverse shapes and forms. Within larger particles there are conspicuous cracks, cavities and channels that form the basis of the microporosity of materials. Otherwise, the inherent high porosity of activated carbons is provided by the presence of particles of irregular shape, a high degree of amorphization and a number of gaps in the structure. Micrograph in Figure 1 gives the appearance with ×250 magnification. In addition to differences in shape, pores vary according to their availability for adsorbate molecules, which is associated with the fact that they can be closed, open at one end or both ends, they can be isolated or joined. Taking into account the classification of pores according to their size, meso-and macropores can be said to be dominant in the sample used.

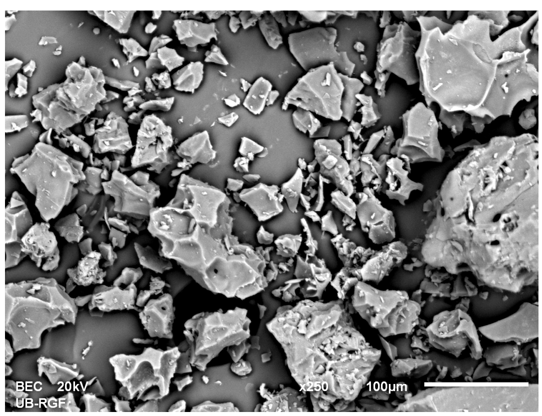

Figure 1: Micrograph of the adsorbent used (activated carbon)

EDS system allows rapid assessment of the elemental composition of the sample (Fig. 2). Sample analysis is non-destructive and quantitative analysis can be obtained by a spatial resolution of the order of magnitude of 1 μm. For finely polished samples analyzed normal to the electron beam, accuracy of the order of 1-2% of a given element contained in the sample can be obtained, and 5-10% for biological samples. However, it should be noted that, if, for example, there was hydrogen, lithium and beryllium (which the instrument cannot detect) or other detectable elements content below 0.05%, then the amount of detected elements should be taken with a reserve, i.e., there is a possibility of a mistake.

In Figure 2 shown is the EDS spectrum of activated carbon, which shows its qualitative chemical composition, on the basis of which was established the presence of the following chemical elements: carbon, oxygen, sodium, aluminum, silicon, sulfur and calcium. This spectrum shows the distribution of X-rays by energies that are characteristic for each element. The abscissa of the spectrum diagram represents the energy of X-rays in kiloelektron-volts, and the ordinate the intensity of radiation pulses.

Based on the data in Figure 2 carbon is dominant, as expected, while the increased presence of oxygen is related to aluminum oxide, silica or aluminosilicate, but since aluminum and silicon are very scarce, it is assumed that this is due to the ability of activated carbon to react with oxygen from the air. The activated carbons exposed to the air are subject to adsorption of atmospheric oxygen which results in increasing the number of surface functional groups such as phenolic, lactolic, carboxylic ... Particularly interesting is the presence of sulfur, which appears in the structure of activated carbons in the elemental form (typically up to 5%) in the form of inorganic or organic compounds. The complexes of carbon and sulfur in the structure of activated carbons are very stable and are not removed even at temperatures above 1100^{o}C, unless the reducing atmosphere of hydrogen is present. Sulfur is included in the structure of activated carbon by capillary condensation, adsorption, and chemisorption and by reacting with surface oxygen functional groups.

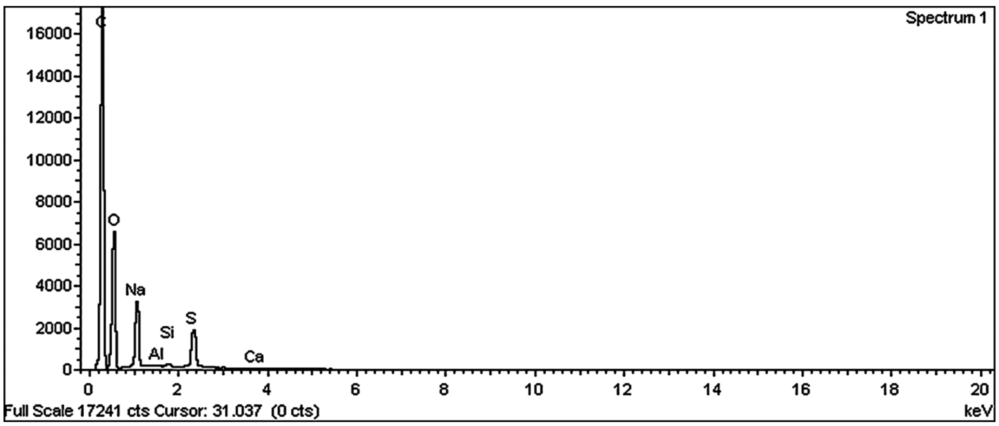

Figure 2: Qualitative composition of the active carbon obtained by EDS spectrum analysis

Table 1 shows the quantitative composition of active carbon, i.e., the percentage of one element in relation to the sum of all detected elements. All elements (e.g., C, O, Na, Al, Si, S, and Ca) detected in this analysis constitute 100% and the individual percentages of each element means that 100 g of all detected elements contain that exact quantity in grams of each element.

Table 1: Quantitative composition of the adsorbent used according to EDS spectrum analysis

Spectrum	C	O	Na	Al	Si	S	Ca	Total
Weight %	57.69	36.13	4.16	0.05	0.10	1.84	0.03	100.00
Mean	57.69	36.13	4.16	0.05	0.10	1.84	0.03	100.00
Std. deviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Max.	57.69	36.13	4.16	0.05	0.10	1.84	0.03	
Min.	57.69	36.13	4.16	0.05	0.10	1.84	0.03	

Analyses of specific surface area and pore distribution of the synthesized activated carbons were carried out by nitrogen adsorption at -196^{o}C on a Sorptomatic 1990 analyzer (Thermo Fisher Scientific Inc.). Before measurements, the samples were degassed for 12 h at 110^{o}C. Determination of the specific surface area of samples was performed by Brunauer-Emmett-Teller (BET) method, the mesopore volume and surface area were determined by Barret-Joyner-Halenda (BJH) method, and the micropore volume was obtained by using the Dubinin-Radushkevich equation.

Textural properties of activated carbon are given in Table 2. The results show different parameters, which by their numeric values characterize the specific surface area, pore volume, pore diameter, etc.

Table 2: Activated carbon textural characteristics obtained by analyzing the adsorption and desorption of N_2

S_{BET} (m^2/g)	$V_{0.98}$ (cm^3/g)	V_{mic} (cm^3/g)	S_{mic} (m^2/g)	V_p (cm^3/g)	D_{max} (nm)	D_{av} (nm)
2.14	0.0051	0.00085	2.40	0.0041	2.3	8.7

S_{BET} - specific area according to BET method
$V_{0.98}$ - total pore volume at a relative pressure p/p_0 - 0.98 to Gurvich method
V_{mic} and S_{mic} - micropore volume and specific surface area - by Dubinin and Raduskevich method
V_p, D_{max}, D_{av} - micropore volume, maximum pore diameter and average pore diameter from the distribution according to Dollimore and Heal method for mesopore

Gas adsorption on porous materials with variable pore sizes takes place in two phases. In the first phase, the gas adsorption takes place in the monolayer and filling of pores continues through multilayer adsorption of adsorbate molecules. The pores filling method depends on the pore size, the size of adsorbate molecules, gas-solid interaction, operating temperature... When the primary and secondary layers are formed, the pore filling reaches the critical size of radius when the capillary condensation occurs in mesopores with a diameter larger than 2 nm. In the micropores with pore diameter less than 2 nm there is only a primary and a secondary layer of adsorbed gas and no capillary condensation.

The adsorption-desorption isotherm (Figure 3) represents a change in the amount of adsorbed gas (V_{ads}), on the solid material as a function of the equilibrium pressure (p/p_0), at constant temperature. The shape of adsorption-desorption isotherm depends on the porous structure of the solid material. According to IUPAC classification there are six types of adsorption isotherms which enable determination of the textural properties (specific surface area, pore volume, pore volume distribution by diameter). Pore volume according to Gurvich for p/p0 of 0.98 was 0.0051 cm^3/g.

The curves shown in Figure 3 correspond to type III isotherms according to the IUPAC classification. The absence of a sharp decline in the area of low relative pressure indicates the absence of micropores. Isotherm has a reversible form throughout the range of the relative pressure. In type III the convexity to the x-axis extends along the entire isotherm. Isotherm convexity means that the particles that have been adsorbed tend to improve the adsorption of other particles from the depth of the phase. It is concluded that the interactions between the adsorbate particles are of primary importance here. Weak interactions at the beginning of adsorption (at low relative pressure) result in less pronounced adsorption. As the pressure increases, and new particles are adsorbed, the attraction between the adsorbate particles are increasingly favoring the adsorption, so the isotherm becomes convex.

Otherwise, type III isotherms are characteristic of systems in which the adsorbate-adsorbent interactions are weak. The density of adsorbate molecules in the monolayer is uneven, with a relatively high concentration of molecules in the active sites. With increasing pressure the average concentration of molecules increases and leads to multilayer adsorption on the active sites.

Desorption of the adsorbate from the surface, after reaching saturation, is the opposite process of adsorption. Adsorbate evaporation from mesopores typically occurs at pressures lower than those at which adsorption occurs. This causes the appearance of hysteresis loops, whose shape and size depend on the shape of the pores in the material (adsorbent). Materials with pores in shape of open cylinders, cones and wedges have the adsorption-desorption isotherm without hysteresis, as is the case in this study.

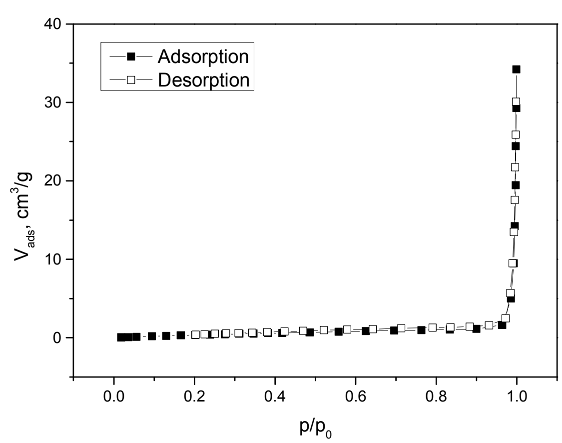

Figure 3: Adsorption-desorption isotherms of activated carbon

To determine the specific surface area by gas adsorption technique, a BET model was used based on the following assumptions: the solid substance surface is energetically homogeneous, monolayer and multilayer adsorption occur on solid surface, the nature of the interaction between the adsorbed gas and the surface is physisorption (ΔH = 10 - 40 kJ/mol), the heat of adsorption of the second and higher layers is equal to the heat of condensation, molecules covered by other molecules cannot evaporate, there is no interaction between the adsorbed molecules.

Determination of specific surface area was done from the linear part of the adsorption isotherm in the interval $0.05 < p/p_0 < 0.35$. Graphical presentation of dependency of relation $p/(V_{ads}(p_0-p))$ as a function of the relative pressure, on which the determination of specific surface area by BET method is based, is shown in Figure 4 (left graph - diagram). Also, in the same figure, the linear form of the BET equation is presented graphically (right graph). From the curve slope and intercept are calculated volume of gas adsorbed in the monolayer (V_m, 0.49 cm^3g^{-1}) and the constant (C_{BET}, 5.22). Specific surface area of the sample, S_{BET}, was calculated and amounted to 2.14 m^2/g.

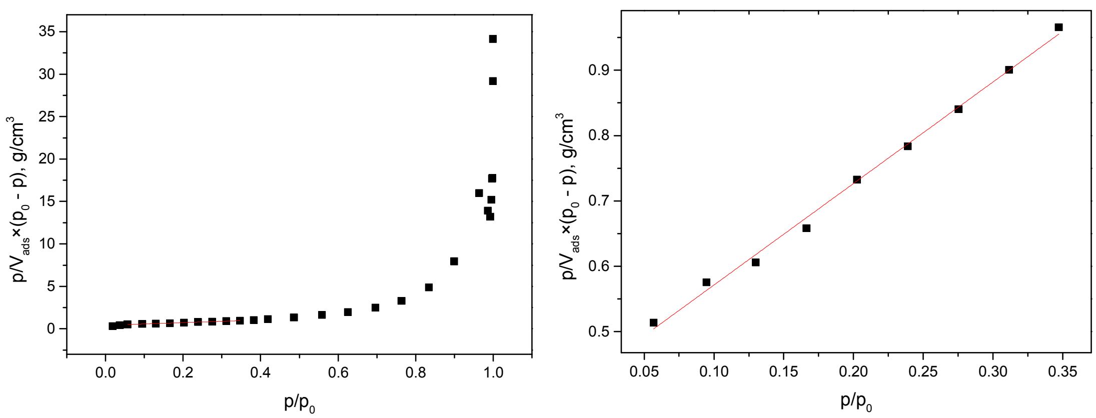

Figure 4: Graphical presentation of BET equation for determination of the specific surface area of activated carbon

Dubinin and Radushkevich method with its equation was used to calculate the micropore volume based on adsorption isotherms. Figure 5 gives the graphical representation of the equation (left graph) and its linearized part (right graph). Value of the intercept on the ordinate ($\log V_{ads}$) is the logarithm of the volume of gas adsorbed in micropores, whereby the micropore volume is calculated.

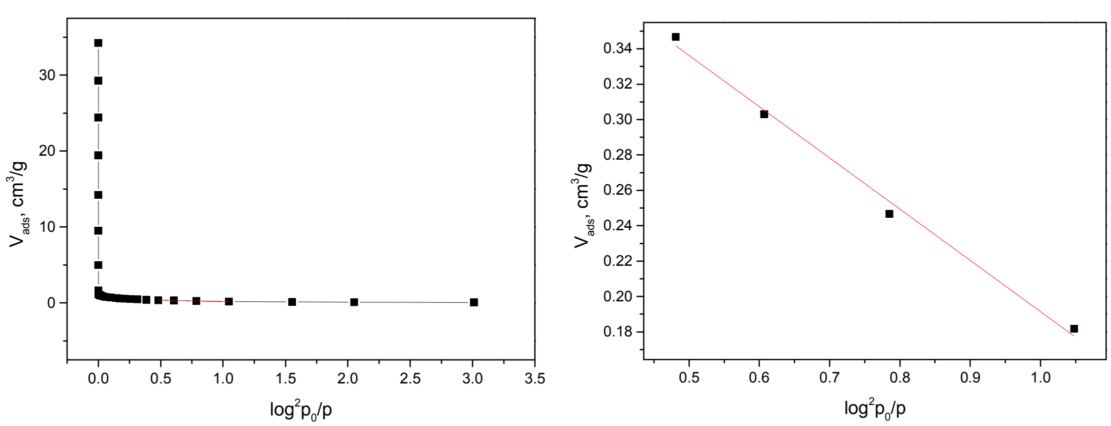

Figure 5: Dubinin-Radushkevich graph for the determination of micropore volume of activated carbon

Activated carbons belong to anisotropic materials. This means that their structural properties change depending on the direction of observation, unlike isomorphic crystalline materials which have identical properties in all directions and a crystal lattice reproducible in space. Rentgenographic studies showed that the basic unit of structure of active carbons were randomly assigned nanocrystallites, composed of layers of condensed hexagonal carbon rings (graphene layers), similar to graphite. The layers are connected by weak van der Waals bonds, whereby the carbon rings are packed in a hexagonal lattice and each layer is a polynuclear aromatic unit. Three of the four electrons of carbon are involved in the construction of σ bond with neighboring carbon atom from the lattice, while the fourth electron is delocalized in π electronic matrix whereby each bond achieves partially unsaturated character. The complex aliphatic-aromatic formations are also of great importance in the structure of activated carbons, because when mixed with nanocrystallites, they represent the basis of inhomogeneity of activated carbons. Microcrystalline structure of activated carbons differs from the structure of graphite in the existence of vacancies (holes). Occurrence of vacancies in the nanocrystalline structure of activated carbons is the basis of their anisotropy and depends on the presence of impurities in the precursor and the methods of preparation of activated carbon. Terminal functional groups are involved in forming bonds between the nanocrystallites [6,7].

4. CONCLUSION

With sulfuric acid as the activating agent, made was the thermochemical conversion of waste cotton fibers in powdered activated carbon. Activated carbon was investigated in terms of physical and chemical properties. In the elemental composition of the produced activated carbon dominated carbon, which was expected and in line with the theoretical data for activated carbon, which lead to conclusion that this material could be considered as a suitable carbon precursor for effective subjection to conversion into activated carbon.

Thus prepared, activated carbon could be used for the adsorption of organic dyes, from colored effluents of the textile industry, for example.

5. REFERENCES

[1] Hameed, B.H., Krishni, R.R. & Sata, S.A. (2009) A novel agricultural waste adsorbent for the removal of cationic dye from aqueous solutions, *Journal of Hazardous Materials*, 162 (2009) 305–311, ISSN 0304-3894.
[2] Sharma, P., Kaur, H., Sharma, M. & Sahore, V. (2011) A review on applicability of naturally available adsorbents for the removal of hazardous dyes from aqueous waste, *Environ Monit Assess,* 183 (2011) 151-195, ISSN 0167-6369.
[3] Wang, S. & Zhu, Z.H. (2007) Effects of acidic treatment of activated carbons on dye adsorption, *Dyes and Pigments,* 75 (2007) 306-314, ISSN 0143-7208.
[4] Denga, H., Li, G., Yanga, H., Tanga, J. & Tanga, J. (2010) Preparation of activated carbons from cotton stalk by microwave assisted KOH and K_2CO_3 activation, *Chemical Engineering Journal,* 163 (2010) 373–381, ISSN 1385-8947.
[5] Malik, P.K. (2003) Use of activated carbons prepared from sawdust and rice-husk for adsorption of acid dyes: a case study of Acid Yellow 36, *Dyes and Pigments.* 56 (2003) 239–249, ISSN 0143-7208.
[6] Girgis, B.S. & Ishak, M.F. (1999) Activated carbon from cotton stalks by impregnation with phosphoric acid, *Materials Letters,* 39 (1999) 107–114, ISSN 0167-577X.
[7] Ozdemira, M., Bolgaza, T., Sakab, C. & Sahinc, O. (2011) Preparation and characterization of activated carbon from cotton stalks in a two-stage process, *Journal of Analytical and Applied Pyrolysis,* 92 (2011) 171–175, ISSN 0165-2370.
[8] Amin, N.K. (2009) Removal of direct blue-106 dye from aqueous solution using new activated carbons developed from pomegranate peel: Adsorption equilibrium and kinetics, *Journal of Hazardous Materials,* 165 (2009) 52–62, ISSN 0304-3894.

REUSE IN EXHAUST DYEING PROCESSES OF TEXTILE WASTEWATERS

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Abstract: Textile dyeing and wet finishing wastewaters are considered a major concern because of the necessity of removing colour and pollutants before their discharge into the environment. Their chemical composition is diverse depending mainly on fashion, material and process. After the homogenization of all the wastewaters coming from the different textile processes, the generally used multi-stage technology for their treatment and purification combines physico-chemical and biological processes. However, these techniques are not efficient enough to eliminate completely colour and chemical pollutants contained.
Advanced oxidation processes (AOPs) are an attractive alternative to decolourize textile effluents, mainly those using solar radiation. One of the main characteristics of AOPs is their scarce oxidative selectivity, as a result of their high reactivity, which makes them desirable to eliminate recalcitrant pollutants.
The purpose of this study was to evaluate the application of a solar-driven photo-Fenton treatment to coloured textile effluents from dyehouses in order to study their decolourization and mineralization. Furthermore, the reuse of the treated wastewaters in new laboratory exhaust dyeing processes was studied with single and a mixture of three commercial direct dyestuffs containing different chromophores. The results of 99% decolourization, 95% DOC decrease and 99% COD removal were measured after no presence of hydrogen peroxide and filtration of the treated effluents. The solar photo-Fenton treated wastewaters were employed to dye the most common textile fibres and fabrics. Their reflections UV-vis spectrum compared to the pattern samples using deionized water were within tolerance (ISO 105 J03 $\triangle E^*$ CMC (2:1).

Key words: Dyestuff, wastewaters, decolorization, mineralization, photo-Fenton, sunlight.

1. INTRODUCTION

Textile industry, particularly dyeing and finishing, is believed to be one of the largest fresh water consumers as a natural resource. Textile dyestuffs are required to have a high degree of chemical and photolytic stability in order that they maintain their structure and colour[1]. However, the fixation of dyestuffs into the fibres depends directly on the material and the dyeing process applied. Consequently, large amounts of coloured wastewaters with a diverse chemical composition are generated [2,3].

Colour in textile wastewaters is considered public concern for their potential polluting effect. In addition, high concentrations of salts as sodium chloride or sodium sulphate are used to ensure maximum fixation of dyestuffs to the cellulosic fibres. Moreover, the variety of chemicals contained in these effluents must be taken into consideration for their effective treatment before their discharge into the receiving media.

A great effort has been made by textile industries with the application of effective multi-stage processes combining mechanical, chemical, physico-chemical, or biological methods. However, most of these on-site wastewater treatments are not efficient enough to completely eliminate the colour and pollutants contained [4,5]. Hence, innovative solutions looking for the sustainable development of textile industry and environmentally friendly processes are needed.

European Council Integrated Pollution Prevention and Control (IPPC) Directive, and the US Pollution Prevention Act (PPA) are among the examples of legislation underlining the significance of in-plant control measures. Besides, environmental and ethical issues attract public attention nowadays[6]. Therefore, the manufacturers are tending to improve their images through avoiding wasteful practices and applying appropriate wastewater treatments that focus on its reuse. Nevertheless, textile wastewater reutilization is only possible at particular phases of certain productive processes and cannot be extensively used.

In the last decades, the research of highly effective treatments as nanofiltration [7], electrochemical methods [8] or advanced oxidation processes (AOPs) has been carried in order to diminish the environmental impact of textile wastewaters. AOPs processes are based on the in situ generation of highly reactive and non-selective chemical species, which makes them suitable to treat recalcitrant pollutants. Although a great number of papers on the decolourization and mineralization of commercial textile dyestuffs using solar AOPs have been published [9], and others have focused on the treatment and re-use [10], very few have studied industrial textile wastewaters.

2. EXPERIMENTAL AND METHODS

2.1 Wastewater treatment

Industrial textile wastewaters containing the homogenization of the factory processes were taken from the on-site treatment plant of a dyehouse. As the wastewaters were a varied mixture of desizing, bleaching, dyeing, printing, washing, rinsing and cooling operations, absorbance measurements did not show a predominant peak. Authors decided to use 400nm as absorbance colour reference because this was the highest value registered in the visible spectra (Table 1).

Table 1: Homogenised wastewaters characterization

	Textile wastewaters
Absorbance $_{400nm}$ (UA)	1,409
DOC[a] (mgC/L)	399,5
COD[b] (mgO_2/L)	1476
Conductivity (μS/cm)	3010
[a] Dissolved Organic Carbon [b] Chemical Oxygen Demand	

Analytical grade hydrogen peroxide (30% w/v) and other chemicals were purchased from Panreac. Deionized water Milli Q grade using the water purification system Millipore model Elix3 from MerckMillipore (USA) was used for preparing pattern dyeing samples and other solutions.

For the solar photo-Fenton process, sulphuric acid was used to adjust the pH to 2.7 and Fe^{2+} (10mg/l) was added as iron (II) sulphate. Solar treatments were performed in Eastern Spain using a 4-litre pilot plant Solardetox, model Acadus-2001, described elsewhere[10]. The decolourization and mineralization of the textile effluents were checked according to Dissolved Organic Carbon (DOC) and Chemical Oxygen Demand (COD) measurements. Three pilot plant treatments varying the quantity of hydrogen peroxide were applied to the textile wastewaters and photochemical reactions were kept until (H_2O_2) consumption. Then, treated waters (T1, T2, T3) were filtered and characterized before being reused.

2.2 Reuse of photo-Fenton treated wastewaters

Solar photo-Fenton treated wastewaters were reused for laboratory dyeing tests of natural and synthetic fabrics and fibres following “All-in” exhaust standard procedures. Commercial dyes with different chromophores were used: 10g of textile material and 0.5% over fibre or fabric weight. A pattern sample using deionized water was prepared for every fibre or fabric dyeing procedure simultaneously. The pH for every dyeing process was adjusted and required auxiliaries were added following standard procedures.

3. RESULTS AND DISCUSSION

3.1 Wastewater treatment results

After the solar photo-Fenton treatments of the textile homogenized industrial wastewaters excellent results of decolourization and mineralization were achieved. The best results were measured employing the stoichiometric amount of hydrogen peroxide (Table 2).

Solar photo-Fenton treatment (T1) achieved complete decolourization and 95% DOC decrease and 99% COD removal. After treatment (T2), with half the stoichiometric amount of hydrogen peroxide, an absorbance decrease of 97%, 92% DOC and 97% COD removal were measured. Finished treatment (T3), with one third of H_2O_2, absorbance decrease was over 96%, 88% DOC and 95% COD removal were obtained.

Table 2: Homogenised textile wastewaters and solar photo-Fenton treated characterization

	Textile wastewaters	**T1**	**T2**	**T3**
Absorbance $_{400nm}$ (UA)	1,409	0,007	0,032	0,048
DOC (mgC/L)	399,5	18,6	29,6	45,9
COD (mgO_2/L)	1476	15,0	37,0	74,0
Conductivity (μS/cm)	3010	4066	4510	4406
H_2O_2 (mg/L)	-	3000	1500	1000
Treatment length (minutes)	-	450	360	300

3.2 Reuse of photo-Fenton treated wastewaters results

According to absorbance in the visible band of the treated textile wastewaters, it seemed interesting to reuse them in new dyeing processes, whose water quality requirement is one of the highest. All the three solar photo-Fenton treated wastewaters were reused in new dyeing laboratory processes because their organic load had a negligible effect.

Exhaust laboratory dyeing tests were performed over the most common textile fibres and fabrics applying an “All-in” exhaust method. Acid Orange 19 was used for dyeing polyamide fabric, Disperse red 60 for polyester jacquard material and Basic blue 41 for acrylic fibre. When dyeing bleached cotton satin, single dyestuff Direct red 80 was used and a mixture of three Direct dyestuffs (0.7% Direct yellow 98, 0.7% Direct red 80 and 0.6% Direct blue 77). For dyeing cotton fabric a proportion of sodium sulphate was added to copy the electrolyte of the pattern sample.

The colour differences (△E*) of the fibres and fabrics dyed using the treated wastewaters compared to the pattern employing deionized water, as calculated by ISO 105 J03 CIE L*a*b* (CMC (2:1)) were within tolerance (Table 3).

Table 3: Colour differences of the solar photo-Fenton treated wastewaters

	T1	**T1**	**T2**	CIE L*a*b*
Polyamide (Acid Orange 19)	0,49	0,64	0,36	△E*
Polyester (Disperse Red 60)	0,34	0,24	0,24	△E*
Acrylic (Basic Blue 41)	0,66	0,99	0,84	△E*
Cotton (Direct Red 80)	0,30	0,57	0,85	△E*
Cotton (0.7% Direct Yellow 98) (0.7% Direct Red 80) (0.6% Direct Blue 77)	0,58	0,65	0,58	△E*

4. CONCLUSIONS

Textile wastewaters are likely to be highly coloured and create a potential environmental and aesthetic problem worldwide. Industries must consider the economic benefits if they improve their manufacturing techniques or adopt eco-friendly wastewater treatments in order to enhance their corporate social responsibility.

Solar homogeneous photo-Fenton has been proved an effective process for the treatment of textile industrial wastewaters. This technique provides the possibility to be applied as a single treatment or coupled to the existing on-site treatment plants. Its worldwide implementation as an innovative and environmentally friendly process in the textile mills would enhance industries sustainability, especially in areas with long solar exposition periods. Moreover, the problem of colour in dyeing and finishing effluents will be eradicated and the polluting effect of the textile wastewaters will be diminished as well.

Treated wastewater quality after the treatments allowed its reuse without dilution in new laboratory exhaustion dyeing processes with a single dyestuff and also with a mixture of dyestuffs with different chromophores. The reflection spectra and colour differences of the samples dyed with reused waters compared to those dyed with deionized water were within tolerance (colour differences △E* CMC (2:1) calculated by CIE L*a*b* ISO 105 J03).

Solar photo-Fenton wastewater treatment and the consequent reuse will help to minimize the fresh water requirements in dyehouses. Furthermore, due to the mineral salts of the wastewaters treated, a reduction in their proportion was used when dyeing cellulosic fabrics. In some countries, the economic benefits for textile industries adopting reuse could be a significant cutback for their wastewater levies.

Nevertheless, due to the chemical complexity and disparity of textile wastewaters, a firm case-by-case study should be necessary for the best efficiency of the treatment process and the subsequent reuse possibilities in any industrial textile operations and procedures.

5. REFERENCES

[1]. Easton, J.R. (1995). The dye maker's view, In: *Colour in Dyehouse Effluent*, Ed. by Cooper P., page numbers 9-21, Society of Dyers and Colourist, The Alden Press, ISBN 0901956694, Bradford.
[2]. O'Neill, C., Hawkes, F.R. & Hawkes, D.L. (1999). Colour in textile effluents – sources, measurement, discharge consents and simulation: a review. *Journal of Chemical Technology and Biotechnology,* 74 (11), October 1999, pp. 1009-1018, doi: 10.1002/(SICI)1097-4660(199911)74:11
[3]. Sharma, K.P., Sharma, S. & Sharma, S. (2007). A comparative study on characterization of textile wastewaters (untreated and treated) toxicity by chemical and biological tests. *Chemosphere*, 69 (1), June 1999, pp. 48-54, doi: 10.1016/j.chemosphere.2007.04.086
[4]. Hao, O.J., Kim, H. & Chiang, P.C. (2000). Decolorization of wastewater. *Critical Reviews in Environmental Sci. and Tech.,* 30 (4), June 2000, pp. 449-505, doi: 10.1080/10643380091184237
[5]. Forgacs, E., Cserháti, T. & Oros, G. (2004). Removal of synthetic dyes from wastewaters: a review. *Environmental International,* 30 (7), 2004, pp 953-971, doi: 10.1016/j.envint.2004.02.001
[6]. Germini, F. (2011). Wastewater Reuse in Textile Industry, In: *Security of Industrial Water Supply and Management*, Ed. by Atimtay A.T. and Sikdar S.K., page numbers 131-139, NATO Science for Peace and Security Series C: Environmental Security. Published by Springer Science+Business Media B.V., ISBN 978-94-007-1804-3, The Netherlands.
[7]. Bruggen, B.V., Boussu, K. & Vreese, I.De. (2005). Industrial Process Water Recycling: Principles and Examples. *Environmental Progress,* 24 (4), December 2005, pp 417-425, doi: 10.1002/ep.10112
[8]. Riera-Torres, M., Gutierrez-Bouzan, M.C. & Valldeperas, J. (2011). Influence of electrochemical pre-treatment in dyeing wastewater reuse for five reactive dyes. *Textile Reseach Journal,* 81 (18), November 2011, pp 1926-1939, doi: 10.1177/0040517511413316
[9]. Torrades, F., García-Montaño, J. & García-Hortal, J.A. (2004). Decolorisation and mineralisation of homo- and hetero-bireactive dyes under Fenton and photo-Fenton conditions. *Coloration Technology,* 120 (4), July 2004, pp 188-194, doi: 10.1111/j.1478-4408.2004.tb00228.x
[10]. Pey, J., Amat, A.M. & Arques, A. (2008). Re-utilization of exhaustion baths in cotton-dyeing processes after solar-based photo-oxidative treatments. *Journal of Advanced Oxidation Technology,* 11 (2), July 2008, pp 389-395

STUDY REGARDING THE OPTIMIZATION OF WOOL DYING WITH NATURAL DYES EXTRACTED FROM GREEN WALNUTS PART 1: DETERMINATION OF THE EFFICIENCY OF THE DYING TREATMENT

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Abstract: In this work it has been verified the efficacy of the treatment of the wool dyeing with dye extracted from green walnuts husks using three methods: determination of the concentration of the dye adsorbed in fibre; determination of total exhaustion and determination of dyeing resistances at 40^0C washing. Using the values obtained for dye concentration absorbed in fibre were established the optimum working parameters for dying process with dye extracted from green walnuts husks.

The husks of green nuts has compounds from naphthoquinones namely juglone (5 hydroxy-1,4 naphthoquinone), red-brown crystals with m.p. = 155^0C. This is in the form of leuco compound which oxidizes in air, becoming dark-brown [1]. Juglone (5 hydroxy-1, 4 naphthoquinone) crystallizes in benzene - petroleum ether, being in a state of 4β-D glucozido-1,4,5-trihydroxynaphthaleno (α-hydrojuglone) and as a mixture of α and β - hydrojuglone with tannins. [2, 3, 4]

The free Juglone is unstable and is rapid polymerizate. It goes in black brown colour matters which colour the textile fibres in shades of brown.

The study has followed the extraction of natural colorant from green nuts and its characterization through spectral and chromatography analysis techniques.

Using the chromatography technique, it was observed the presence of a single coloured spot in brown, the characteristic colour of juglone.

Analyzing the obtained UV-VIS and IR spectra, it was observed the presence of characteristic groups of compounds 5 hydroxy -1.4 naphthoquinones.

Key words: adsorbed dye, exhaustion, wool, naphtocquinone, Juglonine

1. INTRODUCTION

The dye extracted from green walnuts husks is used at natural fibres dyeing with or without mordents [5].

From chemical point of view the dye is part of naphtoquinones class and in technological point of view of the dye structure is complex [5]

This dye can be found in the "Color Index" at position: - C. I. Natural Brown 7 or C. I. 75500, yellow brown dye [5-9], as is shown in fig. 1.

From a structural point of view naphtoquinone contains: two groups carbonyl (>C=O) what constitutes the chromatophores and a hydroxyl group (OH) that constitutes auxochrome [5-9].

Juglonine has solubility because it has the molecular weight: Mjugloine =174,15 g/mol [5-9].

Having in mind that it is a naphtoquinone dye with an OH group, will form salt type chemical bonds with the fabric used as support [9].

For this reason, it was chosen for the study of wool fibre dying the tinctorial mechanism: wool-dyes complex.

About the physical bounds that can be established between dye and fibre, they are: hydrogen bounds and van der Waals bounds [9].

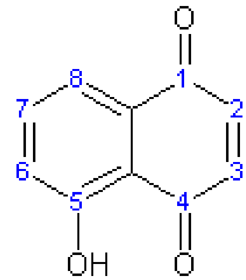

Figure 1: Juglonine's structure (5OH 1-4naphtoquinone)

2. EXPERIMENTAL PART

In this research were used wool fibres sort 11.

The dyeing has been lead under the following conditions:

-x - the concentration of the dye (g plant/g fabric); 2% acetic acid; 2% sodium sulphate;

-y - the temperature (^{0}C); ratio 1:100; -M_{fabric} =1 g.

Before dying was made an activation of the wool fibre in the following conditions: 2% glacial acetic acid; ratio 1:100; - t =15 min; - T= 100^{0}C.

The efficacy of the dying treatment was measured by: determination of the dye concentration adsorbed by the fibre, determination of total exhaustion, determination of dyeing resistances at 40^{0}C washing

The determination of the adsorbed dye concentration was done by the calibration curve method.

The extinctions have been read on a Specord 200, equipped with quartz tanks with a capacity of 3 ml at a selected wavelength in the spectrum UV/VIS of the dye. It was plotted the standard curve for this dye.

The extract was obtained by the maceration of 20 grams plant in 100 ml of distilled water, from which it has been 1 ml extract and it has been diluted in 100 ml of distilled water. The results are presented in table 1 and figure 2 .

Table 1: Extinction and adsorbed dye concentration

Total volume of extract [ml]	Dye mg/3 ml	Extinction
1,5	3	0,1728
0,75	1,5	0,0972
0,38	0,75	0,048
0,19	0,38	0,0189

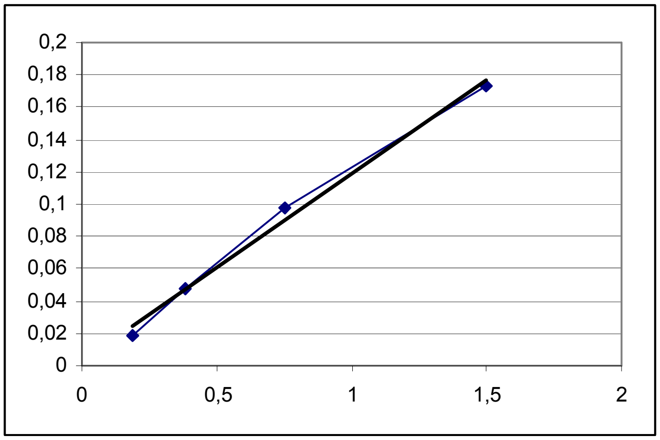

Figure 2: Standard curve of the dye

It has been established the equation of the line that characterise the dye concentration in the bath, depending on the extinction, as is shown in figure 2. The equation is the following:

$$Y = 0,116x + 0,001 \quad \textbf{(1)}$$

Later, was determined the concentration of the adsorbed dye and the total exhaustion of the bath. The results were obtained by measuring the initial and final exhaustion of the bath for each dye. The results obtained after dates processes are shown in table 2.

Table 2: Concentration of the adsorbed dye and the total exhaustion

Sample	λ(nm)	Initial bath extinction Ei	Residual bath extinction Er	Adsorbed dye [g]	Exhaustion %
1	420	0,2561	0,1602	0,2621	37,446
2	420	0,5306	0,288	0,5944	45,722
3	420	0,2757	0,2115	0,1630	23,286
4	420	0,5191	0,3694	0,3749	28,838
5	420	0,2148	0,1531	0,1436	28,724
6	420	0,6102	0,4083	0,4963	33,088
7	420	0,4023	0,2598	0,3542	35,421
8	420	0,4959	0,384	0,2257	22,565
9	420	0,4341	0,2751	0,3663	36,628
10	420	0,4341	0,2751	0,3663	36,628
11	420	0,4342	0,2751	0,3664	36,642
12	420	0,4342	0,2752	0,3662	36,619
13	420	0,4341	0,2751	0,3663	36,628

3. CONCLUSIONS

The experiments were made out in accordance with STAS ISO 105 C 02 or SR EN 20105-C02.

Evaluation of the washing resistance was made using ladder of grey. The notation form has three digits, as follows:
- digit 1 - represents the degree of bleed the dyed and washed sample

- digit 2 - represents the degree of contamination of the sample white from the same material with the dyed sample;
- digit 3 - represents the degree of contamination of white sample from different material (cotton) as the dyed sample

The results are presented in table 3.

Table 3: Dying resistance at washing at 40^0C

Experiences' number	**Dying resistance at washing at 40^0C**
1.	5/5/5
2.	5/5/5
3.	5/5/5
4.	5/5/5
5.	5/5/5
6.	5/5/5
7.	5/5/5
8.	5/5/5
9.	5/5/5
10.	5/5/5
11.	5/5/5
12.	5/5/5
13.	5/5/5

It is found that washing resistance at 40^0C is very good.

4. REFERENCES

[1]. Nenițescu, C.D., Didactic and pedagogic Printing House, Bucharest, 1974, vol.II
[2]. Botu I., Botu M., Achin Gh., „ Cultivation in modern exploitations”, Phonix Printing House, 2001

[3]. CAMERON, D. W., Y CRAIK, J. C. A. 1968: J. Chem. Soc. (C). 3068

[4]. Segundo G.O., [Quinone natural pigments], Editorial Universidad Nacional Mayor de San Marcos, Ed. Salaverry García, Oswaldo, 277 p., 1998.
[5]. Taylor G.W., Natural Dyes in Textile Applications, *Review of Progress in Coloration and Related Topics*, 16 (1), 53-62, 1986
[6]. Wang Y.N., Wang H.X., Shen Z.J., Zhao L.L., Clarke S.R., Sun J.H., Du Y.Y., Shi G.L., Methyl palmitate, an acaricidal compound occurring in green walnut husks, *J. Econ. Entomol.,* 102 (1), 196-202, 2009
[7]. Chen Li, Jun-Xi Liu, Liang Zhao, Duo-Long Di, Min Meng, Sheng-Xiang Jiang, Capillary zone electrophoresis for separation and analysis of four diarylheptanoids and an α-tetralone derivative in the green walnut husks (*Juglans regia* L.), *Journal of Pharmaceutical and Biomedical Analysis*, 48 (3), 749-753, 2008
[8]. Buttery RG, Light DM, Nam Y, Merrill GB, Roitman JN., Volatile components of green walnut husks, *J. Agric Food Chem.*, 48 (7), 2858-2861, 2000
[9]. A.G.I.R., S.T.I.R., „The book of textile engineer”, Vol.II, Part B, 2005

IMPACT OF THE TEXTILE INDUSTRY ON THE ENVIRONMENT IN THE CONTEXT OF ITS SUSTAINABLE DEVELOPMENT

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Abstract: This paper presents the impact on the environment of textile products, highlighting that their pollution is primarily exerted on air and water. Textile industry affects the environment through the consumption of water, energy and chemicals, as a result of the existence of a great number of processes through which fibers are passing until they are transformed into finished products, and the large amount of waste they generate. They may be recoverable (resulting from the spinning phases, yarn waste from spinning mills, weaving mills, knitting, weaving heads and strips from weaving mills and cutting section, patches from the cutting stages etc.) returned to the manufacturing process they can be used to obtain vicuna yarns, non-woven textile fabrics, cotton upholstery for furniture and cars, insulating materials, geotextiles, etc. or irrecoverable – which are incinerated or discarded in landfills - polluting both air and ground. Waste generation involves a loss of materials and energy and imposes high environmental and economic costs to society - of collection, treatment and processing. Therefore we believe that the desire of "zero waste" is currently one of the strategic directions for sustainable development of a society based on knowledge. Suggested solutions to reduce pollution exercised by textiles products various measures were proposed, such as: sound management of waste, recycling and the increase of "green" products in the all textile products.

Key words: sustainable development, textiles, pollution, waste, "green" products

1. INTRODUCTION

Currently, the development concept applied to any economic segment cannot be separated from issues and specific ways of ensuring sustainable development, a concept having global meanings of peace and progress, respect for nature and life.

The best known definition of sustainable development is that given by the World Commission on Environment and Development in the report "Our Common Future", also known as the Brundtland Report, which defined sustainable development as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs* ". We find the message of this report again within the "Principle 3" of the Rio Declaration on Environment and Development (3-14 June 1992), according to which the "*the right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations*."

The concept of sustainable development is indissolubly linked to the quality of life and it includes the achievement of three desiderates [1], namely:

• **economic welfare** - aims to generate a maximum flow of income while maintaining the capital that produced these benefits;

• **social stability** - provides human capital condition necessary for any type of development, including reducing destructive conflict;

• **environment** - aims to conserve biological and physical stability of natural systems.

In recent years, the operationalization of sustainable development has become a strategic objective for all humanity, it must be adapted to country-specific, depending on the specific national demographics, the natural environment, the built space, etc. Thus, undeveloped countries, in the steps that them follow on the development path, not to imitate the way followed by developed countries, from the past until today, their development solution should be based on creating a society that is intrinsically compatible with its environment. [2]

Meaning of sustainable development can only be achieved by finding the best models endogenous reconciliation between man and nature, and the first steps in this direction include [3]:

• knowledge of the natural environment and the interactions between the social, economic and natural systems, providing closer and more distant consequences of these interactions;

• rational use of natural resources, regardless of their origin;

• diligent prevention and combat of environmental degradation, whether man-made or natural causes;

• harmonize the immediate, long term and permanent interests of human society, in the use of natural environmental factors.

Achieving these objectives requires that economic and social development be carried out based on a thorough knowledge of environmental implications and consequences in these fields, and on careful research of the contradictions they may cause, establishing, in each case, practical ways to efficiently solve those contradictions.

Since sustainable development requires the rational use of resources, it was often seen as a process of reduction or moderation of development. [4]

2. ANALYSIS OF IMPACT ON THE ENVIRONMENT OF TEXTILE PRODUCTS

In the context of sustainable development, the textile industry is going through a difficult time, being under pressure from all sides: on the one hand, customers want the lowest price and call, at the same time, for ecological products and technologies, and on the other part - governments impose new environmental policies and a tighter legislation. In addition to these, globally, there is an increase in the prices of energy, water, raw materials, wages etc.

Finding solutions for the needs of manufacturers in this field requires an environmental impact analysis carried out for the entire life cycle of textiles, because, from fiber production to waste disposal, they generate multiple sources of pollution, as can seen in the following figure.

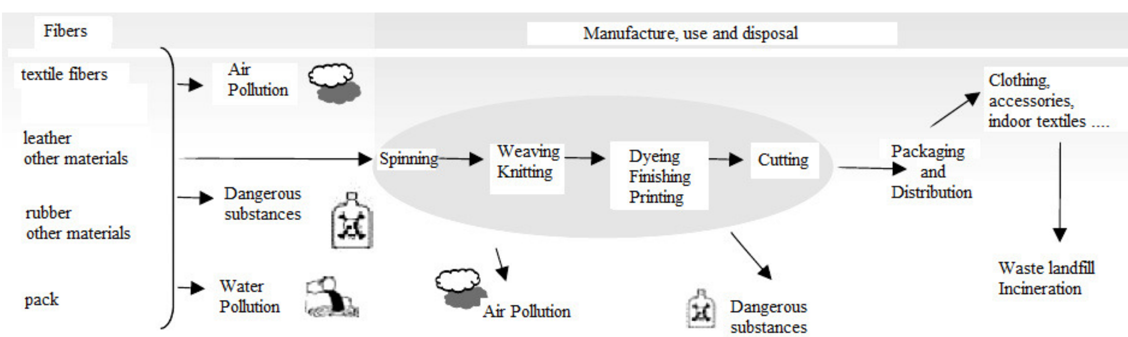

Figure 1 - Types of pollution in textile products lifecycle

Detailing the steps taken in the technological processes in the textile industry, we emphasize that the first step - that of obtaining the natural bast fibers foundries of agricultural raw materials, there is pollution of the air by spreading textile easily in the atmosphere, by evaporation of used chemicals and the release of toxic gases formed during these processes and also the waste water for wet processing results achieved at this stage - high degree of pollution exert pesticides removed from cotton, flax and hemp, and other chemicals (lactic acid, alcohols, peptides, waxes) resulted in the melting process. In processing wool (degreasing, carbonization, carding, washing, bleaching, dyeing, carding, etc.) are used over 800 chemicals [5], such as acids and alkalis, oils , detergents, dyes, SO2, H2O2 and so on, all adversely affecting water quality. Negative effects on water occurs by changing the pH and color by the presence of dissolved or suspended solids, the phenols, chlorides, oils and fats, sodium sulphate etc..

In natural yarn spinning stage, carried out in spinning mills, main pollution released in the air by the lint and the noise in these enterprises (noise pollution). In chemical plants in which artificial yarns are produced pollution comes mainly from the chemicals used: acrylonitrile, antimony, lead, aromatic diisocyanates, sulphur compounds, volatile organic compounds, nitrogen oxides, zinc, copper, etc.

In knitwear factories and mills, there is air pollution from both the loose lint and thread through the noise of the machines used at this stage in the technological process. If the products obtained at this stage that is the fabric or the knitted product are subject to the finishing processes, such as: dyeing, bleaching, printing, ironing, can cause pollution of water and air by the chemicals used in these processes or the already existing in the material structure of the previous stages. Also in this stage textile products may be subject to fluffing operations with negative influences on air.

Next steps, namely cutting, assembly of parts, packaging and distribution of products, do not create serious pollution problems.

After all the processes described above there remains waste. These operations will be subject to cutting, unweaving and defiberizing, to obtain fiber mixtures which are used for the production of nonwoven products - operations with negative impact on air by loose lint, or will be incinerated - where pollution is exercised also on the air.

As it could be seen from the analysis steps taken to make textiles, there are many steps that require water use. Studies on water consumption in textile companies revealed that it ranges between 20 and 1000 m^3/tonne per product. [6]

Regulations in force require rigorous monitoring and performance checks on the handling and use of chemicals used in technological processes. Also it is necessary to find processes that use less toxic substances as finishing processes and finding intelligent systems to reuse wastewater. To reduce air pollution by lint using vacuum cleaners mounted in areas where the lints are formed and some air filtration systems to purify and recycle the air.

3. SOLUTIONS FOR MINIMIZING POLLUTION EXERTED ON TEXTILES

3.1. Rational management of waste

Textile industry, as we showed above, affects the environment by the consumption of water, energy and chemicals, and by the large amount of waste they generate as a result of using a huge number of chemicals and technological processes. Even the used fabrics are an environmental problem because due to the mixed composition of the fibers, many of which cannot be recycled. [7]

Wastes are additional products resulting from industrial activity and waste management is a process by which these products are reduced, reused, recycled, collected, stored, transported or disposed of.

Textile waste called in time as MTS (Secondary Textiles), MR (recyclable materials) and MTR (Reusable Textiles) come primarily from textile manufacturing processes (spinning, yarn preparatory, weaving, knitting, chemical finishing), manufacturing, processing in other industries (chemical fiber plants or units processing the textiles) or as a result of physical and moral wear after some time of using textiles. [8]

Negative effects on the environment and consequently on human health, require solutions for reducing the amount of waste both by reusing the recyclable waste in production processes - as secondary raw materials and also by processing and ecologic storing of those which cannot be reused.[9]

In manufacturing processes for textile subsectors, result recoverable waste (resulting from spinning phases, yarn waste from spinning mills, mills, knitting, weaving heads and strips from cutting mills, patches from cutting phases, etc.) which reintroduced into the manufacturing process can be used to obtain vicuna yarn, unwoven textiles, cotton upholstery for furniture and cars, insulating materials, geotextiles, etc. and irrecoverable waste – which is incinerated or discarded in landfills.

Recoverable waste may be subject to cutting operations, unweaving and defiberizing in order to salvage fibers from them. Further, by working with appropriate classic/unconventional traditional technologies, these fibers can be used to make protective clothing, technical textiles and thermal and phonetic insulating materials, building materials, textile composites (automotive, naval, construction industry), geotextiles, agrotextiles, products for environmental protection.

Results of the project 716 of CEEX-MENER, program - *Competitive Technologies for processing textile and leather waste into products with high added value* revealed that the manufacture of these products (produced from waste) proved to be more profitable than same products made of new or imported material.

Textile waste recycling is a priority of strategic management, but it must be coupled with efficiency in the activities of design, implementation of practices and procedures, equipment and technology choice

The starting point is the legislation, which shows the following tasks [10]:

• avoiding waste must take precedence over statutory and non-toxic capitalization, for their removal respectively;

• inevitable waste will be collected separately and subject to energy or material recovery, mainly in the economic circuit, if this is possible technically or economically.

The law on waste circuit and the tendency to increase charges for storage, are operating more and more intensely, determining the existence of their own strategy in the field, based on selectivity, cutting edge technology, high competitiveness and profitability.

Eco-balance becomes increasingly necessary, eco-auditing schemes, product life cycle analysis, eco-labelling system that ensures harmonization of processing technologies, textile waste and textile products containing recovered fiber according to EU requirements.

Waste management issues, usually fall under general rules of economic activities, the public and private economic initiative having the determinant role, in order to obtain adequate profits for recycling and recovery effort.

To find solutions for waste recovery, it is envisaged that technological advances cannot only pursue the economic criteria.

Current requirements are reflected primarily on the need for new types of technology, including:

• rational technologies - technologies with reduced consumption of materials and energy;

• clean technology - which involves greening of existing technologies;

• environmental technologies – new technologies adapted to environmental requirements.

In this context, waste is a major issue in every European country. Waste generation involves a loss of materials and energy and imposes high environmental and economic costs to society – generated by their collection, treatment and processing.[11] Therefore, the desire "waste zero" is currently one of the strategies of sustainable development of a society based on knowledge.

3.2. Increasing the share of "green" products in all textile products

"Green" products are those who have certain "green" qualities, qualities which include low toxicity, ability to reuse, energy efficiency, responsible eco-packaging, recycled content, produced with minimal impact on environment and minimized use of artificial materials.

Two international studies, carried out in recent years (Sustainability in the 2009 Recession and Green Brands, Global Insight 2011) show that the economic recession has not led to low interest in "green" products or services, quite the contrary.

Consumers around the world associate organic products with the idea of reducing consumption and saving, being prepared, as can be seen from figure 2, to buy more "green" products, especially after the crisis.

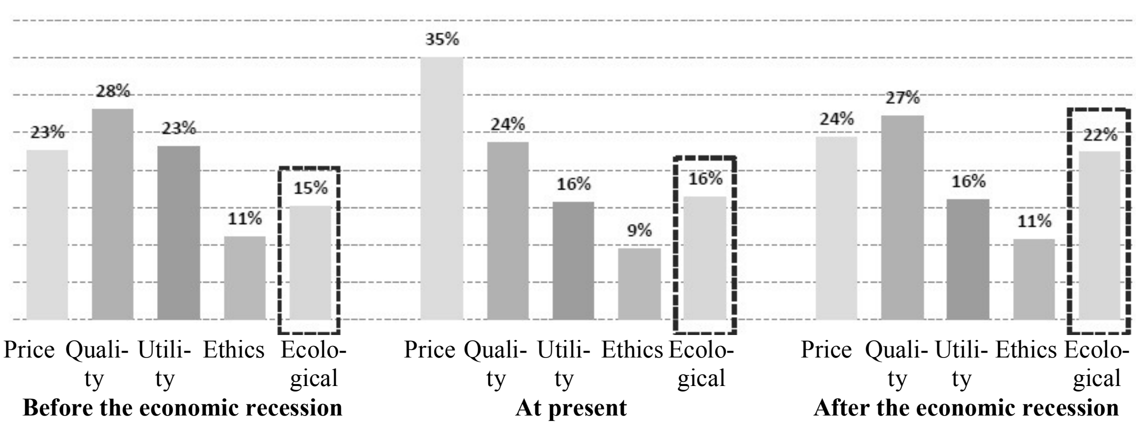

Figure 2 - Factors that influence the consumers in the purchase process [12]

Another study by Green Brands Survey 2011 reveals the same trend that consumers plan to spend more money on "green" products next year. According to the same study, consumers around the world say it is "important" or "very important" for a company to be environmentally responsible. [13]

Having observed the consumers' willingness to pay more for 'green' products, in the retail system there are already leading retailers seeking a certificate (eg Tesco, Marks & Spencer) such as that provided by England (by Carbon Footprint Ltd.) which is demonstrating how to products are obtained. Therefore, in the future, the label will include the energy consumption and CO2 used in manufacturing process of each product and it is expected that starting from next year there will be also regulations in this regard. This will inevitably lead to pressure for environmentally friendly products and energy efficient transferred on the entire chain of production up to textile tools and machinery manufacturers.

A measure introduced in order to encourage "green" production which supports the consumer, is the European Ecolabel. According to the European Commission Decision no. 371/2002/CE the European Ecolabel is awarded to products that comply with certain environmental criteria established at European level. These criteria were identified from complex scientific studies on aspects of the whole life cycle of the product and are valid for 3-5 years, which are regularly reviewed to take account of technical progress.

4. CONCLUSIONS

Negative impact on the environment of textile products is done in particular on water and air. To reduce water pollution some processes must be found to use less toxic substances as finishing processes, finding some intelligent systems to reuse wastewater and to reduce air pollution by lint, the use of vacuum cleaners is necessary, mounted in areas where the lint is formed and also the use of air filtration systems to purify and recycle the air.

In this context, waste is a major issue in every European country. Waste generation involves a loss of materials and energy and imposes high environmental and economic costs to society – generated by their collection, treatment and processing. Therefore, the desire "waste zero" is currently one of the strategies of sustainable development of a society based on knowledge. And in Romania there is interest in this respect, the results of the project *Competitive Technologies for processing textile and leather waste into products with high added value* revealed that the manufacture of these products (produced from waste) proved to be more profitable than same products made of new or imported material.

Given that consumers are willing to pay more for 'green' products, it means that in the future these products will have a larger share of the total textile industry's products, which will contribute to the development of unpolluted technologies and the development of textile machinery with low power consumption - all of which having a positive impact on the environment.

5. REFERENCES

[1]. Bucureşteanu, Anca & Isar, Daniela, Dezvoltarea durabilă – formă de creştere economică. Partea I – Concepte şi principii de dezvoltare durabilă, *Revista Industria Textilă*, vol. 59, nr. 2, pp. 69-72, 2009

[2]. Ivănus, R.C. & Băbăiță, I., Dezvoltarea durabilă – modelul de dezvoltare a omenirii în viitor, *Studia Universitatis "Vasile Goldis",* Arad, Seria Ştiințe Economice, 18, Partea. II, pp. 492-500, 2008

[3]. Cuc, Sunhilde, Dezvoltarea durabilă – deziderat major al producătorilor de maşini textile, Revista *Industria Textilă*, vol. 60, nr.3, pp. 169-174, 2009

[4]. Ianos, I. & colab., Respect for environment and sustainable development, *Carpathian Journal of Earth and Environmental Sciences*, Vol. 4, No. 1, pp. 81 – 93, 2009

[5]. Kulkarni, B.V. & colab., Sequential coagulation studies for primary treatment of textile process effluent instead of acid neutralization . *Journal of Industrial Pollution Control*, 23(1), pp. 125-130, 2007

[6]. Rösch, Hans & Cuc, Sunhilde, Abwasserrecycling in der textilveredelungsindustrie, *International Scientific Conference – Innovative solution for sustainable development of textiles industry*, Ed. Universității din Oradea, pp. 407- 411, 2008

[7]. Taksel, Rebecca, The Material Life: Eco-Friendly Fabrics, *Natural Home*, January/February, 2006

[8]. Zamfir, Maria & colab., *Deşeuri textile - Tehnologii de prelucrare. Tehnologii de recuperare. Domenii de utilizare,* Ed. Performantica, Iaşi, 2007
[9]. Cărpuş, E. & colob., Deşeu zero - direcţie strategică de dezvoltare durabilă a unei societăţi bazată pe cunoaştere, *Revista Industria Textilă*, vol.60, nr.1, pp. 15-20, 2009
[10]. Visileanu, Emilia & Carpus, Eftalea, Managementul deşeurilor textile în România*, Univers Ingineresc*, nr. 18 (448), 16-31 august, 2009
[11]. Cuc, S. & Vidovic, M., Environmental Sustainability through Clothing Recycling, *Operations and Supply Chain Management*, Vol. 4, No. 2/3, May/September 2011, pp. 108-115
[12]. *** PSB-JWT Sustainability Poll, *Available from:* http://www.psbresearch.com/files/PSB-JWT%20Sustainability%20Poll%20ABRIDGED.pdf, Accessed: 17/03/2013
[13]. *** Green Brands, Global Insights 2011, *Available from:* http://www.cohnwolfe.com/en/ideas-insights/white-papers/green-brands-survey-2011, Accessed: 14/03/2012

ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

INFLUENCE OF THE ATMOSPHERIC PLASMA CONDITIONS PROCESS ON WETTABILITY OF THE BIOPOLYMER PLA (POLYLACTIC ACID) FOR TECHNOLOGICAL APPLICATIONS

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Abstract: Recently a remarkable growth in the biodegradable polymers applications has been observed in many industrial sectors. This kind of polymers offers a wide variety of properties such a traditional and easy processing conditions, good chemical barrier behaviour, surface finishing versatility, light, etc. What's more the main property of these polymers is their biodegradability and environmental friendly behaviour. One of the most important commercial biopolymer is polylactic acid or PLA. This is one polyester kind from renewable sources that its produced for anaerobic fermentation of substrates with carbon like glucose, lactose, starch, molasses, etc with microorganisms like lactobacillus bacterium.
Despite this, many polymeric materials offer very low surface energy values. So, in order to obtain polymeric joints, surface cover or printing for technological applications, these surfaces are characterized by poor wettability properties. For solving this real problem we can use some surface treatments like chemicals solvents, physical treatment, etc. One of the most interesting treatment is the plasma technology because is an environmental friendly technology and promotes high surface energy values on polymer surface, improves wettability property.
In this work we have used atmospheric plasma technology to modify wettability properties of a polylactic acid PLA, with different conditions process to optimize the parameters treatment. On the other hand, we have evaluated the main actuation mechanism of the atmospheric plasma technology on polymeric surface.
Wettability changes on PLA surface have been evaluated using contact angle measurements by means of four test liquids with different polarities. Characterization of the surface changes due to the atmospheric plasma funtionalization mechanism has been carried out using infrared spectroscopy (FTIR), X-Ray photoelectron spectroscopy (XPS), scanning electron microscopy (SEM) and atomic force microscopy (AFM). The obtained results show that the atmospheric plasma treatment produces an increase of the PLA surface hydrophilic behaviour, improving its possible technological applications in any industrial sector.

Key words: Biodegradable, polylactic acid, wettability, contact angle, atmospheric plasma

1. INTRODUCTION

The current environmental policies along with the awareness on the part of consumers regarding the use and consumption of low environmental impact materials or environmentally, are the main driver in the development and research of new materials or organic biodegradable.

Given the interest in replacing petrochemical-based materials for natural materials, due to the decrease of forces from fossil resources, polymeric materials are occupying major lines of investigation in this regard. Currently already trading some biodegradable polymeric materials of low environmental impact, with good technical characteristics in some industrial fields. The most important are the polylactic acid PLA, PHB, PHB-V.

The PLA is being used successfully in some fields such as medicine, sutures, prosthetic devices, implants and slow release capsules for drugs. Specifically in internal medicine has great applications to reinforce damaged internal organs. Also used in dentistry dentures, veterinary, etc.. In the industrial field has application in the packaging of foodstuffs. More specifically in the manufacture of films ara crop protection in the field. It is interesting in applications such as food protective film High breathing and short-term storage such as vegetables, and baked goods or pastries. On the contrary a negative factor is the high long-term bacterial growth. [3], [4], [5]

The container-packing industry is one of the industries most interested in implementing this type of material, the high environmental impact of packaging waste produced.

In this application field usually require adhesive properties. The intrinsic nature of the PLA, and generally of polymers, is to present little surface wettability, which hinders the application of adhesives.

This issue search warrants surface modification treatments to improve this low wettability. Different types of surface modification treatments. Chemical treatments originate waste to be treated to prevent environmental impacts, so no residue treatments are more interesting. Within this area, are optimal treatments based on plasma technology.

Different types of application of the plasma, and vary the pressure in the area where the plasma is generated: low pressure plasma, corona plasma and atmospheric plasma.
In this study we used the atmospheric plasma at atmospheric pressure because it works and works continuously, no need to stop the treatment process for a production line.

For this reason we raised as targets in this experimental work the following:

- To study the behavior of polylactic acid atmospheric plasma treated.
- Optimize the parameters of height and speed in the atmospheric plasma surface treatment on polylactic acid.
- Quantify the effects of plasma surface treatment.

2. EXPERIMENTAL

Material:

The material used is polylactic acid, PLA, commercial brand Nature Works Cargill provided by LCC, USA. Injection process dimensiones 160 x 60 x 2 mm.

The adhesive used is the Fast EcoPoxy Hardener, provided by the company Ecopoxy systems with an optimized cure time 90 minutes at room temperature.

Liquids that have been used to determine the wettability of the surface of the PLA, by measuring the contact angle are stabilized diiodomethane 99% (Acros Organics), distilled water, formamide (reagent grade, Scharlau Chemie SA) and 99% glycerol (Scharlau Chemie SA)

Equipment:

Testing the adhesive bond strength of PLA / PLA are performed in a universal testing machine IBERTEST ELIB 30 (SAE Ibertest, Madrid, Spain) to a speed of 300 mm min-1 at room temperature with the load cell 5 kN. The test used to assess the strength of the adhesive bond shear has been the block according to the UNE-EN ISO13445 "Adhesives, determining the shear strength of adhesive bonds between rigid substrates by the block shear methods". The samples have dimensions of 25 x 25 mm being the punch of 10 x 25 mm.

The atmospheric plasma treatment is performed with a computer "Plasma Jet RD1004" Plasmatreat provider, a company based in Germany. Used a circular nozzle (Fig. 1) with a useful substrate speed to 40 mm / min and a distance of nozzle to the substrate in the range between 2 and 45 mm.

Under the test conditions were at different rates, 100, 300, 700 and 1000 mm / s and different heights 6, 10, 14 and 20 mm.

The equipment used for measuring the contact angle of different PLA samples with different contact liquids listed above is the brand STANDARD EASYDROP KRÜSS FM140 model 110/220 V, 50/60 Hz This model has a range measures between 1-180 ° with an accuracy of ± 0.1 °. The camera has a 6x zoom and comes with software SW21 DROP SHAPE ANALYSIS (DSA1).

The method used for calculating the surface energy is the Owens-Wendt, the simplicity of the calculation expressions, because it takes into account the dispersive and polar components of the compounds. The expression graphs the equation y = a + bx is:

$$\gamma_l.(1+\cos(\square))/2(\gamma_l^d)^{1/2}=(\gamma_s^p)^{1/2}.[(\gamma_l^p)^{1/2}/(\gamma_l^d)^{1/2}]+(\gamma_s^d)^{1/2} \quad \textbf{(1)}$$

In this equation is the contact angle, γl is the surface tension γs of the liquid and is the solid surface tension or surface free energy. The terms with the superscripts d and p refer to the dispersive and polar contributions of each phase. Form is easily distinguished from the equation, y = a + bx. And can be represented $(\gamma_l^p)^{1/2} / (\gamma_l^d)^{1/2}$ versus $\gamma_l.(1 + \cos())/2(\gamma_l^d)^{1/2}$. The slope of the line obtained is $(\gamma_s^p)^{½}$ while that point the "y" axis intercept of that line will be $(\gamma_s^d)^{1/2}$. The total surface free energy is the sum of these two components. [6]

3. RESULTS AND DISCUSSION

Atmospheric plasma action on PLA studied causes for surface functionalization species interaction ionized air generated by the plasma, increase the wettability of the same, but this increase is a function of the conditions of application of surface modification treatment . It is therefore necessary to optimize processing parameters atmospheric plasma: speed and distance past nozzle / substrate, by analyzing the variation in the contact angles as the primary indicator of hydrophilicity or hydrophobicity of the surface of the solids.

Table 2. Contact angles obtained on untreated PLA with different test liquids.

PLA VIRGIN				
SAMPLE	WATER	FORMAMIDE	DIIODOMETHANE	GLYCEROL
AVERAGE	**73,44**	**47,07**	**36,96**	**79,14**

The results obtained after performing atmospheric plasma treatment at different speeds and different heights last, seen in the table below as an example of the different heights of substrate studied.

Table 3. Contact angles obtained on PLA with different test liquids to a height of 6 mm.

HEIGHTS 6 mm vs SPEEDS				
SPEEDS (mm/s)	**WATER**	**FORMAMIDE**	**DIODOMETHANE**	**GLYCEROL**
100	44,0	21,6	21,5	36,9
200	50,3	24,4	24,4	40,9
300	53,4	24,4	29,5	48,7
400	55,1	29,1	29,7	56,9
500	55,2	29,3	30,8	58,5
600	60,3	35,1	32,0	62,7
700	61,7	42,1	33,3	64,2
800	66,6	42,4	38,5	68,0
900	69,7	43,6	40,3	69,0
1000	71,8	45,7	43,3	76,5

In conclusion, it appears that at greater distances sustato / nozzle and greater treatment speed, the contact angle increases, thus decreasing hydrophilicity. This study aims to improve the hydrophilicity of the substrate. Working conditions are optimal low speeds (6-10 mm) and slow speeds (100-700mm/s).

In the example of Table 3 shows that in the water at low speeds (100 mm / s) the contact angle is better 44 ° to higher speeds 900 mm / s 1000 mm / s that the contact angle is 69.7 ° and 71.8 respectively. The same applies to the remaining liquid and the other point (10, 14 and 20 mm). If you compare these data with the PLA untreated clearly shows the angle decreased to almost 50%.

The decreased contact angle of the treated samples compared to untreated samples, an increase of wettability.

Initial data PLA untreated total surface energy γs = 24.44185924 and contributions polar γ_s^p =0,58181755 and dispersive γ_s^d=26,8600417untreated substrate.

The surface energy obtained after performing plasma surface treatment, the surface energy increases relative to untreated substrate, concluding that the treatment increases the polar contributions (in height 6 mm and 10 mm then decreases) on the overall value energy of the solid, while the dispersive contributions remain largely unchanged.

The following graph shows the surface energy decreases as compared to the processing speed. A lower height substrate / nozzle and lower speed, higher surface energy, and higher and higher speeds, the surface energy decreases considerably.

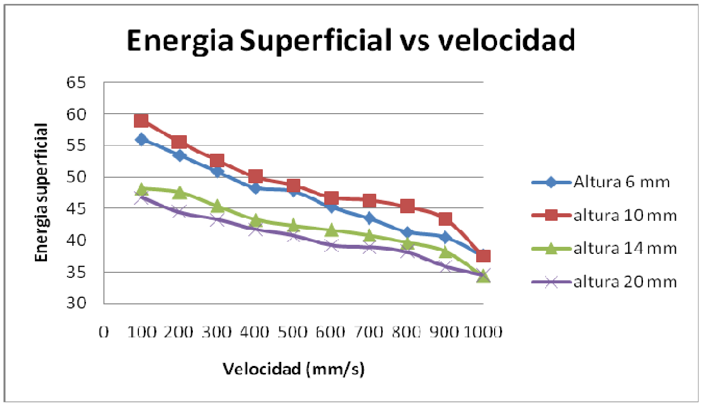

Figure 1. Variation of the total surface energy (γs) vs. processing speeds at different heights.

4. CONCLUSIONS

As conclusions derived from the study of atmospheric plasma treatment on biodegradable polymers include the following points:

• The atmospheric plasma treatment significantly improves the wettability of PLA polylactic acid, significant reductions quantified by contact angle. Hydrophilic behavior improves optimal substrate for further treatment.

• The optimum conditions of application of this surface modification treatment is maintained in the range of low heights die / substrate [6-10 mm] and low / medium speed past [100-700 mm / s] to the same heights.

• The high polymer nozzle distances and / or high speed past the plasma treatment did not positively affect the wettability of the treated surface to lose effectiveness the surface modification treatment.

5. REFERENCES

[1]. Benjamin Bax, Jo¨rg Mu¨ ssig , "Impact and tensile properties of PLA/Cordenka and PLA/flax composites", *Composites Science and Technology 68 (2008) 1601–1607* (2007).
[2]. Shenton, M.J., G.C. Stevens, N.P. Wright and X. Duan (2002). "*Chemical-surface modification of polymers using atmospheric pressure nonequilibrium plasmas and comparisons with vacuum plasmas*" Journal of Polymer Science Part a-Polymer Chemistry 40(1): 95-109.
[3]. Abenojar, J., R. Torregrosa-Coque, M.A. Martinez and J.M. Martin-Martinez (2009). "*Surface modifications of polycarbonate (PC) and acrylonitrile butadiene styrene (ABS) copolymer by treatment with atmospheric plasma*" Surface & Coatings Technology 203(16): 2173-2180.
[4]. Leroux, F., C. Campagne, A. Perwuelz and L. Gengembre (2008). "*Polypropylene film chemical and physical modifications by dielectric barrier discharge plasma treatment at atmospheric pressure*" Journal of Colloid and Interface Science 328(2): 412-420.
[5]. Lasprilla, A.J.R., G.A.R. Martinez, B.H. Lunelli, A.L. Jardini and R. Maciel Filho (2012). "*Poly-lactic acid synthesis for application in biomedical devices - A review*" Biotechnology Advances 30(1): 321-328.
[6]. Madhavan Nampoothiri, K., N.R. Nair and R.P. John (2010). "*An overview of the recent developments in polylactide (PLA) research*" Bioresource Technology 101(22): 8493-8501.
[7]. Michalski, M.C., J. Hardy and B.J.V. Saramago (1998). "*On the surface free energy of PVC/EVA polymer blends: Comparison of different calculation methods*" Journal of Colloid and Interface Science 208(1): 319-328.

BIOPOLYMERS FROM LEATHER WASTE APPLIED IN AGRICULTURE

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Abstract: Many industries, including leather industry, are faced with high expenditure for solid organic waste treatment and disposal.Organic biopolymers represent a source of raw material for agriculture, because the composition of protean wastes provides enough elements to improve composition and rehabilitation of degraded soils.The main target of this scientific paper is investigating the development possibilities for various multicompound systems of biodegradable polymers and studying the effects of these complex products on the structure and chemical and physical characteristics of degraded or contaminated soils (having a poor level of organic matter or submitted to a strong erosion process). All treatments applied to wastes aim at substantially reducing environmental pollution. Complex characteristics of protean wastes from the leather industry are approached by accurately determining waste hide chemical composition and various possibilities of recovery and recycling using biotechnologies

The novelty resides in the theoretically-based practical indications regarding the rational application of complex polymeric products – biofertilizers – on various types of soil (sandy, salty, eroded, dumps etc.) depending on the requirements of soil remediation and nutrition specific to agricultural plants. The work presents a new pilot technology for biochemical decay of the tannery protein wastes and use of the resulted products as fertilizers.

Key words: biopolymer, protean wastes, tannery, polyelectrolytes, soil.

1. INTRODUCTION

The production of leather industry solid wastes has increased and the use of such wastes as fertilizers represents an interesting alternative for their disposal, with less potential impact to the environment [1]. All tanneries and leather product manufacturers are facing serious problems regarding waste disposal, especially since their storage in landfills leads to negative effects on the ecosystem. Therefore, the tannery protein wastes are required to be subjected to biochemical treatments with the view of recycling in the agriculture[2].

The degree of novelty is based first of all on the fact that the promoted technologies have as a starting point obtaining of new complex products by processing organic wastes which can be applied in agriculture. [3, 4].

Researchers from EU countries are looking for methods of reusing tannery wastes, making public their concern through different publications and communications at various international conferences. Efficiency of using fertilizer products depends not only on the soil composition, but also on the nutrition capacity of crop plants. Researchers are concerned about this fact because there is a very tight bond between the permanent and renewable characteristics of the soil and humus.

A new method was suggested for wet white tanned leather waste treatment. Organic biopolymers represent a source of raw material for agriculture, because the protein waste composition provides adequate elements that will improve composition and rehabilitation of weathered soils. Protean waste capitalization represents a necessity of clean, ecological technologies, because only 25% raw hide becomes finished product.

The novelty of this work is based primarily on the fact that the applied research it promotes has as a starting point developing new complex products – multicomponent polymers - by processing organic wastes with application in remediating and/or conditioning degraded or contaminated soils (the combination of organic biopolymers in tanneries and synthetic polymers with applications in pedology.

Reducing the effects of degradation / contamination / pollution involves the application of remediation methods, to improve characteristics of the soil affected by degradation processes or limiting factors, in order to recover its original state of fertility and productivity, higher, or at least to a state close to the original.

2. EXPERIMENTAL DATA AND DISCUSSIONS

Due to the fact that protein matters resulted from biochemical treatments of tannery wastes can be obtained from small and medium industry specialized in processing natural hides, the possible beneficiaries of the studied technology are mainly tanneries, which contribute to environmental protection policy as well as expand their product range and make their business cost-effective; the possible users of the resulted products are leather and agriculture industry enterprises [2,3,4].

All treatments applied to wastes aim at substantially reducing environmental pollution. Complex characteristics of protein wastes from leather industry are approached by establishing with precision the chemical composition of hide wastes and the various possibilities of recovery and recycle using biotechnologies [5, 6, 7].

In this study, we established an adequate hydrolysis method for wet white leather waste, in order to obtain the desired recyclable products and fully use titanium containing leather waste with zero waste.

Figure 1. Facility for processing wet white wastes

Analysis of Ti-containing wet white wastes In order to characterize the new wet-white leather and prove the tanning potential of tanning potential of the newly synthesized compounds, chemical analyses has been carried out both on the split and grain layers of the product leathers and the results obtained are shown in Table 1.

Table 1. Wet-white grain and split leather wastes chemical analyses

No.	Parameter	Layer	
		Grain	Split
1.	Volatile matters (%)	53.1	51.2
2.	Extractible (%)	1.58	2.35
3.	Ash (%)	10.4	10.9
4.	Metal Oxides (%)	8.2	8.3
5.	Dermal substance	35,1	34,8
6.	pH extract	3.98	4.0

A new method of treating wet white wastes was suggested, namely by wet white wastes hydrolysis in 2 steps, obtaining a protean biopolymer which, in combination with other polymers (polyacrylamide, acrylic, maleic, cellulose, starch etc.) will be used in agriculture.

These leather wastes were treated by chemical-enzymatic hydrolysis. Thus, a quantity of wet white leather wastes containing titanium was weighed, then mixed with water (200-500%) and subjected to a pretreatment by adding CaO or 2- MgO for 4-6 h The mixture is hydrolysed in a 50 l autoclave with double jacket and stirrer, adding K_2HPO_4 at a temperature of 90-98°C for 2.5-5 hours. Then, the titanium containing hydrolysate is passed through a sieve with a mesh of about 0.5-1 mm^2. Two parts are thus obtained, a liquid part that has passed through the sieve and an unhydrolysed solid part called "titanium containing sludge", about 4-9% of the original waste subjected to hydrolysis. The liquid hydrolysate is dried and used as a fertilizer in agriculture.

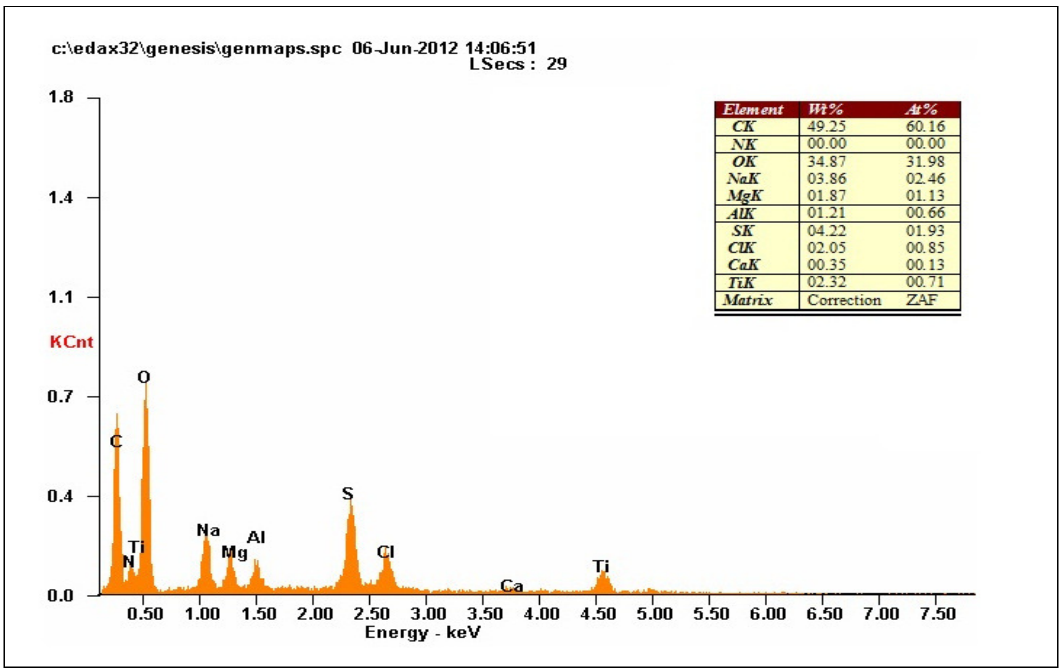

Figure 2. SEM-EDAX mapping of grain layer

The second stage can be carried out, weighing wet white leather waste (containing titanium) and "titanium containing sludge" in proportion of 1:1 and subjecting it to a pretreatment in water (200-500%) and 1:2 MgO with NaOH at room temperature for 4-6 hours. This pretreatment step is required to obtain optimum pH for enzymatic digestion. Then 0.5-1% Swiss commercial enzymatic product K or D containing 30,000 MWU lipase, 900 units/g cellulase, 1.200 unit/g amylase and 10,000 units/g protease are added. The mixture is maintained for 1.5-2.5 hours at 35-40°C.

The process of biochemical combination of synthetic polymers with organic biopolymers from tanneries has innovative applications in pedology. The study involved treating by chemical and enzymatic process the wet white wastes from bovine hide.

Soil conditioning consists in improving the physical properties by means of substances with varied origins, known in literature as "soil conditioners". Soil contamination represents a moderate increase in the concentration of certain substances which are not harmful for plant growth and development, but can represent the initial phase in the pollution process. Decreasing the effects of soil weathering/ contamination/ pollution involves the use of certain methods which lower the negative consequences of the soil fertility degradation and contamination or pollution.

ICPI together with the National Research & Development Institute for Pedology, Agrochemistry and Environment Protection Bucharest have recently tested protein biopolymer systems for use on degraded soils and for greenhouse and field plant growth. Usually, polyelectrolytes and other polymer classes contribute to the improvement of soil properties, through one or more of the following effects: an increase in the aggregation of soil structural elements in weathered soils; prevention of crust formation in the period between sowing and spring, especially for plants with small seeds, which are very vulnerable; an increase in resistance to water and wind erosion of soils located on slopes and coarse grained soils (less than 12% clay).

Micromorphology analyses were conducted on a glazed, loamy-clayish chernozem, on leossoide deposits in the north area of Bucharest, where the protein biopolymer was applied. Micromorphology analyses for thin sections on the distribution behaviour of the soil biofertiliser and its relationship with different components of soils was made possible by using a new technique (marking the conditioner with three types of dyes - hematoxylin, fluorescein, isothiocyanate).

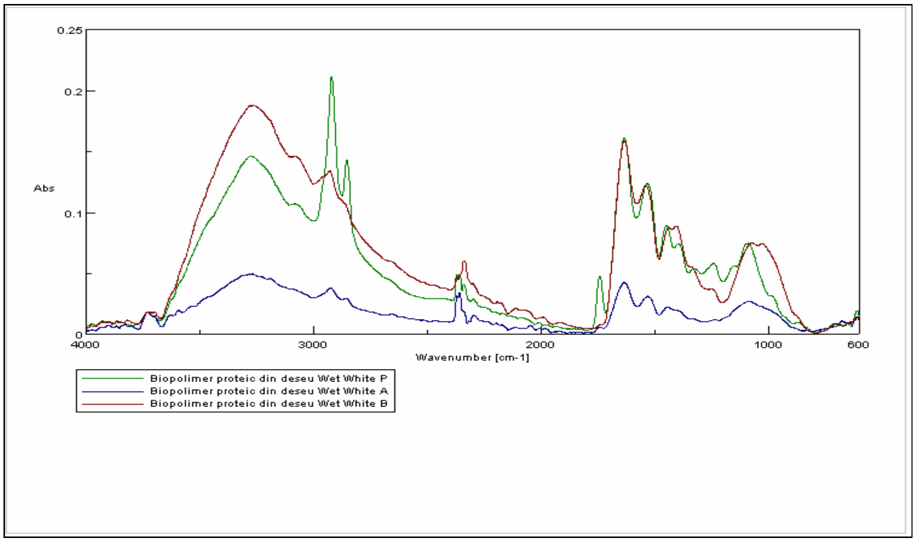

Figure 3. FT/IR-ATR spectra of biofertiliser samples

The biofertiliser was experimented on a culture of peas for improving the land with biologically fixed nitrogen and to allow the early release of land. The land was then prepared for sowing barley. Beside the nutrients in the soil, it has been shown that peas need nitrogenous fertilizers, especially during the first stages of development. Subsequently, it grows at the expense of the fixed nitrogen in the air by bacteria that form nodosities on the roots. The most suitable soil type for pea cultivation is neutral or slightly alkaline, which can be amended with limestone, but only by predecessor plants (not directly). In the blooming phenophase, the nodosities on the pea roots were considered from the treatment before sowing with biofertiliser (0.25 kg/m^2).

The biofertiliser (0.25-0.5 kg/m^2) soil treatment significantly influenced the number of nodules developed on the plant roots. Roots and organic remainders gathered in the soil by the pea plants are an important source of nutrients and energy for soil microorganisms. Additionally, their decomposition results in a significant amount of necessary elements (especially nitrogen) for the nutrition of superior plants.

These studies contribute both to the recovery of poor and degraded soils in agriculture and to the reduction of environmental pollution by exploiting protein wastes.

3. CONCLUSIONS

In conclusion, a Ti-containing wet white leather waste conversion technology can be established, which, through hydrolysis and mixed with 10-20 % protein biopolymers from limed leather wastes, can be used as fertilizers in agriculture. We must mention that as a result of experiments carried out for wet white leather waste hydrolysis no effluents or other wastes result. Biopolymers have been obtained by an innovative enzymatic procedure of processing wet white waste resulted from leather processing. In combination with other polymers (polyacrylamide, acrylic polymer, maleic polymer, cellulose, starch, etc.) they can be used for improvement of degraded/eroded soils and growth of greenhouse and field plants.

All instrumental analyses (UV-VIS, IR spectroscopy, thermal analyses, X-ray diffraction, microscopy etc.) have highlighted both reticulations between the protein polymer and the synthetic one, and the high order of the polymeric structure, which is due to the enzymatic hydrolysis process.

For an efficient crop growth, it is not enough to add only the missing element, but also to satisfy, as much as possible, all the needs of the plants. This implies acting simultaneously on various factors in the complex condition determining agricultural production.

The obtained experimental results demonstrate that the protein biofertilizer materials produced an interesting outcome both in terms of improving the soil quality and growing large-scale crop plants, showing highly potential applications in agriculture and environmental sciences.

4. REFERENCES

[1] Bajza Z., Vrucek V. Thermal and enzymatic recovering of proteins from untanned leather waste.Waste Manag., 21 (1): 79.84 2001.
[2] Brown E. M., Taylor M. M., and Marmer W. N. (1996), “Production and potential uses of co-products from solid tannery waste,” Journal of the American Leather Chemists Association, 91(10), 270–276.
[3] Cabeza L. F., Taylor M. M., Brown E. M., et al.(1999), “Treatment of sheepskin chrome shavings. Isolation of high value protein products and reuse of chromium in the tanning process,” Journal of the American Leather Chemists Association, vol. 94, no. 7, 268–287.
[4] Serrano R.A., Maldonado M., Kösters K. (2003), Characterization of Waste Materials in Tanneries for Better Ecological Uses, Journal of the American Leather Chemists Association, 98, 43-484.
[5]. Zainescu, G., Voicu P., Albu E., Sandru L., Romania, Patent request no. A 00655: Innovative Process of Obtaining Biocompost Based on Hide Wastes, 2008.
[6]. Zainescu, G. et al. "Application of tannery organic wastes in degraded soils remediation", Journal of Biotechnology 150 Supp (november2010) 290 Elsevier
[7]. Zainescu, G. et al. (2010), Application of tannery organic wastes in degraded soils remediation, Journal of Biotechnology 150 Supp (November 2010), 290, Elsevier Science Publishers.

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