

Innovation of the Polish Textile Sector with Respect to Antibacterial and Bacteriostatic Textiles

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Abstract

The situation of many Polish textile producers is difficult. Lifting import quotas on textile products following Polish accession to the EU and the Schengen zone has resulted in a vast increase in the supply of apparel and textile products, mainly from Asian countries. According to the recommendation of the European Commission, one of the methods to remain competitive against low prices offered by China or India is to offer innovative products of considerably better quality. Unfortunately, it is estimated that only 25% of all textile enterprises innovate, most which occurring through imitation. While most Polish companies limit their expenses on R&D activities by adapting external ideas to local needs, some attempt to create competitive advantage has been made by introducing more advanced technologies. Nanotechnology is providing solutions that may help businesses gain technological advantage. This article presents financial aspects of the introduction of antibacterial and bacteriostatic fabrics.

Key words: nanotechnology, Polish textile sector, financing, innovation.

Introduction

Since the beginning of the XXI century, we have witnessed the shrinkage of the Polish textile industry. The once famous and prosperous Polish spinning and weaving mills either go bankrupt, become liquidated or are forced to face uneven competition against Asian companies, which is not easy since China and India are the world's two largest economies as far as the textile industry is concerned. According to information given by Gdynia Cotton Association, it is expected that the share of China and India in world cotton consumption will amount to 57% in the 2010/2011 season [1]. Cheap yarns, cloths, fabrics and clothes are extensively exported to the EU from the emerging countries, which successfully blocks the development of EU internal textile markets. For Poland it is not the only problem influencing the state of the textile industry. There are many factors which have had a large impact on the state of the Polish textile market, one of which was the huge amount of textiles imported

from Turkey after the coming into force of the Free Trade Agreement between the Republic of Poland and the Republic of Turkey, signed October 4, 1999 [2]. In the year 2001 Polish exports to Turkey amounted to \$138 million, whilst imports from Turkey were more than \$250 million greater [3]. In the year 2005 those numbers were much higher, since exports were at a level of \$1,193.6 million and imports amounted to \$1,300.8 million, most of which referred to the exchange of goods from the electro-mechanical industry; however, 27.5% (\$361.6 million) of imported goods concerned light industry, including textiles.

Another factor which contributed to the poor condition of the Polish textile market was the growth of the underground economy and the illegal import of textile goods. According to research of the World Bank [4], Poland ranks as 52 among 162 countries as far as the share of the underground economy in the whole economy is concerned. It is worth pointing out that only 8 EU countries ranked behind Poland. In our country the underground economy and illegal imports refer mainly to light industry. The sales manager of Andropol S.A. – estimates that at the moment (14.10.2010 [5]) at least 50% of imported textile goods are not subjected to any supervision from the side of the government. This state acts against many companies that often fail in the struggle against unfair competitors. This phenomenon is particularly visible in the region of Lodz, which was once famous for its highly developed textile industry. From the numerous knitting, weaving,

and spinning mills as well as companies producing synthetic fibres, which constituted the cradle of the Polish textile industry, there are only a few that are still active on the market. Instead of those companies, we can find many salesmen and retailers selling cheap, imported textiles and fibres which sometimes happen to come from unknown sources. It is true that the phenomena of illegal imports and the underground economy are not new, but recently their impact on the Polish textile market has become more significant. After Polish accession to the Schengen Zone, due to the almost total elimination of boarder controls, such practices have become much easier, hence also more frequent. Polish accession to the EU has also partially influenced the state of the textile market in our country. On the one hand, the enlarged output market for many goods constitutes tremendous export potential, but on the other it has resulted in increased competition. Along with sometimes costly compliance with new regulations imposed by the EU (e.g. REACH - Registration, Evaluation and Authorisation of Chemicals, which affects mainly the chemical industry, but also companies such as dyeing mills), the situation has also led to the bankruptcy of some enterprises.

Another factor working against the Polish textile industry were the actions of the WTO aimed at liberalising trade. On January 1, 2005 ended the process of removing quotas imposed by the WTO on textile trade between developed and emerging countries. The establishment of such restrictions was possible on the

basis of the Multi-Fibre Agreement from January 1, 1974. According to the MFA, emerging economies negotiated maximum quantities of supplies to the markets of importers (developed countries). This agreement ended on December 31, 1994 and on January 1, 1995 was replaced by the Agreement on Textile and Clothing, which was one of the outcomes of the Uruguay Round. The general aim of this agreement was to apply (and gradually diminish) protection for textile and clothing goods after the expiry of the MFA. As a result of the ATC, those goods were fully included in general GATT rules and restrictions imposed by the MFA were eliminated. It should be noted that Poland was a member of both the MFA and ATC (the latter included all member countries that had ratified the agreement with the WTO). Since the expiry of the ATC, the trade in textiles and clothing goods has become more liberal and is regulated only by the general principles and rules of the WTO, which do not impose any quantitative restrictions. Naturally there exist anti-dumping procedures, but their implementation is costly, time-consuming and, in most cases, requires a joint initiative of many companies; hence, in practice, they are rarely used. Countries like China, on the other hand, use this situation, including India, which has the possibility to dominate previously protected markets. These are only a few examples of factors which have influenced the situation of the Polish textile industry. One can probably add many more items to this list, but the examples quoted here were used only to illustrate the general situation and to answer the question why the condition of the Polish textile industry is different from that in other EU countries (e.g. Germany or Greece).

Response of the EU – High Level Group

Some of the issues listed in the previous part have affected the entire EU (e.g. the end of ATC and the strong expansion of China and India to the west), hence in 2004 the European Commission established the High Level Group [6]. This group consisted of representatives of the European Commission as well as selected entrepreneurs, traders, importers and members of local associations strongly related to the textile and clothing market. The main goal of the HLG was to investigate the situation and to give recommendations to improve the competitiveness

of the textile sector and stimulate its future development. The High Level Group presented its findings in a report from June 30, 2004 [7] entitled ‘European textiles and clothing in a quota-free environment’, with further amendments added on September 18, 2006 [8]. The High Level Group stated that ‘imports have grown following the end of the quota system, but their overall increases in both volume and value have been somewhat less than might have been feared’ and that the EU should be able to maintain its technological lead at least up to the year 2020. It was written that, according to the HLG, the textile sector requires restructuring, and it is advisable for companies from this sector to cooperate and invest in development and innovation. Innovations were presented as a logical step aiming at increasing the competitiveness of the sector. However, many entrepreneurs were aware of that fact long before the publication of the report.

Innovativeness of the T/C sector in numbers

Analysing product innovation in the textile sector in the time span from 2000 to 2010, one can observe that many innovative solutions from flame-retardant, heat-proof, antibacterial, bacteriostatic, water proof, oil or abrasive resistant fabrics, polypropylene and aramid yarns to smart and intelligent fabrics which can sense and react to environmental stimuli were introduced onto the market, in spite of which the textile industry is regarded as a low-tech and rather non-innovative sector. Confirmation of such a thesis one can find in many publications, e.g. in the report from the NetFinTex project [9] and the sectoral report of Europe INNOVA [10]. The first document summarises the NetFinTex project, launched in November 2005, coordinated by EURATEX and financed by the European Commission’s 6th Framework Programme. Part of this report summarises research of companies from Belgium, Poland, Germany and Italy (1,500 companies were addressed with an approximately 10% return rate) in terms of their R&D activities, means of innovation financing, etc. The other document is a sectoral report of Europe INNOVA, which is an initiative of the European Commission’s Directorate General Enterprise and Industry, published on 10.05.2008 as part of “Sectoral innovation systems in Europe: monitoring, analysing trends and identifying

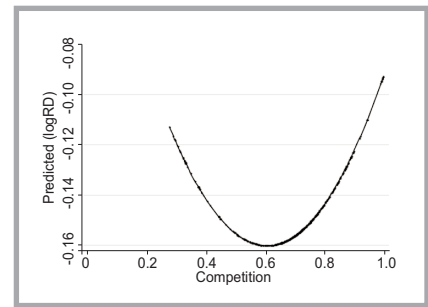


Figure 1. Shape of the relationship between competition and R&D intensity; **Source:** Sector Report – ‘Sectoral innovation systems in Europe: monitoring, analysing trends and identifying challenges’, Michael Böheim, Austrian Institute of Economic Research (WIFO), Vienna, 10.05.2008.

challenges”, edited by Michael Böheim from the Austrian Institute of Economic Research (WIFO). Information from the report was collected having analysed the course of the Innovation Watch – SYSTEMATIC project. In both reports one can find many references to the situation of the Polish textile market. In the Europe INNOVA sectoral report textiles are presented as low-tech with a small share of innovating firms (25%). In this sector innovation occur mostly through diffusion - 12%. The share of intermittent and strategic innovation is 10% and 4%, respectively [10]. The currently prevailing trend in textile innovation is adopting new technologies to already existing products and simultaneous R&D investments. Unfortunately such investments in the textile sector are at a level of 1% (the average of the remaining 9 sectors equals 9.5%), whilst the competition index is above the mean value for other sectors (0.71 in textiles, 0.66 for other sectors) [10]. According to the Europe INNOVA report, it also appears that the relationship between innovation and the amount of competition in the T/C sector is reversed compared to other Systematic sectors. The literature suggests an inverted U-shaped or linear relation, but the T/C sector follows a different pattern. According to the graph (**Figure 1**), with increasing competition (with a low competition index) the intensity of R&D falls and the inflexion point occurs with the competition index equal to 0.6, after which point the intensity of R&D rises swiftly – the relation can be therefore described as U-shaped.

Theoretically, when the competition index in the T/C sector is above average, the R&D intensity should be high. In Poland, with an above average competition

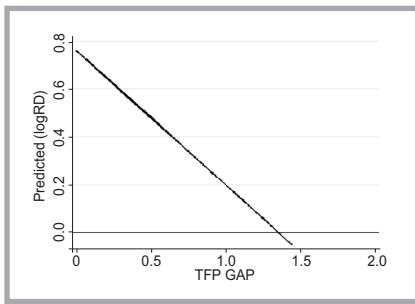


Figure 2. Impact of competition on R&D intensity and the technological gap
Source: *Ibid* Figure 1.

index [2], this is not the case. In order to explain this, one should take into account one more relation – the dependence between R&D intensity and the technological gap of companies in the sector in relation to the world's leaders. If the gap was equal to 0, the function would become a constant, indicating no influence on R&D intensity and meaning that the country is at the level of a technological frontier (**Figure 2**).

Poland is one of those countries where a relatively high competition index does not indicate intensive R&D actions. When the technological gap is greater than 130%, it starts to have a negative influence on R&D [10]. Such a phenomenon also takes place in the Czech Republic, Slovakia, Hungary and Portugal. Despite such afflictive information, recent changes in the T/C sector were appreciated. It was written that in the span of the last two decades, the industry 'has undergone significant restructuring and modernisation efforts, increasing productivity throughout the production chain, and reorienting production towards innovative, high-quality products' [10]. It has been emphasised that the T/C sector suffers from underestimation in terms of innovativeness because companies in this sector tend to invest in non-technological innovation, which is statistically invisible. There are also numerous examples of innovative companies, like EYBL or ELMARCO [10], which, through intensive research on nanotechnology and nanofibres, have managed to improve their products and gained competitive advantage. This proves that in spite of the state of the sector, R&D actions are still vital for the success of innovation. Among many European companies from the T/C industry, such as F.M. Hämmerle Textilwerke GmbH & Co KG, Merina a.s., Vútech-Chemitex s.r.o., Chemosvit Fibrochem a.s., H&M, ZARA/Inditex,

Adidas, Puma and Christian Dior, there is one Polish company – Tricomed. It is regarded as one of the leaders in terms of innovativeness and is a company which invests heavily in R&D – 30% of employees are scientists. Tricomed has used knowledge gained by its research department to invent extremely good products like CODOFIX dressing nets. Unfortunately a set of wrong decisions combined with a change of management and the company's acquisition by TZMO has caused the loss of the company's position on the market.

Apart from some market leaders like LPP (being a leader in the T/C sector in Poland), Polish companies follow the pan-European trend of the textile industry being low R&D intensive. The situation of the Polish textile industry is even worse than in many European countries, which is visible in the second of the aforementioned reports. According to a survey by NetFinTex entrepreneurs, only 50% of Polish textile companies confirm that they invest in innovation (in other countries questioned the result was 85%) and only 13% declare any R&D activities (the overall value among respondents was over 50%) [9]. Additionally more than 50% of companies are marketing innovation [10]. It follows from the content of the report that Polish companies protect their intellectual property using trademarks or brands more often than their counterparts from other countries [9]. On the other hand, the Polish companies questioned practically did not have any patent applications. Patents and outlay on R&D are the two most important indicators of innovativeness. It should be noted that, according to the research, Polish companies spend over 2.5% of their turnover on scientific research and the development of new products, which is the best result among the 18 countries listed in the comparison. [10] Similar values (around 2.3%) were noted by Greece, Belgium, Lithuania and Sweden. T/C enterprises from Hungary, Greece, Portugal and Cyprus spend about 1% of their turnover on R&D, with the EU average being a little over 1.6%. This result does not stem from the fact that Polish companies are R&D intensive but is rather a consequence of their relatively small turnover. Indeed Polish companies invest a high percentage of their turnover in research, but the real values are considerably smaller than in most foreign enterprises. Currently there are only a few

companies of relatively stable position on the market with appropriate funds which are able to measure up to foreign competitors. Formerly a fine example of such enterprises were Polish spinning mills, but nowadays none of the five biggest spinning mills ('Przędzalnia Zawiercie S.A.', WIMA S.A., ELKO Sp. z o.o., Polontex and Przędzalnia Andropol) continue their production activity. A similar but slightly better situation can be seen in other branches of the textile industry.

R&D financing activities among Polish textile companies

In the age of a shrinking textile market, many corporations limit their investments and tend to focus on and develop one flagship product to gain competitive advantage. Not many companies are willing to take a risk and invest in the research and development of many products simultaneously. Some bigger companies like Teofilów (knitting mill), Andropol (finishing mill) and certain other enterprises from the clothing industry are active in terms of innovation and development, but compared to the rest of Europe Poland does not come out well. Our country is below average not only in terms of the number of innovative companies and innovative objects that have patents to protect their intellectual property, but also as far as the total sale of innovative products is concerned.

The situation is slightly different when it comes to statistics about the number of innovators collaborating with other agents (including universities). Most Polish textile companies do not possess sufficient funds to create their own laboratory or R&D department, thus they often outsource such activities to external agents. A perfect example of such an external research unit could be the Textile Research Institute of the Technical University of Lodz, which has been very active in this field over the last 10 years. The Institute has collaborated with many companies and managed to develop, for example, protective clothes for firemen, antibacterial materials for medical purpose, etc. Scientists from the Textile Research Institute not only work on developing different, innovative materials like functional nano- and micro textiles or barrier fabrics for protection against harmful environmental influences, but they also actively cooperate with other

units within, for example, the Polish Federation of Apparel & Textiles and the Gdynia Cotton Association [1]. Cooperation within such units is, however, not optimal since companies perceive other companies as potential competitors, and hence they do not share all the information they possess, thus full collaboration is impossible.

Polish textile sector with respect to bacteriostatic fibres

If the situation of the Polish textile market looks as presented, how does the sector innovate? Innovation is mostly connected either with adapting already existing foreign products to local needs or with cooperating with foreign companies and introducing their products to the Polish market. That way companies limit their failure probability and introduce innovative products at a relatively low cost. The overall situation of textiles as far as innovation are concerned is perfectly represented by the aforementioned antibacterial and bacteriostatic materials. Recently the antibacterial properties of materials have been high on the agenda: companies have started to implement it into many products, from cosmetics, ceramics, furniture, and mattresses to fibres and clothes. One of the first Polish textile companies to start developing antibacterial products is Andrychowskie Zakłady Przemysłu Bawełnianego Andropol S.A. Since 1999 the company has worked in collaboration with the Textile Research Institute of the Technical University of Lodz on a project partially financed by the state aiming at developing special antibacterial materials for the medical industry (project was named 'Przędze i tkaniny antybakteryjne na pościel i odzież dla służby zdrowia'). The successful cooperation of both units led to the introduction of new bacteriostatic products onto the market in 2003. Such fabrics were said to effectively diminish the risk of infections in hospitals, but despite the availability of a ready product there was no demand for it.

The majority of patent applications were created in collaboration with external research units (in this case all were in cooperation with the Technical University of Lodz or the Textile Research Institute). Information from the Patent Office of the Republic of Poland confirms that the most popular form of securing protected knowledge is using trademarks

or brands. The above list also confirms that the number of patent applications is relatively low, but sufficient to protect a few of the most popular methods of obtaining antibacterial and bacteriostatic properties in textile products. Currently there exist a few different methods of incorporating antibacterial properties into fibres and yarns - two methods proposed by Andropol S.A.: the use of NAVIA™ products, Purista® technology used by the Fereti company, and many others like Tencel® with an aloe-vera layer in Gluck products, to name a few. The first two methods were developed by Andropol S.A. together with scientists from the Technical University of Lodz. The first one introduces bacteriostatic properties by incorporation of 2-hydroxy-4,2,4'trichlorobiphenyl (Anvasan AM 110 new). The fabric must be appropriately prepared, subjected to a bioactive agent, dyebathed and subjected to anticontractile finishing. Andropol S.A. used such a technique to produce medical fabrics. The second method used by this company utilises silver nanoparticles. The first step is to prepare a mixture containing Ag nanoparticles (the method used to create such a mixture was patented by the Technical University of Lodz), water as well as binding and condensing agents. Such a mixture is later applied to various textile products with the use of printing, spraying or coating techniques. Another example of a substance which has gained recognition in terms of its bacteriostatic properties is silica with nanoparticles of silver V1. The idea for such a product was imported from abroad and developed in Poland by POCH S.A., which is a part of Kulczyk Holding. The product exhibits bacteriostatic properties that inhibit the growth of bacteria and eliminate nasty odours. On 16.01.2008 POCH's silica gained the acceptance of the Ministry of Health and was allowed onto the market as a bactericidal product. The market name of this substance is NAVIA™. In cooperation with Webertex S.A., POCH S.A. developed the technology of its application to textile goods. After Webertex S.A. filed a petition for bankruptcy, the product was adopted by Thanfarb S.A. and its application method improved in order to keep optimal bacteriostatic parameters for a longer time. The aforementioned Fereti company is a well-known manufacturer of baby bedding. The company enhances its products with Purista® fabrics, the technology of which comes from the United States and is said to be durable antimicrobial

treatment that helps to control bacteria growth. Each of the companies presented tries to gain competitive advantage using different approaches to the same type of innovation. At present, Andropol S.A. is one of the biggest Polish textile companies; it is recognised as the leader in the production of military fabrics for the Polish army and produces many different types of fabrics. Their bacteriostatic fabrics for medical purposes are said to demonstrate bactericidal properties after 50 washing cycles. Tkan farb claims that their technology is even more stable and can keep 85% of their original antibacterial properties after 70 washing cycles. Fereti, on the other hand, specialises in baby beddings and tries to increase their market share by narrowing the target group of potential customers. Many other products are available on the market of antibacterial textiles, but those that gain recognition among customers will be verified by the market. [11]

Conclusions

The end of the MFA and ATC in connection with other factors like the agreement with the Republic of Turkey about free trade and Polish accession to the Schengen zone has had a harmful effect on the Polish textile sector. Globally the sector is considered as low-tech and low R&D intensive [10], with the situation in Poland being even worse. Once prosperous Polish spinning, weaving, dyeing and finishing mills no longer operate, and the market is filled with cheap Asian products. What is more, countries like China and India constantly improve the quality of their products while managing to keep extremely low prices. Despite this fact, there are companies in the textile sector with a strong position on the market which are constantly searching for possibilities to become more competitive. In order to do that they invest in research and development, which not only secures their position on the market, but also helps them to be abreast of new technologies. The example of antibacterial and bacteriostatic fabrics shows that innovation in the textile sector is not only possible but also necessary to increase the competitiveness of the sector and to gain advantage over cheap Asian imports. This situation can be compared to other branches of the textile sector since the situation in terms of innovativeness is common for the whole sector. The example presented also highlights that the majority of innovation are based on

foreign ideas, which stems from the fact that Polish companies do not possess sufficient funds to invest in their own R&D departments or to develop many products at the same time. Polish textile companies prefer to securely invest in one flagship product, thereby minimising the risk of losing their position on the market.



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