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# Current State of Pre-Consumer Apparel Waste Management in Macedonia

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## Abstract

*Effective utilisation of textile waste requires an accurate prediction of the quality of waste generated. Textile waste in Macedonia mainly consists of apparel cuttings. The aim of this research was to characterize the apparel cuttings waste, define the current state of apparel waste management and the potential barriers against introducing efficient waste management systems. Data was obtained via a structured questionnaire distributed to top managers in apparel manufacturing companies. The results indicated that almost all apparel manufacturers use landfills to dispose of their waste. The analysis showed that the waste stream consisted principally of woven fabrics, predominately cotton and cotton blends, with the presence of lycra. Bearing in mind the waste composition, the most appropriate end use for the pre-consumer waste produced is insulation materials. Considering that the industry consists of small and medium companies with limited resources, there is a low likelihood of individual investments in recycling equipment.*

**Key words:** textile waste, apparel cutting waste, textile waste management.

consumption of textile products is an indicator of the growing amount of textile waste generated in the world today. Theoretically 97% of textile waste can be recycled, which would make the textile industry a waste-free process. Yet the recycling of textiles, as a non-hazardous solid waste, is often overlooked.

By its origin textile waste can be divided in two broad categories. On the one hand, there is post-consumer or household waste, while on the other the so called pre-consumer waste generated during the manufacturing process. The division of the clothing supply chain into developed consumer markets and developing countries, where apparel production capacities are outsourced, implies that household waste is present in the former countries, whereas the latter generate more pre-consumer waste.

In the developed world, increasing environmental awareness as well as social responsibility reinforced by strict legislations has led to creating more efficient waste management practices. For instance, following the European Parliament resolution for recycling waste [2], which prohibits burying recyclable waste, including textiles, the disposal of textile waste in landfills in the EU has decreased. Landfills have been officially closed down in France, where producers are legally bound to provide textile waste recycling either by themselves or use the French Environment and Energy Management Agency; the same tendency was seen in Germany. An exception was the United Kingdom, where 70% of textile waste was still disposed of in landfills. Regarding recycling practices, a yearly

decrease rate in textile recycling of 10-20% was seen in European recycling plants (in France, Germany, the UK, Spain, and Belgium), with the exception of Poland [3]. Additionally technologies for recycling post-consumer textile waste in innovative products are sought, such as using textiles as insulation materials by companies like the French Matériaux Naturels and British Bonded Logic.

However, on the producer side of the supply chain, particularly amongst apparel producers, recycling pre-consumer waste is not common. Even though all contemporary waste management systems consider landfill disposal as the worst option, they remain the preferred manner of textile waste removal. Good textile waste management practices can be seen in Turkey. Research conducted in 2008 reported that of the 458,484 tons of industrial waste, 62% was sold to recycling companies, while only 16% was disposed of in landfills. The high recycling rates were due to the fact that the waste is predominantly from spinning plants, while only 7.5% of waste originated from apparel companies [4, 5]. In countries where the apparel industry is dominant, such as Lithuania or the South African Republic, recycling rates were considerably lower. In Lithuania 62.5% of waste originated from the apparel industry, of which 29% was sold/given freely and 71% ended up in landfills [6]. Research on apparel waste management in South Africa showed that the majority of producers (62.1%) disposed of waste in landfills, whereas just 7.6% sold it. A lack of equipment and technology were identified as the main barriers to recycling. Moreover low landfill disposal

## Introduction

Sustainable development has become a constituent part of economic and environmental policy in developed as well as many developing countries. Today's most burning environmental problems arise from the ever increasing volumes of worldwide production and consumption and associated material flows. For instance, according to the 2011 FAO/ICAC survey issued by the United Nations [1], world fibre consumption, and therefore the consumption of final product made of fibres, e.g. clothing, home textiles and industrial textiles, has grown nearly 30 times since the 1950s. The growing

costs did not encourage producers to seek new waste management solutions [7].

Apparel cutting waste is new, clean, and does not require any special treatments before recycling, thus decreasing recycling costs. Besides technology, the sole prerequisite for recycling apparel waste is to collect and sort it by colour and/or fibre content [8]. Apparel waste is sold by manufacturers in different forms that determine the market value. In one of the earliest comprehensive studies Grasso (1995) stressed the importance of sorting and packing apparel waste, as well as the fact that it must be clean and without other objects, as the main condition in turning it from waste to a valuable resource. In addition, his research stated that bailing apparel waste, rather than packing it in boxes or bags, made it more adequate for sale [9]. Using pre-consumer textile waste increased consumer trust in the quality of recycled products, especially if used for clothing [7, 10]. Bearing in mind the heterogeneity of textile waste, cooperation with the textile industry, legislation, adequate resources, hard work and time are necessary to develop energy efficient and cost effective recycling technologies.

The key challenges in recycling apparel cuttings lie in waste availability, consistency of waste supply, and the current market and demand for recycled materials. In countries where the apparel sector is developed the first two of these factors are easily met. Macedonia is a typical example of an apparel producing country. The clothing and textile industry plays an important role in its economy, contributing to 15.2% of the total GDP, and to 21.8% of the GDP by industrial sector. With a 26% share of exports the industry is the second largest exporter of the country, creating jobs for 28% of employees in the industrial sector. About 85% of the industry consists of apparel manufacturing. Macedonian apparel manufacturers export around 1,400,000 pieces of clothing monthly, and during 2010 18,885 tons of apparel was exported. According to recent research over 3,300 tons of apparel cutting waste was left in the country, amounting to 1.6 kg per capita [11]. In order to further process the waste it is necessary to characterise the waste composition and define conditions under which it can be managed. With that in view, the aim of this research was to (a) give a characterisation of apparel cutting waste, (b) define the current state of ap-

parel cutting waste management and (c) define the potential barriers for introducing efficient waste management systems.

## ■ Methodology

The research was conducted through a questionnaire distributed to the top management of Macedonian apparel manufacturers. The questionnaire was designed to analyse the following: the waste types generated (type of fabric, fibre content, lycra content), waste packing practices, the waste disposal behaviours of manufacturers, waste disposal cost, barriers for waste management, and the attitude towards preserving the environment. Structured, multiple-choice questions, with a minimum of 5 and maximum of 7 alternative answers, were used. A pilot test was conducted to ensure the clarity of the questionnaire. The questionnaire was distributed to top managers in 120 apparel manufacturers in Macedonia during September 2012. The sample included all companies belonging to the largest trade association of apparel manufacturers in the country – the Textile Trade Association. Together these companies contribute to about 70% of the employment and 90% of the GDP generated by this industry. All respondents were notified of the end use of data obtained. In 66% of cases a personal interviewing method was used, while 34% of questionnaires were distributed via e-mail. From the questionnaires distributed, 86 completed by the companies' top management were used in the analysis. In the Stip region, as the largest apparel production centre, 54 (62.8%) of the companies were located, whereas the remainder were from other regions in the country. The processing of the data obtained was conducted by applying standard statistical analysis.

## ■ Results and discussion

The sample profile included companies of various sizes. According to EU classification [12], the companies were typically medium sized with 50 to 250 employees (48.8%), followed by small companies with under 50 employees (26.7%), and large companies with over 250 employees (17.4%). In 6 cases data for the number of employees was missing.

Results of the research confirmed that apparel cuttings are the main textile waste generated since 97.67% of companies

reported apparel cuttings as their dominant waste, while only 2.32% had other textiles (nonwovens, fibres, yarns). This reflects the structure of the Macedonian textile industry i.e. mainly composed of apparel manufacturers. The absence of vertically integrated companies implies no possibilities for in situ regeneration of textile waste in the overall production process.

The materials employed were further analysed according to the type of fabric, fibre content and presence of lycra. In general, the analysis showed that the waste stream consisted principally of woven fabrics, predominately cotton and cotton blends, with the presence of lycra. The fabric type, fibre content and presence of lycra determine the procedures for the further treatment of textile waste, which can be mechanical, chemical or thermic. At present, mechanical rather than chemical recycling methods are preferred due to their cost-efficiency.

As seen from *Figure 1*, the majority of companies, 45.35%, used both woven and knitted fabrics. Only woven fabrics were used by 41.86% of the companies, whereas considerably fewer companies, 10.47% used only knitted fabrics. Non-woven fabrics were reported by 2.33% of the companies. Standard mechanical recycling of fabrics requires cutting and opening. The opening process of fabrics necessitates a loose structure, therefore woven fabrics, excluding wool, are harder to process. In order to create demand for woven fabric waste, products using woven fabric cuttings need to be developed.

The type of material used according to fibre content is shown in *Figure 2*. Pure cotton and cotton blends were the most common as raw materials, cumulatively contributing to 50%, while 8.14% worked only with synthetic materials. A substantial number of companies, 41.86%, used materials with different fibre contents, including cotton, cotton blends, synthetics, wool, flax, etc. The presence of animal fibres, such as wool or wool blends, which are frequently regenerated, was negligible (1.16%). The analysis showed that the biggest amount of waste consists of mixed fibre. Utilisation of textile waste from blends and synthetic fibres appears to be a great problem as these are not biodegradable, and hence the task of recycling such fibres should be given priority. In the long term this

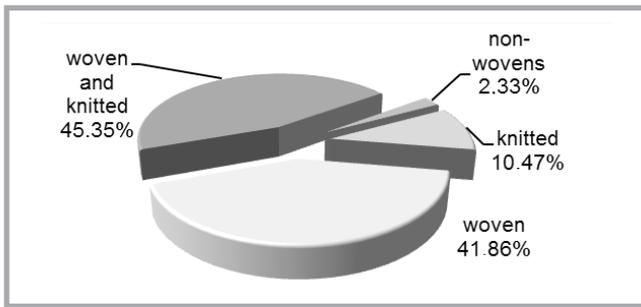


Figure 1. Materials according to fabric type.

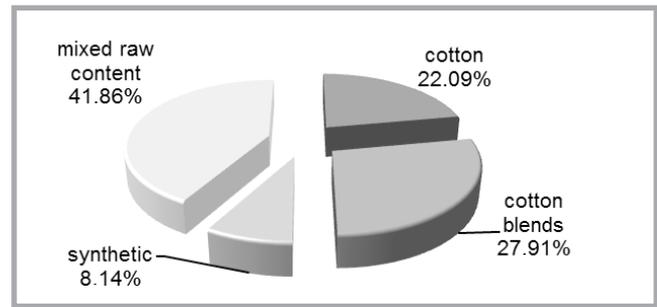


Figure 2. Materials according to fibre content.

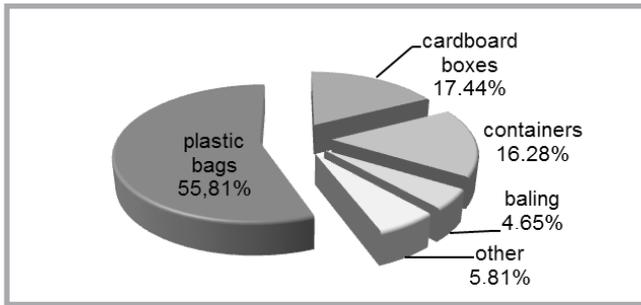


Figure 3. Waste packing practices.

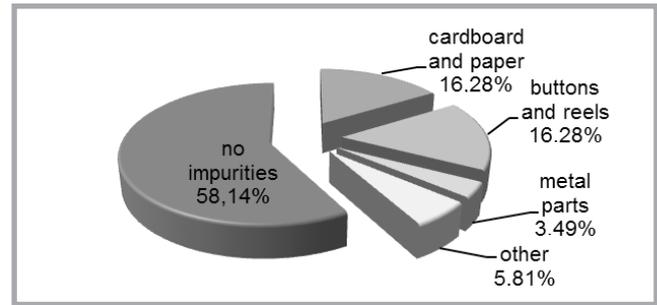


Figure 4. Presence of impurities in textile waste.

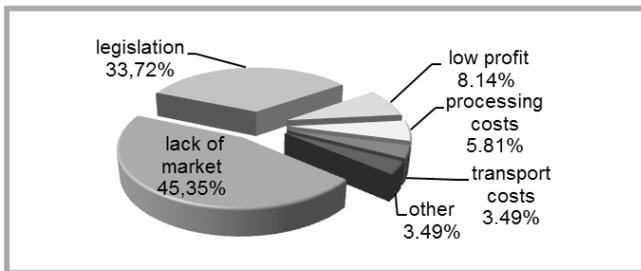


Figure 5. Barriers for waste management.

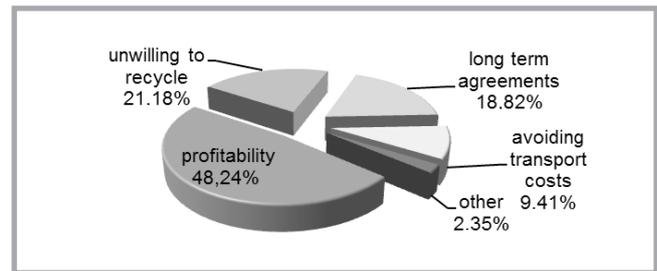


Figure 6. Conditions for waste management.

type of waste can be used in the construction industry as soundproof blocks, insulation, roofing felt, bank stabilisation, pollution control filters, etc. Although cotton fibres are completely degradable, they can theoretically be fully recycled, partly in the spinning process or for quality paper production.

The content of lycra in fabrics was analysed separately, because it has a significant influence on the recycling process. Only 14.12% of companies used materials with no lycra. The majority of companies – 60.0% - used up to 30% of materials containing lycra in their production, whereas 25.88% used over 30% of materials containing lycra. The presence of lycra in fabrics would make the process of classical mechanical recycling even more difficult.

Furthermore the methods of apparel waste management within the companies were analysed, including methods

of packing the waste, the presence of impurities, waste disposal practices and costs. (Figure 3). Packing in plastic bags was the most frequent way of collecting apparel cuttings, as 55.81% of companies used it, followed by packing in cardboard boxes – 17.44%, throwing cuttings straight in containers – 16.28%, baling – 4.65 %, and other methods (e.g. packing in cotton bags) – 5.81%. In other words, the packing methods commonly used do not add any value to the waste produced, as Grasso suggested that baling was the option preferred [9]. The textile waste generated was mainly clean since 58.14% of companies reported that the bags, boxes or bales did not contain any other objects (Figure 4). Dominant non-textile impurities were cardboard and paper – 16.28%, as well as buttons and reels - 16.28%. With 9.3% of companies, mixed impurities - cardboards, metal parts, buttons, and reels were present in the waste.

Recycling practices were virtually non-existent, as only one company recycled the cutting waste. In the majority of companies, 94.19%, apparel waste was collected together with municipal solid waste by governmental waste service companies, and subsequently disposed of in landfills, where it was combusted. Less frequent waste collection methods were by licensed companies, 3.49%, or individuals, 1.16%. Waste management had a small cost compared to the total company budget. For 44.3% of companies waste disposal costs were less than 1% of the budget, and for 34.18% they were between 1 - 2% of the budget. Merely 5.06 % had a disposal cost of above 5%. Relatively low disposal costs indicate that this factor is not a very important motivator for recycling.

Finally barriers for introducing efficient apparel waste management practices (collecting, sorting and selling waste) were analysed in addition to the condi-

tions that would induce manufacturers to apply them (**Figures 5 and 6**, see page 15). External barriers, namely lack of market (45.35%) and legislation (33.72%), were indicated as key factors. Remedying the first of these barriers is a complex issue. Existing markets for apparel waste are in the production of non-woven textiles; however, as non-wovens are not produced locally there is a lack of awareness among apparel producers. Furthermore the European market for textile recycling is constantly diminishing [3], and the need for developing new markets is emerging. No development of new markets can be considered without innovation, which implies costly investments in research and development, but which could have attractive outcomes in terms of environmental protection. Vis-à-vis legislation, current Macedonian legislative requires producers to declare the exact amount of waste generated and disposal of it in the presence of government officials due to customs regulations. This should be kept in mind when creating any policy for apparel waste management. Internal barriers such as processing – sorting and packing apparel waste, or transport costs were not considered to be a problem.

Conditions under which managers would agree to collect, sort and sell the apparel waste generated were profitability of the operation – 48.24%, long term agreements with recycling companies or individual buyers - 18.82%, and avoiding waste transport costs – 9.43%. A fifth of the respondents, 21.2%, would not recycle waste under any conditions. It is interesting to compare these results with the environmental consciousness of the respondents. Despite the fact that 98% of managers declared that preserving the environment is important, almost half of the companies would not manage their own waste if they deemed it unprofitable, and a fifth would not agree to manage their waste under any conditions. In other words, turning recycling into a profitable operation is the main driver in the battle to reduce pre-consumer textile waste. Existing practices have shown that economically feasible recycling operations in the apparel industry are hard to achieve. Considering the relatively difficult financial situation in which the textile and apparel industries are world-wide, as well as the fact that the industry consists of small and medium companies with limited resources, it seems imperative that the Macedonian Textile Association and

government should make a serious effort to assist them in implementing recycling practices.

## ■ Conclusion

The research work presented in this paper was focused on the current state of pre-consumer apparel waste management in Macedonia. The research results indicate that:

- a) Regarding the characterisation of apparel cutting waste, the waste stream mainly consists of woven fabrics, predominately cotton and cotton blends, with the presence of lycra. According to its composition, the waste has a low value for textile application, excluding non-woven production. Therefore alternative usage should be explored. Recycling apparel cuttings for insulation products in the construction industry would be the most appropriate end use for the pre-consumer waste produced. Priority should be given to non-biodegradable waste and using cuttings rather than openings as a recycling method.
- b) Disposal in landfills is the dominant waste management practice. Almost all waste is collected by governmental waste service companies. Even though cleaning the waste is not required, the majority of companies generate waste clean of any impurities. Consequently the goal of obtaining clean waste is easily achievable. Apparel waste is typically collected in plastic bags, a form inconvenient for transport. Another factor that may play an inhibiting role in improving recycling practices is the insignificant waste disposal costs reported by most manufacturers.
- c) External barriers, such as the lack of a market and current legislation were considered to be most important by the respondents, while internal barriers were not regarded as a problem. The majority of respondents would only consider recycling if it adds profit to the company. Bearing in mind that the industry consists of small and medium companies with limited resources, it seems imperative that the Macedonian Textile Association and government should make a serious effort to assist them in implementing recycling practices.

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