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Acta academica karviniensia, 2025 Volume XXV(1): 33-45
DOI: 10.25142/aak.2025.003

Textile Waste Management in Fast Fashion and Solutions for Transition to a Circular Economy in the Industrial Company Chemosvit Fibrochem

Pavol Bujda[1]

[1]*Matej Bel University in Banská Bystrica, Faculty of Economics, Tajovského 10, 975 90 Banská Bystrica*
Email: pavol.bujda@student.umb.sk

Abstract: The textile industry is associated with negative environmental impacts due to the constant use of pesticides and polluting dyes, excessive use of water and electricity, and the release of emissions and polluting fumes into the atmosphere. Textile waste ends up in landfills or is incinerated, which posing a risk of soil, watercourses and air pollution. The increasing amount of textile waste and the lack of technologies for its recycling lead textile companies to seek alternative options for managing this type of waste and to the inevitable implementation of a circular economy. This article highlights the impacts of fast fashion and based on the results of primary research presents recommendations and possible solutions for managing the circular economy in a specific industrial enterprise.

Keywords: circular economy, fast fashion, recycling, textile waste, waste management.

JEL classification: Q53, Q55, Q56

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Introduction

The fast fashion business model is based on the rapid introduction of new textile products into stores, with retail chains offering the latest fashion changing their assortments after just a few weeks. Clothing is currently subject to rapid change, driven by affordability and people's obsession with image and appearance. The fast fashion business model, which regularly brings new "fashionable clothes" to the market, is focused mainly on the production of low-cost clothing. Offshore production, located mainly in Asian countries, allows to produce cheaper clothing in larger volumes (Rivoli 2005), which often results in lower quality, faster wear, greater consumption and frequent waste. This accelerating process begins with the cultivation of industrial crops, continues with the processing of textile fiber into fabric, from which cheap clothing for short-term use is sewn, and ends with the disposal of unwanted clothing in a textile waste landfill. The end consumer, who supports the fast fashion model with their frequent and repeated purchases of clothing, is usually unaware that the regular and accelerated production cycle of textile products cause significant damage to the environment. The imaginary spiral supporting fast fashion trends, regular replacement of textile products and disposal of clothing thus spins ever faster, as clothing becomes unwanted after a few uses, quickly becomes obsolete or falls apart (Arrigo 2016). This trend remains unsustainable, as the total estimated waste of the global clothing industry is 92 million tons per year (Smith 2022). Most textile waste is currently disposed of in landfills or incinerated, both of which have a very negative impact on the environment. An alternative option for waste management is to provide the textile product for further use to the new owner or for recycling. However, the reduction of textile waste generation itself also plays an important role, the prerequisite for which is a change in consumer behavior. The aim of this article is to present the implications of the fast fashion business model, specifies alternative options for managing textile waste and suggests recommendations that can be implemented into the circular economy management of the studied company. Some of the recommendations filling a research gap in professional studies dealing with the mentioned issue. The contribution of this article are the proposed solutions based on the research carried out in a specific industrial company and these solutions can be an example for other chemical

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and textile companies. The first chapter deals with a review of the literature focused on the issue of the consequences of fast fashion and alternative options for processing textile waste. The second chapter defines the research objective, research questions and the method of the research. The third chapter presents the research results with a discussion. The conclusion connects theoretical knowledge from the literature with the results of primary research.

1 Literature review

Global clothing consumption doubled between 2000 and 2014 (Remy et al. 2016), and the global clothing industry is currently estimated to have a market value of US $ 1.5 trillion and a 5% annual growth rate (Clark 2023). Fashion is the driving force behind the textile sector. The current mode of fashion consumption is increasingly fast-paced and characterized by the artificial novelty of one-off trends and aesthetic fads, with new styles quickly introduced to the market, replacing old ones and stimulating consumers' constant desire for novelty and change (Ozdamar & Atik 2015). The cycle that is now known as "fast fashion" begins with the cultivation of cotton, continues with the production of textile fibers, their treatment, processing and finalization into garments, mainly in Asian countries, and subsequent transportation to fast-moving brand stores around the world (Balogová 2023). Consumers, flexibly responding to changes in fashion trends in the field of clothing, expect new goods every week and quickly buy "the latest and most fashionable clothes", thereby spreading the phenomenon of fast fashion, i.e. "disposable clothes", which decorate consumers' wardrobes for only a very short time (Balogová 2023). Such short-term clothing becomes unwanted also because consumers do not value cheaply purchased clothing and do not care about its further fate. This "throwaway society" (Hellmann & Luedicke 2018) is characterized by the production of large quantities of short-lived clothing. Consumers buy more clothes and wear them less often, throwing them away more often, thereby causing a catastrophic generation and increase in textile waste (Islam 2023). Short-term used or unsold goods end up in landfills, with a large part exported outside the EU and the USA. Outsourcing of production, combined with the rise of fast fashion business models, leads to several numbers low-cost and low-quality textile products, which causes increased consumption of textile products and shortening their life cycles, resulting in increased textile waste (Thompson 2017). The production of textile waste is influenced by the production of textile goods, and therefore the higher the production, the greater the amount of waste generated (Blackburn 2009). On average, consumers in the EU throw away around 5.8 million tonnes of textiles per year, which is around 11 kg per person, of which synthetic fibers such as polyester and nylon make up almost 60% of clothing and 70% of home textiles (Global Fashion Agenda & The Boston Consulting Group 2017). At the end of the textile chain, a large amount of waste is still generated worldwide, making waste management a huge challenge for manufacturers (Amutha 2017). During landfilling, there is a risk of contamination of soil and waterways, because textile waste contains chemicals and dyes and is therefore difficult to biodegrade. The disposal of textile waste by incineration increases CO2 emissions, which pollutes the air (Clark 2023). One of the main reasons why this type of waste is not currently being recovered is, in addition to the issue of collection and sorting, its high complexity in terms of the diversity of its composition, which makes mechanical recycling difficult (Balogová 2023). Alternative options for managing textile waste are aimed at limiting the creation and reduction of the amount of textile waste. One solution is to implement the "3 R" strategy, aimed at reducing the amount of waste (Reduce), reusing (Reuse) the product and recycling (Recycle) the product. This strategy can help minimize the amount of waste disposed of, with an emphasis on conserving natural resources and extracting maximum value from original products (Islam 2020). Fashion retail organizations have realized that the fast fashion model-based approach to product development is no longer economically or environmentally viable, and a transition to

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a circular economy is imperative. This will soon lead to the entry into a new marketing era that can best be described as the era of the “circular fashion economy” (Islam 2020).

1.1 The impacts of fast fashion

Fast fashion and its environmental impacts begin with the cultivation of cotton, the most common natural material used in the clothing industry. It takes thousands of liters of water to grow one kilogram of cotton, and since cotton is a highly chemically intensive crop, its cultivation involves the use of large amounts of fertilizers and other chemicals such as crop protection agents (Clark 2023), which contribute to water and soil pollution. According to the World Bank, the global fashion industry produces 20% of the world’s wastewater annually (Global Fashion Agenda & The Boston Consulting Group 2017) which is largely due to the use of toxic chemicals and dyes during textile production. Asian countries, where most fast fashion clothing is produced, have limited or no regulations for wastewater disposal, so untreated wastewater from textile factories is discharged directly into rivers and waterways. These toxic chemicals then enter the soil and groundwater, which can ultimately affect the quality of drinking water and cause health problems for residents. The global textile and fashion industry are responsible for air pollution by producing 1.2 billion tons of CO2 per year, which is more than 10% of global carbon emissions, and it is estimated that if the increased demand for textiles continues, the clothing industry will contribute to approximately 25% of all global carbon emissions in 2050 (Clark 2023). The production of jeans consumes more than 3,000 liters of water, uses about 10 kg of chemicals and releases 13 kg of carbon dioxide into the air (Global Fashion Agenda & The Boston Consulting Group 2017). If such trousers end up in a textile waste landfill, their degradation process will take approximately five months if they are made of cotton and several hundred years if they are made of synthetic and other mixed materials. Although natural fibers are naturally biodegradable, the huge amounts of dyes and chemicals used in the dyeing and finishing process poses a threat to soil contamination (Nimkar 2018). The degradation of synthetic materials poses a risk of releasing microplastics and other harmful chemicals into the environment (Balogová 2023). In 2015, the fashion industry was responsible for the creation of 92 million tons of global waste, and this number could increase by 62% to 148 million tons by 2030 if current trends remain unchanged (Global Fashion Agenda & The Boston Consulting Group 2017). Fast fashion has social aspects that affect mainly the people involved in its production, but also the final consumers of the goods. Nowadays, information is often presented about the working conditions of employees in developing countries, which are characterized by low wages, long work shifts, hazardous environments and child labor. On the consumer side, health problems can arise due to the use of harmful chemicals in the production and dyeing of textile products. Fast fashion creates the illusion that it is necessary to constantly buy new pieces of clothing in order to be "in" and socially accepted. This pressure is often reinforced by social media and marketing strategies.

1.2 Alternative options for managing textile waste

The main principle of protecting the environment from the negative impacts of global textile production is currently to support the reduction of textile waste and limit its generation (e.g. repairing damaged items instead of buying new ones), the reuse of textile products (take-back, sale, exchange, donation) and the recycling of textiles.

a) Reducing textile waste

An important aspect of reducing waste and limiting its creation in the textile industry is the necessary support for changes in consumer behavior, which starts with responsible shopping. This means that the consumer will buy only what is necessary and realistically needed (Pookulangara & Shephard 2013), will avoid buying fast fashion products, will prioritize quality over lower price and will buy fashion brands that behave responsibly and transparently.

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Such support for changes in consumer habits should discourage consumers from buying large quantities of cheap textile products with a short lifespan and consequently reduce the amount of textile waste going to landfills. It is important to convince the consumer to prefer sustainable fashion that does not support overproduction and helps minimize the negative impacts of textile production on the environment (Thompson 2017). Sustainable fashion should be promoted by world-class models who influence global fashion trends in the clothing industry by showcasing the latest clothing models.

b) Reuse of a textile product

Reuse aims to extend the life of a textile product. One form of reuse is the donation or sale of unwanted textiles to second-hand retailers (Hawley 2006), who then sell the goods in their second-hand retail stores for a profit. People usually donate unwanted clothing to their close family, acquaintances or friends. A common practice is to donate children's clothing, which is then used by another family with children. Very often, consumers sell unwanted clothing at reduced prices through internet portals and online bazaars or donate it to charitable organizations, which usually give it to disadvantaged groups of the population free of charge (Bianchi & Birtwistle 2012). Another option for reusing unwanted textiles is so-called swapping, which offers consumers the opportunity to meet other consumers and exchange used and unwanted clothing. In these ways, the textile garment finds its new owner, giving the product a second life and extending its lifespan. According to Thompson (2017) a barrier to the success of reuse strategies is the lack of information, as consumers sometimes do not know what can be donated and so decide to throw things away.

c) Recycling of textile waste

For textile products, finding their “final destination” is a significant question mark (Lacy & Rutqvist 2016), as the environmental fate of textiles in landfills depends on their material composition. Mechanical and chemical processes can be used to recycle textiles, which allows the decomposition of textiles and the production of new fibers. Depending on the process, the resulting fibers are either of lower or equal quality and can be used for different applications (Thompson 2017). Textile waste is very difficult to recycle, as it is almost always a mixture of several materials, while chemical additives including dyes, flame retardants, adhesives, biocides and surface treatments further increase the complexity and difficulty of recycling (Balogová 2023). Waste reduction is therefore currently focused on the use of textile materials that allow the recycling of clothing products. The lack of recycling schemes, technical support, research and development in the field of fiber sorting (Balogová 2023) causes textile materials to end up in landfills (Steinbring & Rucker 2003), or be incinerated, or exported to countries that are also unable to reprocess them.

d) Upcycling and clothing rental

Alternative waste management methods include upcycling. This is a way of looking at waste creatively and transforming it into something new (Ainamo 2014). Upcycled clothing uses significantly fewer raw materials and massively reduces the harmful impacts of fashion production, while also reducing the amount of clothing that would otherwise end up in landfill (Aishwariya 2018). The e-commerce business model “Rent the Runway” was introduced in the United States and focuses on renting luxury clothing. The store provides consumers with the opportunity to rent designer clothes at retail prices, thereby reducing their consumption and promoting slow fashion (Fernandes et al. 2018).

2 Methodology

The main criteria for selecting a specific company to be studied were its activity in the industrial sector and the possibility of influencing the fast fashion business model. The studied company

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is a Slovak industrial company operating in the chemical production of synthetic fiber, which it sells to B2B customers, and therefore its products are purchased by large, medium-sized, and small textile companies. The company has long been cooperating on the development and research of recycled synthetic fiber and recycled clothing together with major global sports brands, which makes it closely connected to the textile industry, and through its customers as well as to the end consumer. The research objective of this article is to analyse waste flows in the studied enterprise and to propose recommendations and solutions for circular economy management that can be implemented in the studied enterprise and in enterprises engaged in textile production. Based on the research objective, the following research questions were defined:

RQ1: How does the studied company recover industrial waste?
RQ2: What solutions does the studied company apply when implementing a circular economy?

To achieve the research objectives, the semi-structured interview research method was used. This research method enabled flexible data collection, provided the opportunity to respond operatively to individual findings during the interviews, thus creating space for formulating new questions related to specific responses of the respondents. This research method contributed to the fulfillment of the research objectives in terms of obtaining detailed information regarding waste management and the implementation of circular economy elements in the surveyed company and in companies engaged in textile production. The research method used was suitable for conducting qualitative research due to the collection of data related to processes and settings in the circular economy. The interviews were conducted in the form of a personal meeting with the respondents. Questions for the respondents were prepared in advance, while during the interview new questions were also asked that arose during the interviews based on the respondents' answers. Semi-structured interviews were conducted with the quality manager, the research and development manager, the production manager, the sales manager and the waste management manager, who were asked questions regarding waste management in this industrial enterprise and the use of other waste management options. The respondents answered questions regarding the implementation of circular economy elements and cooperation with enterprises that continue to process synthetic fiber into a textile product. The data obtained from these interviews are the main source of data, together with data obtained from publicly available sources about textile companies. The interviews with company managers were conducted during October and November of last year 2024.

3 Results and discussion

The fourth part of the article is divided into two subchapters. The first subchapter deals with the analysis of waste flows in the studied company and answers the first and second research questions: how the studied company deals with industrial waste and what solutions the studied company applies in implementing the circular economy. The second subchapter deals with the proposal of recommendations and solutions for the implementation of the circular economy, which the company should implement in its business practice.

3.1 Analysis of waste flows in an industrial company

This article presents an analysis of waste streams in an industrial company (Fig. 1) Chemosvit Fibrochem, which is focused on chemical production. The investigated company producing multifilament synthetic fiber is a major European producer of polypropylene fibers. The final product is used mainly by textile companies that manufacture fabrics, knitwear, garments, and clothing. The company produced synthetic fiber in the volume of 1,205 t in the past year 2024, with waste accounting for 95 t (7.9% of the production volume). Of the aforementioned waste

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volume, 5 t (5.3% of waste) were disposed of in landfills and 90 t (94.7% of waste) were sold to companies that use it for further processing. This post-industrial waste can be used for filling mattresses and toys after initial treatment (e.g. by cutting), where it functions as a secondary material that would otherwise end up in a landfill. Other companies use purchased textile waste as primary material to produce of goods, e.g. rugs and mats, which can be considered a form of upcycling. A third way of using pre-industrial waste is recycling, during which the waste passes through a recycling line and the result is regranulate, from which it is possible to reproduce already recycled fiber. Figure 1 shows the material and waste flows in the studied company and in companies that further use synthetic fiber, together with a circular system of waste utilization for the production of recycled products. Companies purchasing multifilament synthetic fiber process the fiber on textile machines and use it to produce fabric or knitwear, which is then used to sew clothes, apparel, and other textile products. Companies producing fabrics and apparel produce pre-consumer waste during their production, which they either dispose of in textile waste landfills or collect for other purposes, most often for recycling. Final textile products are sold to consumers, who choose from a wide range of goods in clothing stores, but consumers are rarely aware of the material composition of the purchased textile product and its recycling or reuse options when purchasing. Clothing sold to consumers is worn for a certain time and after a short time becomes textile waste, which ends up in a landfill and awaits disposal, or can be recycled as post-consumer waste. The company under investigation is developing activities aimed at ensuring that all links in the supply chain influence the end users of textile products so that consumers do not automatically throw away unnecessary clothing, but hand it over to collection containers, or provide it for further use in the form of sale, exchange, or donation. The amounts of textile waste collected in this way from collection containers are given the chance to undergo thorough sorting, which selects textile waste for further use, recycling, or simply disposal.

Recycling of textile waste is carried out by specialized recycling companies, which sort and process the collected textile waste on a recycling line into the form of regranulate, which is then sold to companies producing synthetic fiber. Last year, the company under study produced and sold 5 t of recycled synthetic fiber, for the production of which regranulate obtained from the recycling of textile waste was used. The Slovak company sells the produced recycled synthetic fiber to its customers, textile companies, both at home and abroad. Textile companies produce new textile products from the purchased recycled fiber, thus closing the material circle and creating elements of the circular economy when textile waste is converted back into a final product using recycling technologies.

The company under study has been working on a project for several years to produce a fiber made from a natural polymer based on castor oil and a fiber based on lactic acid. Based on research and development, some natural materials can be used to produce a polymer, which is the input raw material for fiber production. Since these are fibers made from natural materials, their characteristic property is the possibility of degradation in natural conditions, which provides the prerequisite for industrial and domestic waste composting. Clothing and garments made from these biodegradable fibers could be one of the options for reducing the generation of textile waste and an ecological form of disposal of this waste.The aim of the industrial company under study is to create a collaborative circle between fiber producers, textile companies, end consumers, waste collection and sorting companies and recycling companies in the textile product recycling project, which would ensure a continuous supply of textile waste for the production of recycled fiber and its subsequent use in a new textile product.

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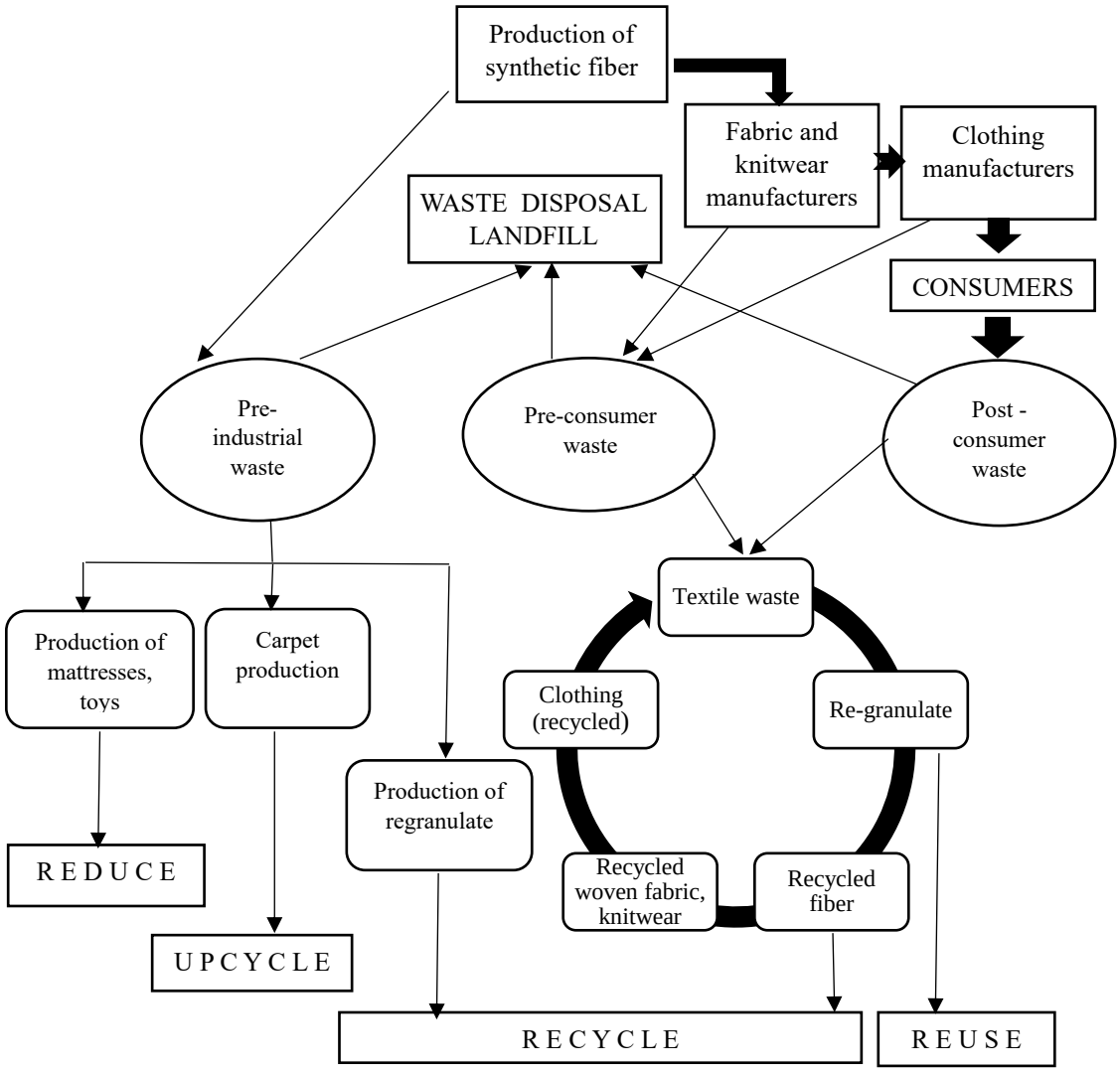
Figure 1: Analysis of waste flows in an industrial enterprise



Source: Authors' research, 2023

The Slovak company under study cooperates on the recycling project with large sports brands, which can significantly influence consumer behavior, thinking and decision-making of the end user of a textile product through their marketing. An equally important role in this process is played by the legislative and institutional support of the state, which can create legal frameworks in specific areas and activities of textile waste management through legal norms, laws and regulations. The research results point to possible alternative solutions for waste management, such as reuse, upcycling and recycling, which can contribute to reducing the generation of textile waste and thus reducing negative impacts on the environment. At the same time, the company under study contributes through its research and development to the creation of new products that can significantly help mitigate the negative impacts of fast fashion. In the case of standard production of biodegradable fibers and clothing from biodegradable materials, there can be a great potential for reducing the amount of textile waste in landfills and mitigating the consequences of the fast fashion business model.

3.2 Recommendations and solutions for the implementation of the circular economy in the studied company

Currently, most textile waste is disposed of in landfills, while possible alternatives and solutions for waste management could be take-back, reuse, upcycling, recycling, and industrial and

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domestic composting. The most preferred form of waste processing today is recycling, when textile waste is used to produce regranulate using recycling technologies and a new textile product for the consumer. In this way, a cycle of textile product use could be created, which is one of the prerequisites for a functioning circular economy. The recycling process itself in recycling companies is only one element of the cycle, which includes companies focused on waste collection, companies for the production of recycled textile fiber from regranulate, and textile companies producing fabrics and clothing from recycled fiber. Upcycling is also a developing form of using textile waste, which offers new possibilities for sustainable solutions to waste streams in the form of changing the original purpose of the product. To reduce textile waste, it would be appropriate for a retail chain selling clothing to allow consumers to take back the product, which could prevent textile waste from automatically ending up in a landfill. Textile products returned in this way can still be sold in "second hand" stores, where the clothing can find a new owner and can be used for another time. Domestic and industrial composting of textile waste is also expected shortly, which is conditional on the use of biodegradable textile fibers. Biodegradable fibers will be a huge challenge for textile fiber manufacturers, as they enable an ecological solution to waste management. Activities aimed at preventing the creation of textile waste and reducing its amount should be supported by government. Changes should be necessary, which should start with the selection of raw materials, continue with research into the selection of materials, presentation of design by fashion designers and change in consumer behavior. Currently, it is possible to see many barriers that make it difficult to close the material flow within the textile and clothing industry. These are barriers in the area of consumer purchasing behavior, the area of business policy of fashion brands, the area of legislation, collection systems, infrastructure or recycling technologies. Legislative barriers exist mainly due to unclear waste laws. Unclear definitions of when waste ceases to be waste and becomes a secondary raw material hinder its easier reuse and trade. Many existing laws focus primarily on how to deal with waste that has already been generated (landfilling, incineration) and less on waste prevention and reuse. Obtaining permits to operate waste treatment facilities is often costly and time-consuming. Legislation often does not provide sufficient financial or regulatory support for businesses that develop and implement innovative circular business models. Although synthetic textiles are technically recyclable, there are currently very few commercially viable recycling programs due to the persistence of several economic and technical problems (Balogová 2023). Ideas and possible recommendations that could help overcome these obstacles are as follows:

1. Increase in collected volume and quantity of textile waste

Nowadays, the amounts of textile waste collected are not sufficient to support a commercially viable recycling industry. One possible solution is to introduce a system of extended post-consumer collection networks, such as textile collection boxes, and to implement educational campaigns to ensure a sufficient and continuous supply of raw materials for recycling companies. Nowadays, we can only register a very low level of textile waste collection, Mandatory collection of textile waste is to be introduced in all EU Member States by 1st January 2025, therefore education is needed to change citizens' consumer behavior and make the most of the collection containers.

2. Prioritizing monomaterials over mixed textile waste

Textile waste is in most cases a mixture of several types and types of materials, both synthetic and natural, which significantly complicates the possibilities of mechanical recycling. A possible solution to this problem could be the support of textile materials offering the possibility of simple mechanical recycling. Mixed textiles need to be sorted consistently, which, however, increases the overall costs of the recycling process. Nowadays, polyester and cotton fibers are

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used in bulk in textile products and very often in combination, which makes simple mechanical recycling impossible. The difficulty of recycling is also increased by the presence of a large number of dyes and pigments and the chemical resistance of many fibers (Balogová 2023). It will be very important to direct designers and manufacturers of clothing and textiles, but also end consumers as soon as possible, to prioritize the use of so-called monomaterials, which would be easily mechanically recyclable. Fashion designers would, due to conscious purchasing behavior, supply fashion products with a built-in aspect of recyclability or reuse.

3. Replacing current synthetic textiles with biodegradable materials

Nowadays, a large amount of textile waste ends up in landfills, where soil and groundwater are polluted by chemicals and dyes used in their production, or in incinerators, which pollute the air. A major challenge for the fashion industry will be the use of biodegradable textiles, which would be produced from biodegradable polymers and would completely decompose over time. Biodegradable polymers obtained from natural sources are expected to be fully degradable in controlled industrial composts. The challenge of these polymers remains in their processability and the possibility of achieving physical and mechanical properties of fibers suitable for subsequent processing on textile machines (Balogová 2023).

4. Changing consumer purchasing behavior and reducing demands on the final product

Today's consumer has a rich offer and a wide range of clothing choices from various types of materials, cuts, designs and colours at relatively low prices. When buying, they usually consider the design and colour design along with the price, so that they can distinguish themselves from other people with their clothes. In the case of clothing made from biodegradable polymers, the breadth of the offer and colours is significantly narrowed, which is why active education is important, which would help influence consumer preferences. With biodegradable polymers, there will be design limitations and restrictions, and therefore it is necessary to change the consumer's settings and reduce their demands for colours, flexibility, or a mix of multiple materials. When buying, the consumer should pay attention mainly to the material composition, the possibility of reuse or recycling, and the overall impact on the environment, when after some time the product will no longer be needed.

5. *Recycling of biodegradable products*

Recycling of biodegradable products is one of the great challenges of the future in the textile and clothing industry. The possibility of re-recycling biodegradable textiles and their subsequent use in other less demanding biodegradable products would be a significant positive factor in the textile industry. To overcome these challenges, intensive research, innovation and new technologies are necessary and essential. The existence of recycling of biodegradable textiles could lead to a significant reduction in the growth rate of textile waste and thus to the mitigation of ecological impacts in the environment.

6. Consumer education

Changing consumer purchasing behavior can be achieved through ongoing consumer influence and education, because only the consumer decides what clothes to buy and what the requirements and demand for textile products will be. The first form is raising awareness about the negative impacts of fast fashion through campaigns on social networks, documentaries and educational videos, articles and blogs. Social media campaigns can spread truthful content about the environmental impacts (water pollution, waste in landfills, air pollution) and social impacts (child labor) of fast fashion through posts. Documentaries videos can help consumers learn about the behind-the-scenes of fast fashion. Publishing articles helps explain the problems associated with fast fashion. The second form of consumer education is providing information

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about alternatives to fast fashion through the promotion of fashion brands focused on product quality, the promotion of second-hand stores, the promotion of clothing exchange meetings and of clothing rentals. The third form of consumer education is associated with organizing lectures at schools and universities, workshops and exhibitions on contemporary fashion. Based on knowledge from literature and data obtained using research questions in the form of semi-structured interviews, the following solutions are proposed for company for the implementation of a circular economy.

1. Sustainable fiber production

The company under investigation produces high-quality polypropylene synthetic fiber, which has a longer service life, which extends the lifespan of the final products and reduces the need for their frequent replacement. Compared to natural materials (cotton, nylon), textile material made of polypropylene fiber has a much lower overall environmental impact. The company under investigation should focus intensively on the development of biodegradable fibers, which represent the future of the textile industry due to their low environmental burden.

2. Use of non-toxic materials in the production of the fiber

When producing polypropylene fiber, the company under study is recommended to use only non-toxic chemicals and additives that do not hinder recycling and are safe for the environment and health. It is important that the company uses only certified additives in the production of its products that do not have a negative impact on the environment and that facilitate the recycling process of the textile product.

3. Introduction of material tracking systems

For the company under study, an important recommendation in implementing a circular economy is the use of smart technologies (e.g. blockchain, digital labels), which will allow the company to track the origin and composition of the fibers throughout the value chain. This will facilitate the identification and sorting of materials for recycling purposes.

4. Optimization of production processes

By optimizing production processes, waste should be minimized. The company under study should identify sources of waste, optimize machine settings, and implement quality controls to prevent poor quality products.

5. Creation of a support team

The recommendation for the company under study is to create an internal team consisting of employees responsible for implementing the circular economy in the company. This team would regularly work on tasks assigned by the company management and report to the company management on the current status of these tasks.

6. Cooperation with other fiber manufacturers to create infrastructure

Creating recycling infrastructures is very demanding in terms of investment and human resources. Its creation requires financial resources and qualified employees and experts who have experience with recycling projects. It is recommended for the studied company to cooperate in the development of joint recycling infrastructures and standards for the circular economy with competing companies.

7. Active participation in the creation of legislation

In order to create legislative conditions for the circular economy, it is necessary for the studied company to actively communicate with the government and state administration bodies to

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create policies and regulations that support the circular economy in the textile industry. An essential step to support the circular economy is the promotion of economic incentives.

8. Implementation of its own take-back system
It would be very useful for the company under study to establish programs where consumers can return old textile products containing synthetic polypropylene fibers, which would allow the company to control the flow of materials and ensure their recycling.

9. Cooperation with fashion brands on design changes
The company under study should, through its B2B customers, which include major global fashion brands, actively support the change in fashion design in favor of mono-material products that are easier to mechanically recycle. The recommendation for the company under study is cooperation with the design departments of major global fashion brands.

10. Partnerships with recycling companies
An important recommendation for the company under study is to actively cooperate with recycling companies that deal with mechanical recycling processes for synthetic fibers. The result of the cooperation should be the optimization of mechanical recycling processes for synthetic fibers to minimize the degradation of fiber quality during repeated processing.

11. Cooperation with companies focused on the collection of textile waste
One of the recommendations for the company under study is to support joint projects aimed at developing effective systems for the collection, sorting and processing of textile waste containing synthetic fibers. The purpose of such cooperation is to increase the volume of collected textile waste, which would enable recycling companies to regularly recycle.

12. Cooperation with retail chains
The recommendation for the company under study is to cooperate with retail chains to create joint systems for the return of textile waste, which would increase the amount of unnecessary textile products for recycling purposes.

13. Support for research and development
The company under study should invest in joint development and research of innovative solutions to support the circular economy in the textile industry with domestic and foreign research institutions and universities. Currently, the company under study is conducting research focused on the development of biodegradable fiber and its recyclability, which could replace synthetic fibers and textiles in the future, which would be a significant shift in the circular economy of the textile industry. An important recommendation is to actively participate in initiatives that support circular production. The company under study is currently a member of the Slovak Plastics Cluster, which brings together companies involved in the plastics industry.

14. Awareness and change in consumer purchasing behavior
One of the recommendations for the studied company is to spread awareness and educate consumers. To support the circular economy, it is important for the consumer to have information from the manufacturer about the composition of the synthetic fiber. When purchasing a textile product, the consumer must have knowledge about the importance of proper handling of the textile and about the possibilities of its repair, reuse and recycling. In this way, it is possible to achieve a reduction in consumer demands for the variety of colors and the combination of materials used.

The implementation of these solutions requires investment in technology and cooperation throughout the value chain. However, the transition to a circular economy can bring significant environmental and economic benefits for the studied company producing synthetic fiber. The recommendations and solutions mentioned can help and be an inspiration in managing the circular economy for other companies.

Conclusion

Currently, the fast fashion business model has extremely negative impacts on the environment. Huge quantities of quickly produced textiles with a short lifespan end up in landfills, where they can contaminate the soil for years with chemicals added during their production. The amount of water and pesticides used in cotton cultivation and polluting the soil, the huge volume of water, chemicals and dyes discharged into waterways during the production of textile products, and the high volumes of carbon dioxide released into the air during transportation or disposal of waste raise the need to find solutions to stop, or at least slow down, the environmental pollution caused by fast fashion as soon as possible. The negative environmental impacts of the textile and clothing industry should be a warning signal for changes affecting all relevant parts of the textile industry supply chain. The results research indicated that possible solutions for waste management in fast fashion could be in alternative waste management methods with an emphasis on recycling, through which textile waste is processed in recycling companies and used to produce a new product. A significant obstacle to mechanical recycling technologies is currently the material composition of textile waste, which is usually a mixture of several natural or synthetic fibers. A change in consumer behavior will also be very important. Consumers' preference for the mono-material composition of clothing should help to sort textile waste faster and recycle it mechanically more easily and efficiently. Promoting the selection of sustainable fibers, their production, consumption, design, and waste management, improving separate collection, reuse and recycling can help develop and support waste prevention, thereby creating the conditions for reducing the negative environmental impacts of fast fashion and developing the potential of the circular economy value chain in the textile industry. Based on the research results, recommendations and solutions were defined that the analysed company can implement in the circular economy. These solutions concern the optimization of production processes, the quality of purchased materials, the introduction of smart technologies, as well as communication and cooperation with suppliers, employees, customers, consumers, competing companies, government, research institutions, recycling companies, waste collection companies and business partners.

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