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The Current Situation Of Fast Fashion Industry And How To Reduce The Waste

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Abstract: Since entering the 21st century, the development of fast fashion has faced a number of environmental problems. The design of circular economy is the best way to deal with fast fashion pollution, while the existing recycling system, traditional waste disposal methods are inefficiencies and are no longer enough to deal with the pollution caused by today's fast fashion industry. So this paper discusses some cutting-edge technologies to meet the development of circular fashion and achieve the approaches for sustainable development of fashion industry. After a specific analysis of the pollution of the fast fashion industry to the climate, water and the waste caused, this paper introduces the infrared technology to accelerate the sorting of clothing raw materials in the waste, enzymatic technology to process and degrade the raw materials, and the use of new sustainable materials in three steps to obtain an advanced technology support, sustainable fashion circulation system. In the future, this improved fast fashion circulation system still needs more experiments to be tested, also the government and relevant departments need to formulate relevant policies to support the development of this system. On the other side, the fast fashion industry's pollution of the environment, especially water bodies, and its treatment methods need to be studied.

Keywords: fast fashion, pollution, circular economy, sustainable materials, sustainable fashion circulation system.

1. Introduction

Fast fashion developed in Europe in the twentieth century, and it is the production that combines the four fundamental social trends of globalization, democratization, youth, and networking [1]. Since entering the 21st century, the development of fast fashion has faced a number of environmental problems. According to consulting firm McKinsey, the global apparel industry makes 100 billion a year the carbon footprint caused by the garment system accounts for 10% of the world's total carbon emissions [2]. In order to achieve the 1.5-degree pathway for climate change mitigation defined by the (IPCC), the fashion industry must reduce its GHG emissions to 1.1 billion tons by 2030. According to the relationship between whether to take emission reduction measures and the change in carbon emissions, based on the fashion industry’s current trends, GHG emissions will

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increase to 2.7 billion tons by 2030 if the economy recovers quickly after COVID-19 and further emission reduction measures are not taken under current development circumstances. If GHG emissions from fashion industry continue to grow at the current rate, they could reach 2.1 billion tons by 2030 [3]. To meet the 1.5℃ target, the industry must accelerate efforts over the next decade to halve emissions by 2030.

In general, the fast fashion industry has caused huge environmental pollution and energy consumption worldwide. In order to deal with the environmental problems brought by fast fashion industry, a new circular fashion economic system is very necessary. Although a lot of studies has being done on the sustainability of clothing material waste treatment, there is a lack of research on the construction of recycling system and new technologies that can be applied in each link of the system.

The primary purpose of this article is to construct a complete circular fashion economy system, not only to develop sustainable materials, but also to solve the problem of existing waste. This paper first introduces the pollution caused by the fast fashion industry to the climate, water and waste, and then introduces the technical support required for optimizing the structure of raw materials, designing textiles based on the principle of circular economy and recycling and upgrading of waste textiles in the recycling system. Finally, the circular fashion economic system is constructed.

2. The current fast fashion industry

Fashion's impact trickle up to the global environment silently, while more polluting industries such as energy generation, concrete production and transport more likely to attract public attention. Because of the just-in-time production philosophy and rapid response strategy, fast fashion can go from design to market in a matter of weeks, compared to the traditional garment industry's production cycle of six months [4]. The fast fashion industry focuses extensively on trend forecasting and works on a direct-to-consumer business model. The objective is to deliver items on a wide scale as inexpensively and fast as feasible. As a result, they often encounter large amounts of excess inventory [5].

2.1 Fashion industry pollution

Every stage of the garment's life cycle generates a lot of waste, which is mostly disposed of in landfills. Waste in the industry comes from many sources -- fabrics left over when clothing is cut, last-minute changes in fashion or design decisions make stock unusable, stock unsold and, finally, consumers dispose of clothing at the end of its life (or when clothing is considered "fashionable").80 percent of fashion products become "trash" and are discarded within the first six months. Polyester fibers, which are used heavily in clothing, often take up to 200 years to decompose naturally after landfills.

2.1.1 Climate

The fashion industry is one of the largest contributors to global greenhouse gas (GHG) emissions due to the carbon footprint of the fast fashion model [6].

The product life cycle process usually refers to all stages from the acquisition of raw materials, production of products (or provision of services), product packaging, distribution and transportation, use and disposal, and recycling. The information reflected in the product carbon footprint accounting serves as the foundation and reference for internal and supply chain carbon footprint management, as well as low carbon product design and transformation [7]. Fig. 1 shows the GHG emissions of different stages of the product life cycle process.

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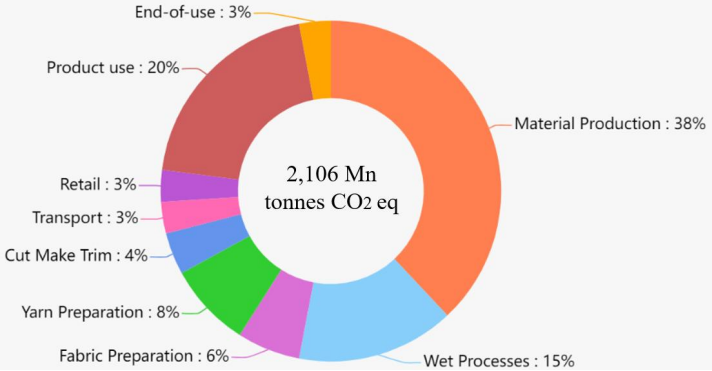

Figure 1: GHG emissions from the apparel and footwear value chain in 2018 [3].

2.1.2 Aquatic Environment

The fast fashion clothing industry consumes 1.5 trillion liters of water every year [8]. Dyeing, bleaching, washing, and cleaning textiles generate twenty percent of global industrial water pollution [9]. According to estimates, the fashion sector is responsible for 31% of all plastic pollution in the ocean. Approximately 8 million tons of plastic are poured into the ocean each year, including 1.5 million tons of microplastics manufactured from polyesters and other synthetic fabrics in the form of microfibers [10]. Infiltration of these microfibers into Marine or aquatic systems is inevitable because most wastewater treatment plant processes do not trap and filter these microfibers. The household washing process is considered to be a significant source of microfibers in the aquatic environment [11].

2.1.3 Food Chain and human health

It has been demonstrated that microplastic particles from a wide range of hydrophytic and terrestrial animal species can enter the human body through the food chain, and the microfibers prevalent in the atmosphere can be inhaled by humans through breathing. In addition to human exposure to microplastics through ingestion and inhalation, fibers with residual monomer forms might enter the body through the skin. Wearing polyester for a long time can cause chronic respiratory infections [12]. Microplastic particles, which hinder cell growth, have been shown to have substantial effects on cell shape, according to researchers [13].

2.1.4 The value orientation delivered by fast fashion

Fast fashion encourages a throw-away culture, which leads consumers to seek emotional "pleasure" through repeated impulse purchases [13]. While some stores encourage people to donate old clothes for recycling, they also offer coupons to encourage people to spend more. As a result, the fundamental issue of excessive consumption has not changed and may have gotten worse.

3. Fast fashion waste treatment

3.1 Design for a circular economy

In the last 25 years, solving the environmental challenges produced by the fashion industry has become a focus of attention. Among the measures to deal with the pollution of fashion industry, the more comprehensive and widely used one is to design for a circular economy--"economic competitiveness, decreased reliance on natural resources, and waste avoidance" [14]. CE in the

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fashion industry is committed to building a closed-loop system to recycle waste clothing and materials, so as to keep the worth of the materials used in apparel while reducing pollution in the

Figure 2: A fashion circulation system model [15, 16].

garment business. At present, many fashion cycle models based on CE have been designed and applied in practice. By summarizing the similarities of different circulation systems, a flow chart (Fig. 2) reflecting the actual situation of the current fashion circulation system is drawn on this basis [15, 16].

It all starts when people put old clothes into the clothes recycling bin. These clothes are transported to the sorting plant. The old but usable clothes are sent to those who need help, and the rest is sent to the clothes treatment plant as textile waste for further treatment. Unfortunately, under the existing treatment methods, only a small part can be transformed into new textile materials and reused in the production of clothes together with other materials.

In fact, the existing fashion recycling system is inadequate to cope with the pollution caused by today's fast fashion industry. Less than 15 percent of the material used in garments is recycled on a global scale. The main cause of this result is: There is no advanced technology to support the operation of the circulation system, which will greatly slow down the efficiency of clothing cycling in practice. Therefore, it is necessary to explore some cutting-edge technologies to meet the development of circular fashion, so as to realize the sustainable development of fashion industry.

3.2 Near infrared spectroscopy technology for textiles

3.2.1 Near infrared spectroscopy

NIRS is a technique that measures molecule absorption in the near infrared region of the spectrum [17]. Organic substances are responsive to NIRS. Because all textiles are organic, the number of fibers that can be recognized is unlimited. Fig.3 shows the accuracy of NIR technology [18].

Figure 3: NIR's recognition rate for different textile materials [18].

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3.2.2 Automated textiles sorting machine.

Textile fibers have a higher efficiency value when they are recycled and classified according to their colors and fiber content, according to studies. Hence, Automated textiles sorting machine has been invented using NIR techniques. In the sorting machine, NIRS is a major identification technique, using a different spectrum for each material to identify the specifications of the material [18]. Process of the automatic textile sorting machine can be divided into three parts: Scan, reading and classification [19].

3.2.3 Advantages.

Automatic textile sorting machines speed up the overall sorting process, and the sorting accuracy is beyond the range of manual sorting. More than that, textiles Automatic textile sorting machines have greatly reduced the labor consumption of the garment sorting industry, and now only one to three people can complete the sorting operation compared to the past [19, 20]. Studies show that the price of textile classification materials is between 0.30 and 0.50 euros per kilogram. As more clothing is sorted, the machines can turn a profit more quickly [20]. Besides, it can be used commercially by third parties: other companies can lease the machine and use it for their purposes.

3.3 Enzymatic Hydrolysis of Cellulose

3.3.1 Cellulose

Cellulose is a mostly sugar that is insoluble in most organic solvents and purified water. The cotton has nearly 100% cellulose. Cellulose is very rigid and stable at room temperature due to hydrogen bonding and polar molecules, which is why cotton is considered the primary material for making clothing. However, cotton clothing is also difficult to be disposed of through traditional clothing treatment methods.

3.3.2 Enzymatic Hydrolysis

Cellulase is a complex of many single enzymes, such as EGs, CBHs, and BGs. The enzymatic hydrolysis of cellulose is highly specified. Many experiments have been carried out on cellulose degradation by cellulase [21].

The application of cellulase in textile industry makes it possible to degrade the textile with cellulose as the main component. However, cellulase needs to react with specific sites of cellulose before it can be degraded. At the same time, the cellulase degradation process needs to be carried out under the appropriate temperature and PH [22]. These factors hinder the application of cellulase in textile processing industry. There are still some ways to solve these problems. Pretreatment of cellulase can greatly improve the suitability of cellulase under normal conditions. Nowadays pretreatment methods mainly include chemical method, biological method and physical method [21].

3.4 Interesting Recycling System

In today's fashion cycle system, clothing recycling bins are an indispensable part. But according to research, only 12% of the material used in garments is recycled on a global scale. And Research shows that the willingness of young people in particular to take action to help the environment has been declining for years [23].Therefore, it is necessary to improve the existing clothing recycling system in order to get more people to put their old clothes in the recycling bin instead of throwing them away.

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3.4.1 Visual clothing recycling bins

The current clothing recycling bin is very similar to the dustbin, which has become a reason for people to despise the clothing recycling bin. One way to improve clothing recycling bins to make them more unique is to recycle visualization. After placing the machine in the recycling bin, people can watch their clothes go through the recycling bin and eventually get a link to a website that allows them to track their clothes. On the site, people can also get bonus points for clothing contributions and participate in various activities, including getting various items for free.

3.4.2 Advantages

A similar system has been developed and tested on a small scale in the Netherlands [24]. The results showed that most of the participants (57%) found the system very interesting, half (50%) of them said it would improve their motivation for recycling clothes, and nearly half (46%) said they were happy to use the system and participate in subsequent activities on the website [24].

3.5 Eco-friendly materials

In recent times, the industry of fast fashion has been the biggest contributors of the pollutant. It is equally important to focus on eco-friendly materials as one of the source of pollution and an important part of the circulatory system The definition of eco-friendly materials can be popularize that it contains a total of six properties, which are: low-carbon, low-energy, naturally free of harmful substances, degradable, recyclable and Short production.t. Relevant information shows that the exploration of eco-friendly materials in the some clothing industry can be mainly divided into three aspects. The first one is about the Natural fiber fabrics, which derived from natural plant or animal fur materials The second one is new materials may not exist in nature and need to be manufactured through technological innovation. The last one, is the technology of staining. This is an indispensable part of the process of making clothing, and its impact on the environment cannot be ignored.

3.5.1 Natural fiber fabrics

The first aspect is about the selection of materials before the fabric processing. Some sustainable natural materials like the use of organic cotton, natural wool, hemp, organic bamboo as well. These materials are clean and pollution-free during the secondary processing of planting and textile production, which have ecological and environmental protection characteristics. The advantage of natural wool is that it is 100% biodegradable compared to conventional materials. The wool will degrade rapidly after bacterial action, releasing nutrients into nature's carbon and nutrient cycles, providing energy for organic growth [25] .By consulting the relevant information: organic cotton also has many advantages over traditional cotton. Organic cotton can reduce water use by 88 percent, disposable energy by 62 percent, soil acidification by 70 percent, and global warming by 46 percent [26]. However, some natural plant fiber materials often more difficult to grow and the yield is lower that is the problem needed to solve in the future.

3.5.2 New materials

The second aspect is the about the new technology for the processing of new materials. Some materials that originally seemed to have nothing to do with clothing have become new materials for making clothes through scientific and technological innovation, which is not only conducive to environmental protection but also plays the benefits of the materials themselves. These materials may be something very common in our lives, maybe food, animals, or other common things.

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Researchers find proteins with controllable properties, and use fermentation and purification techniques to make spider silk proteins The process of producing spider silk protein is clean and harmless, and the material is ultimately biodegradable, making it an excellent material for outdoor activities [27]. Unlike man-made fibers from petroleum, such as nylon, fermented from natural fiber raw materials, it no longer relies on petrochemicals as the main raw material, and does not produce or decompose into microplastics that are harmful to the environment. Besides, all protein fibers are renewable materials that are biodegradable and have less impact on marine ecology which can also reduce issues such as greenhouse gas emissions associated with the use of animal fibers.

3.5.3 Staining technique

Finally, there is the dyeing technique, which is as important as the choice of material. Through relevant data display the staining industry has exerted profound influence on the environment, in terms of water use and water pollution. The textile industry discharges nearly 20 tons of toxic wastewater each year. Overall, industrial wastewater from textile pollution accounts for more than 15% of the total industrial wastewater. In UK, Faber Futures is developing another method of fermentation and staining by bacteria such as Streptomyces [28]. They have a complex life cycle and robust secondary metabolism, and produce a large number of molecular substances, one of which is a pigment molecule that can be stained. The specific color of these pigment molecules depends on the pH of the colony This dyeing technique saves 500 times more water than conventional dyeing. The production cycle is shorter, the cost is lower, and it is easier to industrialize production.

The development and utilization of new materials will become an inevitable trend in the development of the fast fashion industry. Perhaps soon after any material can be processed into a new type of material in the fast fashion industry.

3.6 Improved fashion circulation system

Finally, incorporate these techniques: Near-infrared spectroscopy, Enzymatic Hydrolysis of Cellulose, Interesting Recycling System and Eco-friendly materials into our flow chart, and obtain an efficient and sustainable fashion circulation system supported by advanced technologies (Fig. 4). Visual clothing bins make more people willing to donate their old clothes, which means more clothes are sent to the sorting plant. Automatic textile sorting machines using near infrared technology can replace the original sorting workers and speed up the sorting process. Waste cotton fabrics that cannot be treated can also be degraded by enzymatic hydrolysis, which greatly reduces environmental pollution. In the end, the eco-friendly sustainable raw materials will replace the original textile raw materials into production, from the root to alleviate the environmental problems caused by the current fast fashion industry.

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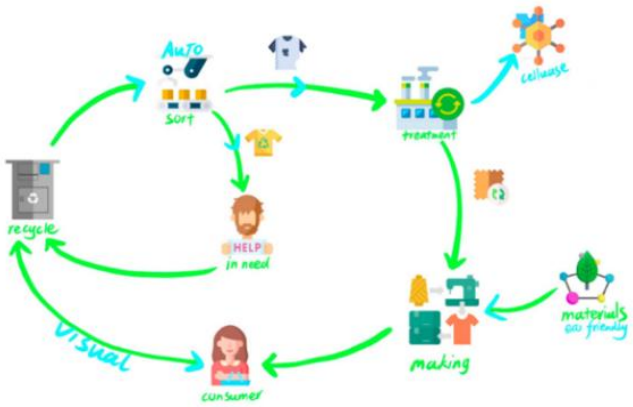

Figure 4: An improved fashion circulation system model.

4. Conclusion

In general, as the world pursues sustainable development goals, more and more people are paying attention to the environmental problems of fast fashion industry. Although the current recycling system of fast fashion industry cannot solve a series of problems caused by clothing waste, but with the support of several appropriate technologies, the circulation system of the fast fashion industry can improve the overall efficiency of operation compared with the previous, and can increase the recycling of old clothes, which finally shows that an improved circulation system is crucial to the management of waste in the fast fashion industry. But more experiments are needed to bring these technologies to mass production. The operation of the whole circulatory system requires the coordination and joint efforts of each link. Moreover, the realization of the circulation system is also inseparable from the support of the government, so the improvements in government and related departments' policies are also essential. Another issue worth paying attention to is the environmental pollution brought by fast fashion industry, especially the pollution of water bodies, and the treatment methods in this respect still need to be further studied. Last but not least, as the pillar of the fast fashion industry, the behavior orientation and consumption concept of fashion consumers need to be improved.

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