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Analyse the Recycling Process of Textile Wastes via Technology Structure Technology

1. Background

Due to the continuously increasing textile consumption, the global textile industry have contributed around three million dollars with steady annual growth. However, in doing so, the textile manufacturing processes which heavily rely on toxic chemicals used in textile handling, have triggered severe environmental impact and rising public concern. For instance, 92 million tonnes of textile waste are produced worldwide every year, 85% of which end up landfilled or incinerated. As a result, the textile industry notably contributes to the 10% of the global greenhouse gas emissions. In order to level out the significant environmental impact of the textile industry, measures such as promoting concepts of slow fashion and innovating the synthetic fibres that are harmful to the environment have been broadly discussed. However, the fast fashion category, an irreplaceable component of the textile industry, is known for the critical feature of constant provision of new styles at affordable prices, making it impractical for fast fashion brands to utilise completely environmentally-friendly raw materials. Hence, it is worthwhile to investigate how to reduce the environmental impact by extending the textile lifespan, through which the global re-use and recycling rates can be enhanced.

2. A description of the global recycling process:

2.1 Collection

In order to cut down unnecessary waste and prevent reusable textiles from being landfilled or incinerated, the collection of used textiles has been increasingly promoted in recent years. Based on the condition of the textile, some can be circulated to new users while others can be exploited for their material content to make new products.

2.2 Reuse

Re-use tends to be a suitable solution for most pre-consumer waste that consists of by-products from the manufacturing process. This type of textile waste could be shredded and made into mops by mechanical recycling. In addition, a large proportion of the collected textiles end up exported primarily to developing countries. Moreover, re-use can also be achieved via charity shops or second-hand commercial outlets.

2.3 Recycling

Apart from pre-consumer textile waste, which is usually regarded as "clean waste", some of the post-consumer waste and industrial waste, which are derived from commercial textile applications, deemed "dirty waste", need to be spun into via a chemical recycling process and made into new fibres.

3. Textile recycling data collection of different regions

3.1 EU

The existing accounts fail to reveal the overall data detected or data of textiles handed to the market every year. However, the estimated annual collection data of Denmark, Germany, France, Flanders (Belgium), Italy, the Netherlands, and Sweden have been collected, which indicates that EU countries such as Germany (12.5kg/capita), Denmark (7.4/capita) and Netherlands (5.4/capita) have more used textiles collected.
Regarding the recycling rate, it can be concluded from the table that EU counties such as Finland, Poland, and Ireland are better performers than the rest.
In order to further improve the re-use and recycling of second-hand textiles, the EU is closely following and innovating the Waste Framework Directive which targets boosting the re-use and recycling of wasted materials by 50% by 2025 and 60% by 2030. Furthermore, the 2023 Revision points out that the Circular Economy Action Plan should focus on reducing the overall textile waste generation, building safer and cleaner waste streams and enhancing the quality of recycling (EC, 2020).

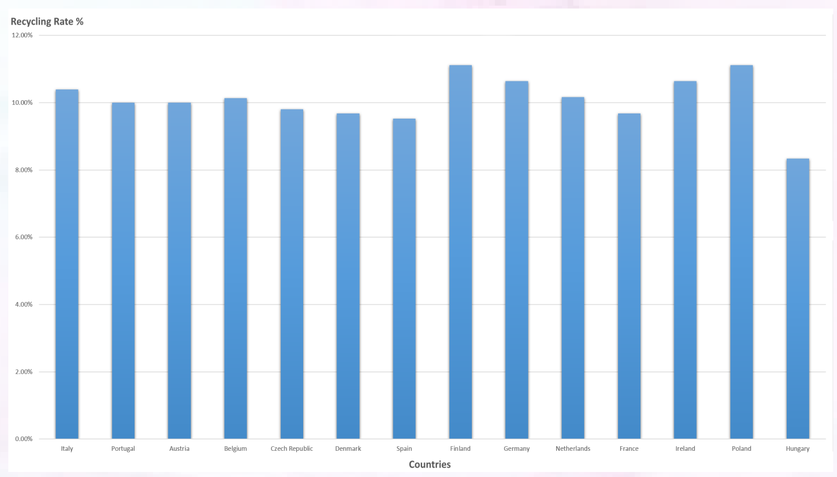

Figure 1: Graph displaying various European Countries' Recycling Rates

Figure 2: All-Purpose Light Wiping Cloths Made from Used Bedsheets (Left)

Figure 3: Acoustic Underlayment Made from Upcycled Textiles (Right)

3.2 UK

About 600,000 tonnes of used textiles were collected for re-use and recycling in 2017 in the UK, with a notable rise to 620,000 tonnes in 2018. As collected data implied, 60% of the collected textiles are exported with 32% being resold via charity shops and second-hand outlets, 3% being recycled and 5% wasted. Two of the primary recycling applications for the UK used textiles are wipers and non-woven products.Before being remanufactured into wiping cloths, wasted fabrics undergo the process of recycling back into fibres without the usage of chemicals. Wipers tend to be made from used household textiles such as bedsheets, which integrate the benefits of cotton's absorbent properties as well as flat and large surfaces.
Non-woven products represent chemical recycling, in which a series of chemical processes such as depolymerisation and dissolution are adopted to make used textiles into new fibres. Non-woven products are usually applied as acoustic underlays in the car manufacturing sector.

3.3 China

In comparison with other targeted regions, China is found to have a relatively lower collection rate due to citizens' mistrust of some charitable organisations and its insufficient collecting and sorting infrastructure.
According to data by the Chinese government, almost 45% of the produced textiles are wasted, and only 3.5 million tonnes of the collected textile wastes are reused or recycled. Within a range of 26 million tonnes of researched textiles, the re-use rate and re-utilisation rate are respectively estimated to be 1% and 15%.
Currently, the I:Collect take-back system that organises textiles collection and thereby enhances the circulation of unwanted but reusable textiles is adopted by China to increase the textile recycling rate.

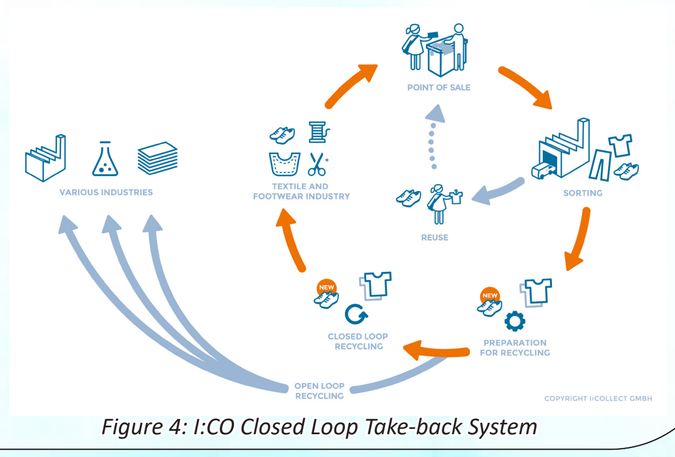

Figure 4: I:CO Closed Loop Take-back System

4. How is the global recycling process investigated via research in the EU, UK and China?

The EU, UK and China are three of the countries that have a large scale of textile consumption while creating a huge amount of textile waste. However, the three regions vary in used textile collection strategies and recycling actions. Therefore, we can find out the most effective recycling system and most efficient recycling tactics by comparing the recycling data of the three areas.
We can summarise from the presented data that some countries such as Denmark and Italy have already significantly boosted their re-use of textile wastes via the second-hand market by increasing the amount of local charity and community shops. Nevertheless, the recycling rate of used textiles is generally low worldwide due to the quality loss along the process and lack of technology applications.
Therefore, popularising feasible technologies that have been examined to be effective in enhancing textile recycling on a small scale is a recommended future solution for addressing textile wastes. For example, Vinnova is currently funding projects such as SIPTex that aim at developing automated sorting for textile recycling. Due to the intense labour requirement, sorting a large batch of used textiles can be costly. Thus, an automated sorting system is able to reduce the labour costs.

5. Future Insights

Therefore, popularising feasible technologies that have been examined to be effective in enhancing textile recycling on a small scale is a recommended future solution for addressing textile wastes.
Vinnova is currently funding projects such as SIPTex, which operates on a recognition and sorting technology based on near-infrared (NIR) to fulfil automated textile sorting. Automating the sorting system is ideal for reducing costs due to the current intense labour requirement for sorting a large batch of textiles. Another recycling technology in action is the Worn Again Technology, which improves the recycling process by turning the non-reusable textiles into equivalent virgin materials. The distinctive benefit of this technology is that dyes and finishes can be separated from polyester bottles and packaging.

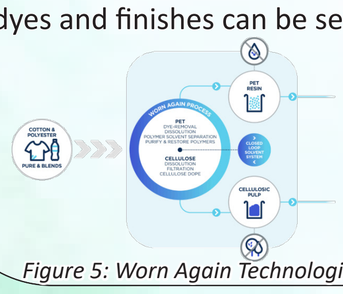

Figure 5: Worn Again Technologies Recycling Process

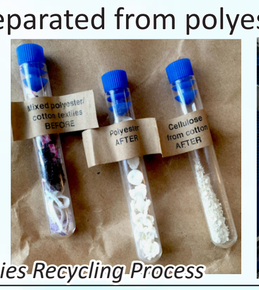

Figure 6: SIPTex – Swedish Innovation Platform for Textile sorting