

Closing the Loop: Advances in Textile and Apparel Recycling

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Introduction

The textile and apparel industry is one of the largest and most resource-intensive industries globally, contributing significantly to environmental degradation. In response to this, significant advancements have been made in textile and apparel recycling, aimed at "closing the loop" and creating a more sustainable, circular economy. This article explores these advancements, from innovative recycling technologies to new business models and policy frameworks, highlighting how they collectively contribute to reducing the industry's environmental footprint. Keywords: textile recycling, apparel recycling, circular economy, sustainability, recycling technologies, fashion industry, environmental impact. The textile and apparel industry has long been criticized for its significant environmental impact, from excessive water usage and chemical pollution to the vast amounts of waste generated annually. However, the industry is undergoing a transformative shift towards sustainability, with recycling at the forefront of this change. This article delves into the latest advances in textile and apparel recycling, illustrating how these innovations are instrumental in closing the loop and promoting a circular economy. The environmental footprint of the textile and apparel industry is staggering. According to the Ellen MacArthur Foundation, the industry produces over 92 million tons of waste annually and is responsible for 10% of global carbon emissions. Furthermore, textile production is highly water-intensive, with the World Bank estimating that the sector accounts for 20% of global industrial water pollution. These figures underscore the urgent need for sustainable practices, including effective recycling methods. One of the most promising developments in textile and apparel recycling is the advent of advanced recycling technologies [1].

Description

Traditional recycling methods, such as mechanical recycling, often result in a degradation of fibre quality, limiting the usability of recycled materials. Companies like Car bios and Worn Again Technologies are at the forefront of developing these technologies, enabling the creation of high-quality recycled textiles that are virtually indistinguishable from virgin materials. Biological recycling involves the use of enzymes or microorganisms to break down natural fibres like cotton and wool. This method is still in its nascent stages but holds great potential. For example, the European project Resented is exploring enzymatic recycling processes to convert textile waste into valuable raw materials. Textile-to-textile recycling aims to create a closed-loop system where old textiles are directly recycled into new ones. Companies like Recover and Renew cell are pioneering this approach, producing recycled fibres that maintain the quality and properties needed for new apparel. In addition to technological advancements, new business models are emerging to support textile and apparel recycling. These models emphasize the importance of product longevity, reuse and recyclability. This model involves leasing clothing instead of selling it. Brands like Mud Jeans and Vega offer subscription

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services where customers can rent apparel and return it for recycling once it reaches the end of its life cycle. This approach reduces waste and ensures that garments are recycled properly. Many brands are implementing take-back programs, encouraging customers to return used clothing for recycling. Patagonia's Worn Wear program and H&M's Garment Collecting initiative are notable examples. These programs not only facilitate recycling but also raise awareness about the importance of sustainable practices [2].

The rise of second-hand marketplaces, both online and offline, is also contributing to the circular economy. Government policies and regulatory frameworks play a crucial role in promoting textile and apparel recycling. Several countries and regions are implementing measures to encourage sustainable practices within the industry. EPR schemes hold manufacturers accountable for the entire lifecycle of their products, including post-consumer waste. The European Union's Waste Framework Directive includes provisions for EPR in the textile sector, compelling producers to take responsibility for the collection, recycling and disposal of textile waste. Some regions are imposing bans on textile waste in landfills and incinerators to incentivize recycling. For instance, France has introduced legislation banning the destruction of unsold textiles, requiring companies to donate or recycle them instead. Governments are also providing incentives and subsidies to support the development and adoption of recycling technologies. In the United States, the Environmental Protection Agency (EPA) offers grants for projects that promote sustainable materials management, including textile recycling initiatives. While technological and regulatory advancements are critical, consumer behaviour also plays a significant role in the success of textile and apparel recycling efforts. Increasing awareness about the environmental impact of fashion and the benefits of recycling is essential [3].

One of the significant drivers of textile and apparel recycling advancements is innovation in design and materials. Designers and manufacturers are increasingly focusing on creating products that are easier to recycle and have a lower environmental impact from the outset. This approach involves designing garments in such a way that they can be easily taken apart at the end of their life cycle. This facilitates the recycling of individual components, such as zippers, buttons and fabric panels. Brands like Adidas are exploring this concept with their Future craft Loop shoe, which is made entirely from recyclable materials and designed to be disassembled and recycled into new shoes. Using a single type of material in a garment can simplify the recycling process. Mono-material products eliminate the need to separate different fibres, making it easier to recycle the entire garment. This approach is gaining traction, especially for items like t-shirts and socks, which can be made from 100% cotton or polyester. The development of bio-based and biodegradable materials is another exciting area of innovation. Materials like Thence, made from sustainably sourced wood pulp and Penates, derived from pineapple leaf fibres, are not only renewable but also biodegradable, reducing the long-term impact on landfills. These materials offer a sustainable alternative to traditional synthetic fibres, which can take hundreds of years to decompose. Collaboration across the textile and apparel industry is essential to advancing recycling efforts. Partnerships between brands, technology providers and recycling facilities can help scale up recycling initiatives and create more efficient systems [4].

Industry-wide initiatives like the Fashion for Good project bring together stakeholders from across the fashion ecosystem to collaborate on sustainable solutions. By sharing knowledge and resources, these initiatives help accelerate the adoption of best practices and drive collective progress towards sustainability goals. Partnerships with academic and research institutions are also vital. Universities and research centres can provide valuable insights into new recycling methods and materials. For instance, the

H&M Foundation's Global Change Award supports ground-breaking research in textile recycling, fostering innovation and providing a platform for new ideas to be tested and scaled. The shift towards a circular economy in the textile and apparel industry has significant economic and social implications. Recycling not only addresses environmental concerns but also creates new economic opportunities and promotes social responsibility. The expansion of textile recycling infrastructure can create new jobs in collection, sorting and processing facilities. This can be particularly beneficial in regions with high unemployment rates, providing stable employment opportunities and contributing to local economies. For brands and manufacturers, recycling can lead to cost savings in the long run. By reducing reliance on virgin materials, companies can lower their production costs and mitigate risks associated with supply chain disruptions. Additionally, recycling initiatives can enhance brand reputation and attract environmentally conscious consumers. Embracing recycling and sustainability practices demonstrates a commitment to social responsibility [5].

Conclusion

Textile and apparel industry is at a critical juncture, facing both significant challenges and exciting opportunities in its quest for sustainability. Advances in recycling technologies, innovative business models, supportive policies and changing consumer behaviour are all contributing to the development of a more sustainable and circular fashion industry. By embracing these advancements and working collaboratively, the industry can significantly reduce its environmental impact and move towards a future where fashion is not only beautiful and functional but also sustainable and responsible. Closing the loop in textile and apparel recycling is not just an environmental imperative but also an economic and social opportunity, promising a brighter and more sustainable future for all. Advances in textile and apparel recycling are paving the way for a more sustainable and circular fashion industry. From cutting-edge recycling technologies to innovative business models and supportive policy frameworks, these developments are crucial in reducing the environmental impact of the industry. By closing the loop, we can create a future where fashion is not only stylish but also sustainable, contributing to the well-being of our planet and its inhabitants.

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Conflict of Interest¹

None.

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