ADVANCING TOWARDS A CIRCULAR ECONOMY IN THE TEXTILE INDUSTRY

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Abstract

The textile and garment manufacturing process in the textile industry produces a significant amount of waste, including fabric scraps, dyes, chemicals, as well as leftover fibers and yarns, leading to environmental pollution. The issue of fabric and garment waste is a major concern within the industry. This review provides an overview of the prevailing waste challenges in the textile sector while exploring the basics of the circular economy. The review incorporates additional findings and relevant research related to these proposals, aiming to promote sustainable solutions for waste reduction in the textile industry.

Introduction

Circular economy means growing more materials, reducing reuse and recycling resources. While the textile industry is a major driver of economic growth and innovation, it also leaves a significant environmental footprint in the form of waste. The multi-layered waste stream, which includes fabric residues, chemical discharges, dye impurities and residual fibers, poses significant environmental challenges [1,2]. The circular economy represents a promising framework to revolutionize the sector's prevailing linear production model. Textile wastes, including fabric residues, chemical wastes, dye impurities and fiber residues, lead to soil degradation, water pollution and damage to aquatic ecosystems [3,4]. The textile industry's heavy dependence on natural resources such as water, land, and raw materials exacerbates resource depletion when wastes are inadequately managed [5,6].

Strategies and Initiatives for Circular Economy

Economically, textile waste represents a significant loss, as valuable materials are wasted and the potential for job and revenue creation through recycling and circular economy is not realized. Inadequate textile collection, sorting and recycling infrastructure in many regions further complicates waste reduction efforts. Finally, consumer behaviors such as overconsumption and premature disposal of clothing exacerbate the textile waste problem [7-9].

Addressing these challenges requires a comprehensive, coordinated effort involving industry stakeholders, governments, consumers and environmental organizations. Remedial strategies include circular design, improved recycling infrastructure, sustainable production practices and the promotion of responsible consumption. The research conducted by Majumdar et al. is one of the first initiatives to address the barriers and strategies for building a circular supply chain in the textile and apparel industry [10]. Zaragoza-Benzal et al. reported on their research to introduce a sustainable gypsum composite material that partially replaces conventional raw materials with expanded polystyrene waste and waste textile fibers from tires. This material retains its strong mechanical properties even after rigorous moisture and drying cycles, thus complying with the principles of circular economy for sustainable construction [11].

Circular economy principles aim to promote sustainability in resource management, production, and consumption [12,13]. In addition, these principles advocate resource efficiency, waste reduction, and closed-loop systems to minimize environmental damage. Key principles include durability in design, waste reduction, resource efficiency, reuse, recycling, collaborative consumption, digital tech, sustainable materials, service-oriented products, stakeholder engagement, and circular business models [14,15]. The textile industry can shift from its linear, resource-intensive approach to a more sustainable circular model by embracing these principles [16,17].

Circular Economy Principles and Suggestions

Several articles deal with different aspects of circularity in the textile industry. Rossi et al. investigate circular economy indicators for organizations considering sustainability and business models [18]. A techno-economic analysis of innovative biorefineries for a cleaner management of textile waste is conducted by Farahmandpour et al [19]. Jia et al. present a systematic literature review on circular economy in the textile and apparel industry [20]. Jäämaa and Kaipia examine the problem of collecting reusable textiles from consumers in the circular economy [21]. orchestration of the circular economy in the textile and fashion industry to meet the challenges of the circular economy is examined by Saccani et al. Luoma et al. discuss future scenarios for the use of data in the textile circular economy [22]. The issues addressed in these studies contribute to the development of solutions for the problems of the textile industry in connection with the circular economy. The study of circular economy indicators for organizations and the implementation of an intelligent waste management system are examples of measures that can contribute to solving these problems. In addition, the techno-economic analysis of innovative biorefineries and the discussion of different approaches to recycling offer important insights and solutions for a more sustainable textile industry [23-30].

Conclusion and Outlook

The textile industry faces significant environmental challenges due to the generation of waste throughout the manufacturing process. The circular economy offers a promising framework to address these challenges and promote sustainable solutions for waste reduction. Strategies and initiatives such as circular design, improved recycling infrastructure, and responsible consumption are necessary to transition towards a circular economy in the textile industry. Various studies have explored different aspects of circularity in the industry, including the integration of circular thinking in product development processes, the transformation into a smart circular economy, and the development of closed-loop recycling approaches.

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