Circular Waste Management in Synthetic Fibre Recycling for Textile Industry

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Abstract

The world is facing a challenge in the production and use of synthetic textiles, leading to a surge in textile waste. It is considered that by 2040, a significant proportion of textile products will be at the end of their life. This rising demand for waste materials has driven the development and deployment of advanced recycling technologies in the textile industry. It mitigates environmental degradation, preserves natural resources, and fosters circularity in the production system. This study aims to perform a comprehensive techno-economic and environmental assessment of synthetic fibre recycling in the textile industry, with a focus on its sustainability effectiveness. The research analyses mechanical and chemical recycling technologies for synthetic fibres by evaluating process efficiency, operational energy requirement, technical challenges, and material reclaim efficiency. A techno-economic analysis will be conducted to estimate the capital expenditure required, financial viability, and operating expenses, in comparison with virgin fibre production. Moreover, a life cycle assessment (LCA) will be conducted to assess environmental impacts, including greenhouse gas (GHG) emissions, energy consumption, and opportunities for waste minimization. The study will also examine the social sustainability perspective by scrutinizing potential employment generation, industrial stability, and support for sustainable, resource-efficient textile value chains. The expected results include identifying environmentally and economically sustainable recycling pathways, providing analytical findings for policymakers and industry stakeholders, and supporting the transition to circular, sustainable textile systems. This research is expected to contribute to the Sustainable Development Goals by promoting sustainable environmental practices, resource efficiency, and reduced environmental footprint in the textile sector.

Keywords: Carbon footprint; GHG emissions; Sustainability; Textile industry; Life cycle assessments; Synthetic fibers; Environmental impact