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Assessing Greenhouse Gas Emissions in PET Recycling: A Case Study of Flake and Yarn Production in Sri Lanka

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Abstract

Polyethylene terephthalate (PET) is one of the most widely used types of plastic globally, particularly in the beverages, cosmetics, and apparel industries. Extensive PET usage poses a risk of plastic waste accumulation and contributes to plastic pollution. The plastic recycling industry plays a critical role in mitigating these impacts, although recycling is energy intensive. This study evaluates greenhouse gas (GHG) emissions associated with PET recycling processes. The study was conducted at a larger recycling facility in Sri Lanka. The analysis encompasses three key stages of the recycling process: (1) collection and transportation of consumed PET bottles, (2) production of PET flakes through washing and processing, and (3) conversion of flakes into recycled polyester yarn. Primary data was collected from company records for two plants for the year 2023 to calculate emissions and assess the resourced utilization. The carbon footprint of polyester yarn was determined using the Intergovernmental Panel on Climate Change (IPCC) methodology. Emissions were calculated for the production of recycled PET flakes from post-consumer bottles and their subsequent conversion into polyester yarn. The results indicate that, on average 249±36.65 tons of PET bottles were collected monthly, producing 195.29±40.84 tons of PET flakes and 139.83±46.22 tons of polyester yarn. The total GHG emissions of polyester yarn production was 281.32±72.98 tons of CO_2e monthly, with an average of 2.58±0.49 kg of CO_2e emitted per kg of yarn produced. Electricity plays a major role in emissions, contributing 98% during the flake-to-yarn conversion process and 70% during the bottle-to-flake conversion. Reducing emissions from electricity use is challenging without a shift to renewable energy sources. The study highlights potential strategies to reduce emissions from fuel consumption, transportation activities, water use, and waste generation. Strategies such as adopting biomass boilers, optimizing transport routes, and implementing rainwater harvesting and water reuse can enhance the sustainability of PET recycling into textiles.

Keywords: *Polyethylene terephthalate, Recycling, Polyester yarns, Greenhouse gas*