Proceedings of the Canadian Society for Mechanical Engineering International Congress
32nd Annual Conference of the Computational Fluid Dynamics Society of Canada
Canadian Society of Rheology Symposium
CSME-CFDSC-CSR 2025
May 25–28, 2025, Montréal, Québec, Canada

Recycling post-industrial polyester fibers

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ABSTRACT

The production of clothing has experienced exponential growth, primarily driven by "fast fashion," resulting in significant environmental challenges. Alarming estimates from the Ellen MacArthur Foundation (EMF) highlight that every second, the equivalent of a truckload of textile waste is either landfilled or incinerated globally. In 2022, 52% of fibers produced were polyester (Observatory of Economic Complexity, Textile Exchange, Bettenhausen et al., 2022).

This thermoplastic polymer has become one of the leading contributors to post-industrial and post-consumer plastic waste. Its properties and low cost have led to high production levels, which in turn have caused severe environmental issues. Most products made with this polymer are designed for short-term use, leading to their rapid accumulation in landfills.

In response to this environmental crisis, it is imperative to rethink production and waste management practices in the textile industry. In this context, this presentation focuses on exploring sustainable solutions for the valorization of textile and plastic waste, with a particular emphasis on mechanical recycling.

The project used post-industrial polyester fibers collected from textile manufacturing waste. The recycling process involved several steps: thermocompression to form solid plates, grinding to produce polymer chips, and extrusion to obtain plastic granulates. To optimize the quality of the recycled materials, various parameters were meticulously controlled, such as temperature, pressure, and the addition of chain extenders like Joncryl® ADR4468. These additives were essential for improving the viscosity and processability of the recycled PET (rPET). Analytical techniques included Fourier-transform infrared spectroscopy (FTIR) to verify material composition and detect contaminants, differential scanning calorimetry (DSC) to determine melting points and crystallinity and melt flow index (MFI) measurements to assess the fluidity of the molten polymer. A detailed evaluation of the recycling process parameters ensured compatibility with industrial applications such as 3D printing and injection molding.

In collaboration with ETS and Vestechpro, a center for research and innovation in apparel, this exploratory project on the valorization of textile waste into polymeric shaping materials aims to reduce the environmental impact of textiles in Quebec while promoting their adaptation to more sustainable and circular practices.