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

Enhancing the Recyclability and Thermal Properties of a Novel Low-Carbon Engineering Polymer, Aliphatic Polyketone, through Graphene and Glass Fiber Incorporation

Omayma Belgacem[1], Emna Helal[1*]
[1]Department of mechanical engineering, École de Technologie Supérieure, Montréal, Canada
*emna.helal@etsmtl.ca

ABSTRACT

Aliphatic polyketone (PK) is an innovative thermoplastic with mechanical and barrier properties comparable to or superior to polyamide, a widely used engineering polymer, along with significantly enhanced moisture resistance. Notably, PK features also a lower environmental impact compared to other engineering polymers and a carbon footprint up to 60% lower than Polyamide 66 (PA66). However, its limited thermal stability restricts its application at high temperatures and makes its processability and recyclability challenging. The incorporation of graphene, known for its exceptional thermal, electrical, and mechanical properties, presents a promising approach to overcome these limitations while improving the functional properties and performance of PK. Additionally, graphene's lubricating effect has the potential to facilitate PK processing, improving its manufacturability.

The objective of this study is to explore the potential of graphene in enhancing the thermal stability, recyclability of PK and PK/glass fiber composites while simultaneously optimizing the mechanical performance of PK/glass fiber composites and other functional properties.

In this study, two graphene grades with different specific surface areas and aspect ratios were dispersed in PK and PK/glass fiber composites using a melt compounding process. The impact of graphene nanoplatelets on the thermal stability and crystallization behaviour of the resulting nanocomposites was analysed through thermogravimetric analysis and differential scanning calorimetry. Their morphology was examined using scanning electron microscopy, while polymer/graphene interfacial interactions were assessed via dielectric spectroscopy and dynamic mechanical analysis. Furthermore, mechanical testing was conducted to evaluate the reinforcement effect of graphene nanoplatelets on PK and PK/glass fiber composites. By fine-tuning graphene dispersion and spatial distribution as well as the nanocomposite formulations, we aim to develop materials with superior durability, reduced environmental impact, and enhanced performance comparable to or higher than polyamide composites.

KEY WORDS:

Aliphatic Polyketone (PK), Graphene Nanoplatelets, Thermal Stability, Recyclability, Polymer Nanocomposites, Sustainable Engineering Polymers, Low-Carbon Materials.