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

RHEOLOGICAL INVESTIGATION OF THE MISCIBILITY OF LLDPE-LDPE: INFLUENCE OF MOLECULAR WEIGHT, COMONOMER CONTENT AND CHAIN BRANCHING

Judith Zaessinger[1], Daria Strugova[1], Celine Bellehumeur[2], Nicole Demarquette[1]
[1]Mechanical Engineering Department, École de Technologie Supérieure, Montréal, Canada
[2]NOVA Chemicals, Calgary, Canada

ABSTRACT

Polyethylene (PE) is mainly used due to its versatility in applications such as packaging and household items. Its strong resistance to degradation also makes it an excellent choice for recycling. One of the most popular recycling methods involves blending recycled and virgin polymers. However, this process is challenging for PE because of the varying densities of its grades, such as high-density polyethylene (HDPE), low-density polyethylene (LDPE), and linear low-density polyethylene (LLDPE). These differences make separation difficult. Moreover, the miscibility of these grades is not well understood and remains ambiguous.

This study investigates the rheological behavior of blends composed of different PE grades. The goal is to better understand their miscibility and control the properties of the resulting materials. LDPE was blended with several LLDPE grades, which varied in molecular weight, molecular weight distribution, comonomer content, and branching structure. The blends were prepared by melt mixing using a twin-screw extruder. Three ratios were tested: 20/80, 50/50, and 80/20. Rheological characterization was performed in the linear viscoelastic range using small-amplitude oscillatory shear (SAOS) tests.

Several analytical techniques were applied to examine blend morphology. These included log additivity rules, Cole-Cole plots, Han plots, and models such as Palierne, Bousmina, and YZZ models. The results highlighted the impact of chain branching on polymer miscibility. Additional analyses were conducted using Raman spectroscopy and atomic force microscopy. These methods provided further insights into the morphology of the blends