EFFECT OF TITANIUM DIOXIDE ON RHEOLOGICAL PROPERTIES OF POLYMER BIOCOMPOSITES FILLED WITH HAZELNUT SHELL

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The growing demand for sustainable materials has fueled interest in the development of polymer biocomposites that combine renewable natural fillers with synthetic polymers. Hazelnut shells (HS), as a waste product from the food industry, have been explored as a promising bio-based filler due to their abundance, low cost, and favorable mechanical properties. However, incorporating natural fillers into polymer matrices often presents challenges such as poor dispersion and limited compatibility. Titanium dioxide (TiO_2), a high-surface-area inorganic filler, is known for improving mechanical properties and processability in polymer composites. Despite its benefits, limited research has been conducted on the synergistic effects of TiO_2 in biocomposites containing natural fillers like hazelnut shells.

The rheological behavior of a composite material is a critical factor in determining its processability and final performance. This study investigates the influence of TiO_2 on the rheological properties of polypropylene-based biocomposites filled with HS. The composite materials were prepared using a random copolymer of polypropylene (Hyosung Topilene R200P) as the polymer matrix, HS sourced from 'Azhazelnut' LLC, and TiO_2 in rutile form as the filler (Fig.1). Rheological measurements were performed using a capillary rheometer (CEAST MF50, Instron (Fig.1)) to assess viscosity, flow behavior, and processability at varying shear rates.

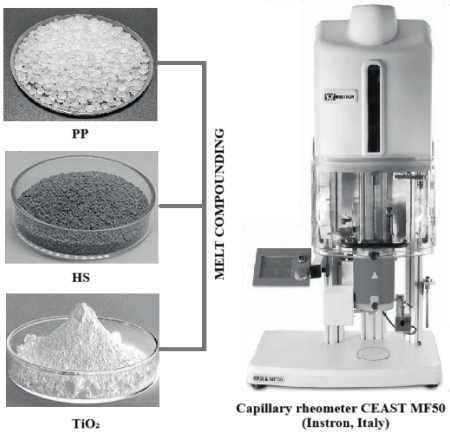

Fig. 1. Polymer biocomposite components

Results showed that the addition of TiO_2 significantly increased the composite's viscosity and enhanced its elastic properties, particularly at higher concentrations. TiO_2 also improved the dispersion of HS particles within the polymer matrix, leading to a more uniform filler distribution. These findings highlight the role of TiO_2 in enhancing both the mechanical performance and processing characteristics of polymer biocomposites. This work offers valuable insights into optimizing sustainable materials for advanced manufacturing, demonstrating the utility of capillary rheometry in evaluating rheological properties.