ID-449: Enhancement of Mechanical Properties of Virgin and Recycled High Density Polyethylene Composites using chemically treated natural fiber

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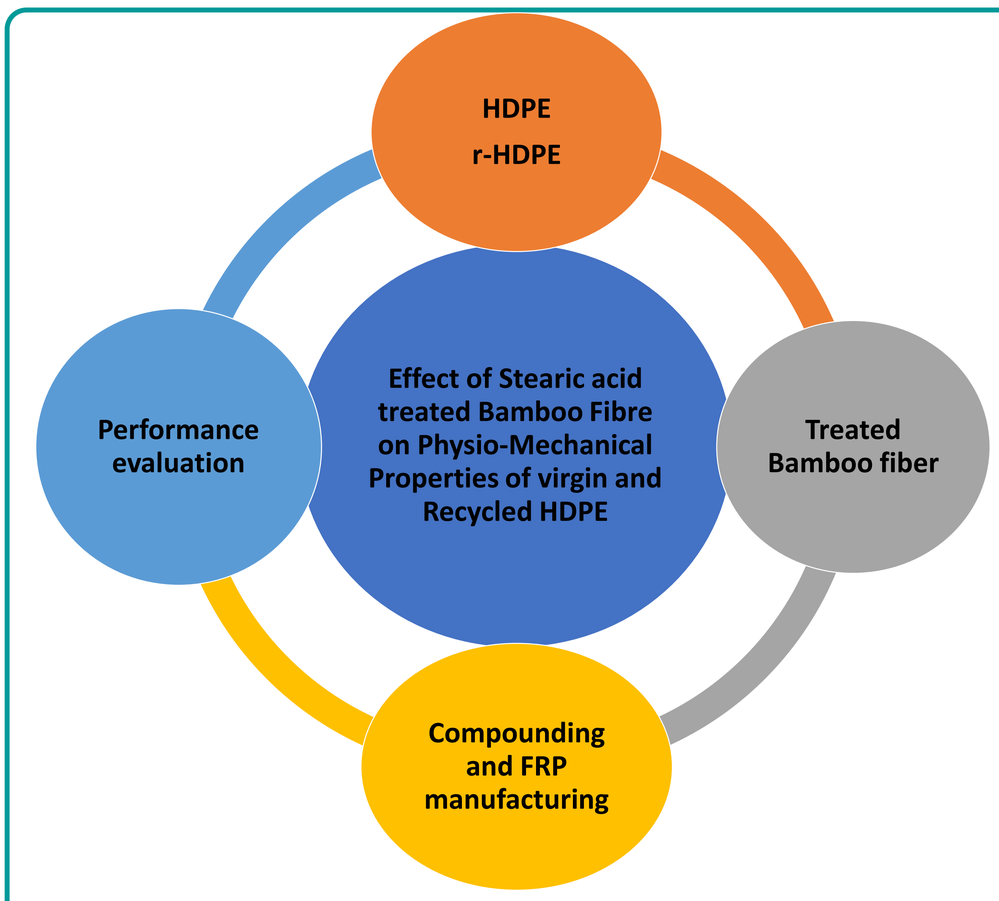
Abstract

Natural fibre reinforced polymer composites are considered to have advantages over synthetic fibre composites. Most importantly they are more eco-friendly and show superior mechanical properties; however, the interfacial interaction between the fiber and polymer is a matter of concern. Therefore, in this work the effect of surface treatment of bamboo fiber is studied. For preparation of Bamboo fiber composites, virgin and recycled High-Density Polyethylene polymer was considered. Bamboo fibers are treated with stearic acid and mechanical and thermal properties are evaluated. Before fabrication, bamboo fibres are treated with NaOH. The mass ratio of vHDPE/rHDPE and bamboo fibre is maintained as 70:30 %. Virgin / recycled HDPE plastics and bamboo fibres are mixed in a Twin Screw extrusion moulding with barrel temperatures ranging from 180-210°C. Specimens were made by Injection Moulding Machine. Mechanical Tests like Tensile, Impact and thermal property are evaluated. The interfacial bonding between bamboo fiber and HDPE matrix and good dispersion between fibers and matrix are confirmed through the SEM images of composite fractured surfaces.

Introduction

- Automotive Industries
- Household Appliances
- Aerospace Application
- Fabrication
- Building Construction

Objective and Materials



MATERIAL SELECTION

Matrix:
Virgin and Recycled HDPE

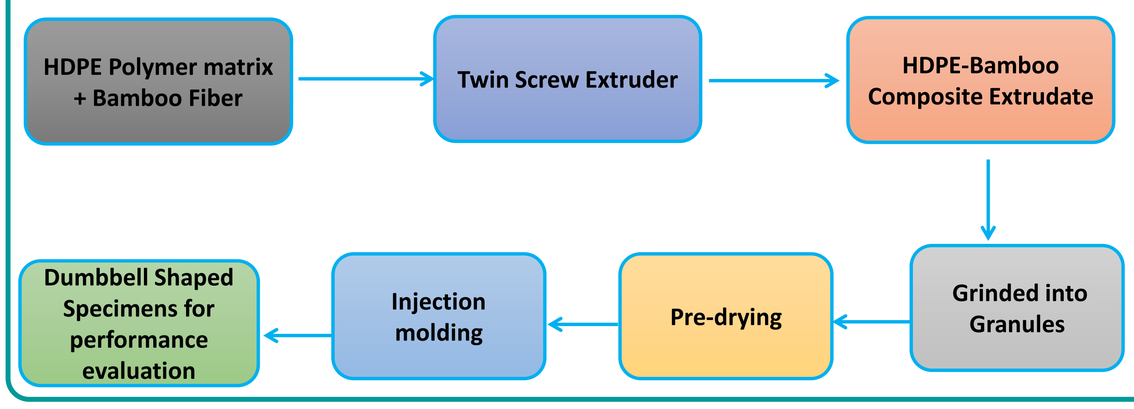
Reinforcement:
Petung Bamboo Fibre

Methodology

Phase 1: Treatment of BF

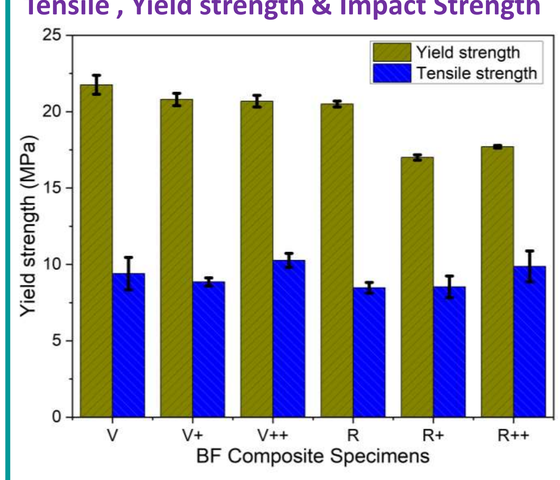
BFs were cut and lignin was separated → Grinded in to 5 mesh size → Treated with NaOH/Stearic acid → Washed → Dried for 12 hrs at 60 °C

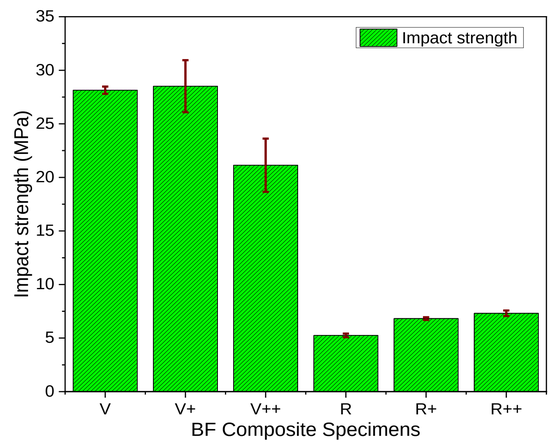
Phase 2 : HDPE/BF Composite preparation

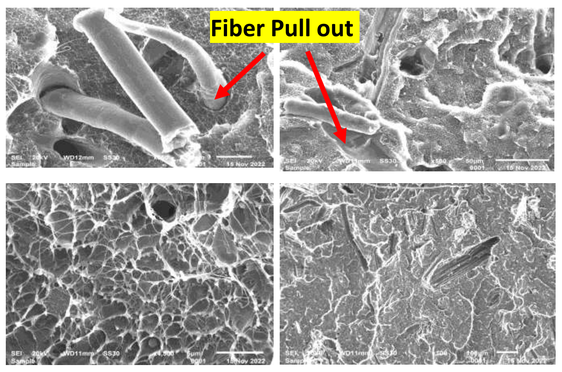


Results

Tensile , Yield strength & Impact Strength







- BF/HDPE composites (V++) prepared after chemical treatment of the fibers show improved tensile properties compared to the unreinforced specimen (V).
- Stearic acid treated BF/HDPE (V++) composites show an enhancement of tensile strength by 10.06%.
- Similarly, the BF/r-HDPE composites (R) show an enhancement in tensile strength with chemical treatment
- The R++ composites show an increment of 12.5%.
- BF/r-HDPE composites significant improvement in impact strength
- Considerable amount of HDPE is attached on the BF surfaces, which indicates good fiber–matrix bonding

Conclusions

- On alkali and stearic acid treatment, more fibrillation and surface roughness are observed in BF surface which created additional contacting surface to increase the interfacial bonding between the BF and HDPE & r-HDPE matrix.
- The tensile strength of stearic acid treated BF/HDPE (V++) is increased by 10.06% and stearic acid treated BF- rHDPE (R++) show an increment of 12.5%.
- Similar observations are made for impact strength which confirms the improved dispersion of BF in both the matrices.
- The improved interfacial bonding between BFs and HDPE matrix, good dispersion between fibers and matrix can further be established from the SEM images of composite fractured surfaces.

References

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