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Morphological and Characteristics of Synthesized Polystyrene Composites

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Abstract: *A variety of polymers are used in engineering and medical applications. Polystyrene is one of the most important commodity polymer widely used in technical applications. It has applications in household goods, packaging, automobiles and other engineeringapplications. Four fillers calcium carbonate, graphite, mica and talcum powder of micrometer size in the form of powder with threelevel of concentration 1%, 2%, 3% by weight were synthesized with polystyrene. The composites were produced by in-situ polymerization method and the samples were prepared by hand operated injection moulding machine. The melt flow index was performed to study the effects of fillers and their concentrations on the flow properties of composites. The morphological analysis by SEM and EDX were also performed. The particle size was found to be varying from 0.2 µm to 0.5µ m.Two-way ANOVA using "Minitab 15" software was used to see the contributions and significance of the input parameters on the output parameters.The addition of fillers are found to be significant while concentrations of fillers insignificant at 5% level of significance.*

Keywords: *Composites, Polystyrene, Flow characteristics, Morphologyand ANOVA.*

I. Introduction

Composites are the combinations of two or more materials in which areinforcing material is embedded in a matrix in a controlled manner to obtain a new material having distinct properties.Varieties of polymers for composites are thermoplastic polymers, thermosetting polymers, elastomers, and their blends.Conventionally, there are three methods to synthesize polymer composites. They are in-situ polymerization, melt intercalation and solution methods.[1] Studied the synthesis and characterization of polystyrene clay nanocompositesby melt intercalation, in-situ polymerization and masterbatch methods. At less than 1 % clay, in-situ formed nanocomposites
showed the best improvement in tensile, flexural, impact strength and Young's modulus. The maximum improvement was 88.5 %, obtained at 0.73 wt. % organoclay in the in-situ formed material.[2]Studied the characterizations of expanded graphite/polymer composites prepared by in situ polymerization. Microscopic results disclosed that the expanded graphite has a legume-like and honeycomb sub-structure survived after hot-pressing, resulting in a graphite network penetrating through the entire composite body, which produces a composite with excellent electrical conductivity.[3] Studied the effect of talcum filler content on the mechanical properties of polypropylene composites. They examined that the increase in filler content lead to an increase in the strength of the composite material with a simultaneous decrease in the fracture toughness and the increase in tensile strength were from 15 to 25% and the maximum tensile strength at break was found to be 22 MPa. [4]Studied the effects of mica, with varying concentration5 to 40 weight % of mica prepared by twin screw extrusion, on mechanical, thermal, electrical, rheological and morphological properties of polyester thermoplastic elastomer and depicted that the flexural strength and modulus increased with mica concentration, whereas tensile strength decreased at higher concentrations. Morphological studies revealed that there is a good dispersion of filler in the polymer matrix at lower concentrations.[5] Explored the nano-calcium carbonate ($CaCO_3$)/polystyrene core- shell nanoparticle. All composites were prepared individually by incorporating nano-$CaCO_3$/PS hybrid nanoparticles and bare nano-$CaCO_3$ with 0.10–5.0 wt% on BrabenderPlastograph. It was shown that rheological, thermal, mechanical and morphological properties were improved as hybrid nano-$CaCO_3$/PS particles reinforced in high impact polystyrene (HIPS) matrix.

1.1 Objectiveof the Study

In this work, the effects of graphite powder, mica powder, calcium carbonate and talcum powder and their concentrations1%, 2% and 3% by weight on melt flow index and SEM/EDX of synthesized polystyrene polymer matrix composites produced through in situ polymerization method is explored and the properties of the output parameters of the composites are analyzed by a software "Minitab 15" using two-way analysis of variance (ANOVA).

1. Design Ofexperiment

2.1 Input and Output Variables

Table1 Input and Output Variables

Input Variables		Output Variable	
Filler Materials	Graphite Powder, Mica Powder, Talcum Powder, $CaCO_3$	Morphological Analysis	SEM, EDS
Filler Concentration	1%, 2%, 3% By Weight	Flow Characteristics	Melt Flow Index (MFI)
Stirrer Speed	800±50 rpm		

Table 2 Quantity of Additives used

Mass of Styrene (in grams)	% ByWeight	Mass of Additives (in grams)
590.85	1	5.9085
590.85	2	11.817
590.85	3	17.7255

II. Conclusion

The following comments could be concluded:

1. Determination of the braking force is the most crucial aspect to be considered while designing any braking system. The generated braking force should always be greater than the required braking force.
2. The calculation of required clamping force helps us to decide the diameter and the number of pistons to be used. Space and assembly constraints are also an important factor while designing the caliper body.
3. The seal groove geometry is pivotal to the operation of the caliper as it allows the piston to retract after the required clamping force has been applied.

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