

Effect of Polypropylene/Glass Fiber on the Mechanical Properties of Polymer Composites

Manjunatha G*,¹, Vishnu Kumar K L*,¹

¹ Dept. of Mechanical Engg. M.S.Ramaiah Institute of Technology, Bangalore, 560054, India.
gmanjumsrit@gmail.com, klvishnukumar@gmail.com

Abstract - The polypropylene/glass fiber composite materials prepared using injection molding technique. The samples with 25 and 50 wt. % glass fiber loading were compounded using a single screw extruder before undergoing injection molding process. Experimental study was carried out to investigate the mechanical properties such as tensile strength and impact strength. The results show that the tensile strength decreased with the increasing of glass fiber loadings which are attributed to the absence of adhesion between polypropylene and glass fiber. The impact strength increased with increasing of glass fiber loadings.

Key Words: Polypropylene (PP), Glass fiber (GF), Screw extruder, Injection molding process.

1. INTRODUCTION

Polymer matrix composites (PMC) are comprised of a variety of short or continuous fibers bound together by a polymer matrix. PMC is designed so that the mechanical loads to which the structure is subjected in service are supported by the reinforcement.

The thermoplastics offer great promise for the future from a manufacturing point of view, because it is easier and faster to heat and cool a material than it is to cure it. This makes thermoplastic matrices attractive to high-volume industries. The reinforcing fibers of composites are responsible for their high strength and stiffness. The most important fibers in current use are glass, graphite, and aramid [1].

S.Vamshi Krishna et al. [2] developed a composite material with optimum properties so that it can use synthetic fiber reinforced composite material for a suitable application. The composites (fibers like Glass as reinforcement and polypropylene as matrix) are to be prepared by using compression molding process and these laminas are evaluated mechanical properties as per ASTM standards. From the results it is observed that when the length of fiber increases the strength increases.

J. Biagiotti et al. [3] have been worked on composites. The polypropylene reinforced with natural fibers were produced and their mechanical properties are measured together with the distribution of the fiber size and the fiber diameter. The relationships between experimental results and theoretical predictions were statistically analyzed using a probability density function estimation approach based on neural networks. The results obtained show a more accurate expected value with respect to the traditional statistical function estimation approach.

Shao-Yun Fu et al. [4] have carried out detailed discussions on the effects of particle size, particle/matrix interface adhesion and particle loading on the stiffness, strength and toughness. It has been shown that, to develop high performance particulate composites, it is necessary to have some basic understanding of the stiffening, strengthening and toughening mechanisms of these composites.

Based on the literature survey it was found that very less work was completed with weight compositions of 75% and 50% to prepare composites. In present work polypropylene used as matrix with weight compositions of 75% and 50% along with glass particulate as reinforcement with weight compositions of 25% and 50%, which is embedded to make polymer matrix composites using injection molding technique. The mechanical properties such as tensile strength and impact strength were studied.

2. MATERIALS

The materials selected for preparation of polymer composites are polypropylene as the matrix and glass fiber as reinforcement. Polypropylene are in the form of pellets and glass in the form of flakes was purchased from GLS Polymer Private Ltd, Bangalore. Table.1 shows the mixture in terms of different percentage.

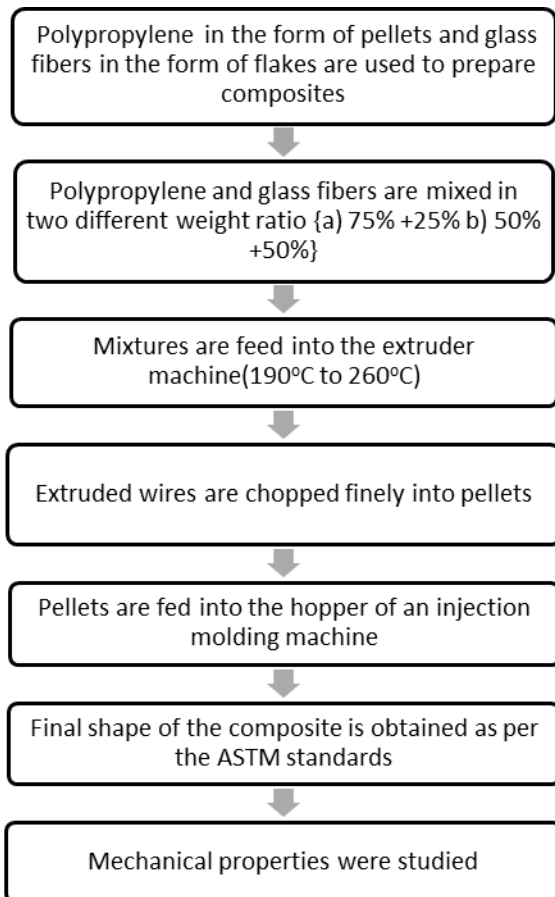
Material	Trial 1	Trial 2
Polypropylene(PP)	75%	50%
Glass fiber(GF)	25%	50%

Table.1: Mixture in terms of different percentage

3. EXPERIMENTAL DETAILS

3.1 Composite preparation

The composite were prepared with two different weight fractions of matrix and reinforcement materials. The flow chart shows the steps for the preparation of polymer composites.



3.2 Tensile Test

The tensile test was conducted according to ASTM D638 using Mecmesin Multi Tester. The dimensions of specimen 200mm (length) x 20mm (width) x 3mm (thickness). The test was performed at a cross head speed of 5mm/min with 10KN load cell. In each case, three samples were tested and the average value was tabulated.

3.3 Impact Test

The impact test was performed at room temperature according to ASTM D256. The dimension of rectangular specimen is 125(length) x 12.7(width) x 10(height). In each case, three samples were tested and the average value was tabulated.

4 RESULTS AND DISCUSSIONS

The Figure1 and 2 shows composites specimens prepared at different filler content.



Fig-1; 50% PP + 50% GF



75% PP + 25% GF



Fig-2; 50% PP + 50% GF



75% PP + 25% GF

4.1 Tensile Test Results

Tensile test was conducted on polymer composites on 3 specimens of each wt. % of matrix and reinforcement material. The results of which are shown in the Table 2.

Sl. No	Composition (GF+PP)	Ultimate Tensile Strength (kg/Sq.cm)	Young's modulus (MPa)
1	Pure PP	294.506	890.129
2	25% GF + 50% PP	329.478	936.58
3	50% GF + 50% PP	326.033	971.269

Table 2: Test results for tensile test

Table 2. Shows a decrease in tensile strength at glass fiber 50%. This is due to poor dispersion of glass fibres into polypropylene. The tensile strength is maximum at 25% glass fibers mixed with PP.

4.2 Impact Test Results

The impact test was conducted on polymer composites on 3 specimens of each wt. % of matrix and reinforcement material. The results of which are shown in the Table 3.

Sl. No	Composition (GF+PP)	Impact Strength J/m
1	PURE PP	30
2	25% GF + 50% PP	39
3	50% GF + 50% PP	56

Table 3: Test results for impact test

The table 3 shows an increase in the impact strength of the composite as the percentage of glass fiber increases from 25% to 50% compared to pure polypropylene. This is mainly due to the improved interfacial bond between glass fibre and polypropylene and also the presence of hard glass fibre particulates.

5. CONCLUSIONS

- [1] Compared to Pure PP, there is an improvement in strength with Glass Fiber Reinforced PP.
- [2] The Ultimate Tensile Strength is high with 25% GF reinforcement as compared to 50% GF.
- [3] The Young's modulus is higher in Reinforced GF with 50% composition compared with 25% GF.
- [4] Impact strength is improved with 50%GF compared to 25% GF reinforcement.
- [5] Due to uneven dispersion of GF & PP, the UTS is decreased as composition of GF reinforcement is increased.

6. REFERENCES

- [1] R.A Weiss, "Mechanical properties of polypropylene reinforced with short fibers", Polymer composites, July, 1981, Vol 2, No 3.
- [2] S.Vamshi Krishna, M.V.Satish Kumar and K.Shankaraiah, "Investigation on Mechanical Properties of Glass Fiber Reinforced Polypropylene Resin based Composites", International Journal of Current Engineering and Technology, Vol.5, No.5 (Oct 2015), 3175-3181.
- [3] J. Biagiotti, S.Fiori, L.Torre, Lopez-Manchado, M. A. and Kenny, J. M, "Mechanical properties of polypropylene matrix composites reinforced with natural fibers: A statistical approach" Polymer composites, Volume 25, Issue 1, February 2004, 26-36.
- [4] Shao-Yun Fu, Xi-Qiao Feng, Bernd Lauke, Yiu-Wing Mai "Effects of particle size, particle/matrix interface adhesion and particle loading on mechanical properties of particulate-polymer composites", Composites: Part B 39 (2008) 933-961.