EFFECT OF TALC ON BENDING STRENGTH OF POLYPROPYLENE COMPOSITES

MUBBASHER ALI KHAN¹ & M. ARIF SIDDQUI²

¹Research Scholar, Department of Mechanical Engineering, Z.H.C.E.T, AMU, Aligarh, Uttar Pradesh, India
²Associate Professor, Department of Mechanical Engineering, Z.H.C.E.T, AMU, Aligarh, Uttar Pradesh, India

ABSTRACT

In this study the Polypropylene (PP) was taken as a base material. The PP composites were made with talc at various concentrations by weight. The specimens used for the experiments were made on Injection moulding machine (De-Tech 60LNC5 made by Larsen & Tubro). To obtain the test specimens the die was clamped onto the injection moulding machine. The talc was added and mixed manually in 10, 20 & 30% by weight and the specimens were made at 4, 5 & 6 MPa injection pressures. For performing the bending strength tests a NETZSCH bending stress test machine manufactured by GERATEBAU was used.

After placing sample on bending strength test machine point load of 60N was applied gradually over the centre of specimen & deflection was noted. Increase or decrease of modulus of elasticity was calculated on behalf of deflection obtained through bending strength test of PP composites. Talc added PP composites showed an increase of modulus of elasticity upto 20 percent addition of talcum powder as compared to the pure PP and decreased at higher concentration. There was no significant effect of injection pressure on talc containing PP mould.

KEYWORDS: Polypropylene, Talc, Composites, Bending Strength Test, Injection Molding Machine

INTRODUCTION

Polypropylene (PP) is one of the most important polymers, widely used in engineering as well as in medical applications.

The intrinsic properties of PP such as low density, high melting temperature as well as nature of being toughened with elastomers. It is also widely used in various application of automotive and electrical industry. In automotive industries PP talc composites are used in bumpers, heater housings, door pockets, timing belt covers, and claddings [1].

Mineral fillers are added to polymers for enhancing the properties & cost reduction. Most of the polymers have embrittle effect with the addition of mineral fillers [2]. When a reinforcing filler is used with PP then it shows improvement in its properties when compared to pure PP [3, 4].

Talc is a widely used mineral filler used in polymers [5]. Mechanical properties of PP composites containing fillers depends on shape, size & also properties of filler as well as composite matrix [6]. Plate like structure of the talc is responsible for imparting, stiffness, creep resistance to the polymer matrix [7].

MATERIALS USED

The morphology of base material, PP, and the Talc used in this study is given in Table 1.
Table 1: Morphology of Materials Used

<table>
<thead>
<tr>
<th>S.No</th>
<th>Materials Used</th>
<th>Morphology of Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Polypropylene</td>
<td><img src="image1.png" alt="Polypropylene Morphology" /></td>
</tr>
<tr>
<td>2.</td>
<td>Talcum powder</td>
<td><img src="image2.png" alt="Talcum Powder Morphology" /></td>
</tr>
</tbody>
</table>

**EXPERIMENTAL SET UP**

The specimens used for the experiments were made on injection moulding machine (De-Tech 60LNC5 made by Larsen & Tubro) in Plastic Technology Laboratory at A.M.U. Aligarh, U.P., India.

The following were the specifications of the moulding machine:

**Injection Unit**

- Screw diameter = 35mm
- Screw L/D ratio = 20
- Injection pressure = 202.4 MPa
- Shot weight in poly styrene = 153g (maximum)

**Clamping Unit**

- Clamping force = 600kN (60 ton)
- Moulding opening stroke = 310mm
- Total mould carrying capacity = 420kg
- Total mould weight in moving platens = 280kg
- Hydraulic ejector stroke = 200mm

**PROCEDURE**

The detail of specimen of PP and its composites were produced according to ASTM D638 used in the present study and is shown in Fig.1. To obtain the test specimens the die was clamped onto the injection moulding machine. The talcum powder were added and mixed manually and the specimens were made. The PP and the talcum powder containing PP was fed to the machine through hopper and was entered in to the injection barrel by gravity where the PP with and without talcum powder were heated to a temperature of about 225°C. The material was injected into the mold by a reciprocating screw injector.
Effect of Talc on Bending Strength of Polypropylene Composites

Figure 1: Details of the Specimens Used to Carry the Experiment

Figure 2: Bending Strength Test Apparatus

Figure 3: Deflection Showed by Polypropylene with Different Concentration of Talcum Powder at 4 MN/m$^2$

Figure 4: Deflection Showed by Polypropylene with 30% Talcum Powder at 4, 5 & 6 MN/m$^2$ Injection Pressure
BENDING STRENGTH TEST

For performing the bending strength test on the sample having different combination of talcum powder with polypropylene and processed at different injection pressure a NETZSCH bending strength test machine manufactured by GERATEBAU was used as shown in Fig. 2. In this test, sample acts as a simply supported beam having point load at its centre. After placing sample on bending strength test machine a point load of 60N was applied gradually over the centre of specimen & deflection was noted. As we know that deflection is inversely proportional to modulus of elasticity.

RESULTS AND DISCUSSIONS

Table 2 shows deflection over the specimens having the different combination of Polypropylene & talcum powder at different injection pressure. Figure 3 shows deflection in Polypropylene with different concentration of talcum powder at 4 MN/m$^2$ injection pressure. It was found that on increasing the concentration of talcum powder from 10% to 20% in polypropylene leads to increased modulus of elasticity (as deflection decreased) because of increased brittleness in talcum-PP matrix due to increased talc concentration as talc act as a strong reinforcing filler in PP-talc composites [8]. But further increased concentration of talcum powder from 20% to 30% decreased elastic modulus value (due to increased deflection) which showed that the brittleness starts decreasing between 20% to 30% of talcum powder in PP reason may be that saturation point may occur for the additive on 20 to 30 % mixing in PP & the brittleness of talcum –PP matrix starts decreasing within this range. Figure 4 shows deflection of Polypropylene with 30% talcum powder at 4, 5 & 6 MN/m$^2$ Injection pressure. It was also found that increased injection pressure leads to small increase in modulus of elasticity of composites but it was quite significant in case of pure PP which may be due to the compaction of particles of talc & polypropylene [9]. Drastic change in the properties are not found which may be due to the orientation of talc particulates during injection moulding of composites in along flow direction [10].

**Table 2: Shows Deflection over the Different Specimens**

<table>
<thead>
<tr>
<th>PP%</th>
<th>Talcum Powder (%)</th>
<th>Injection Pressure (MPa)</th>
<th>Point Load(60N) Deflection (mm)</th>
<th>E (N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>10</td>
<td>4</td>
<td>13.5</td>
<td>111.1181</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>13</td>
<td>115.3918</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>12</td>
<td>125.0078</td>
</tr>
<tr>
<td>80</td>
<td>20</td>
<td>4</td>
<td>10</td>
<td>150.0094</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>10.5</td>
<td>142.8661</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>12</td>
<td>125.0078</td>
</tr>
<tr>
<td>70</td>
<td>30</td>
<td>4</td>
<td>12</td>
<td>125.0078</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>10.5</td>
<td>142.8661</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>10.5</td>
<td>142.8661</td>
</tr>
<tr>
<td>100</td>
<td>-</td>
<td>4</td>
<td>7.5</td>
<td>85.71964</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>13.5</td>
<td>111.1181</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>12.5</td>
<td>120.0075</td>
</tr>
</tbody>
</table>

CONCLUSIONS

Addition of talcum powder up to 20 % in PP increased its modulus of elasticity which in turn increased hardness and reduced ductility of the composite whereas the addition of the higher amount of talcum powder decreased the modulus of elasticity. Small incrementen in modulus of elasticity was also found with increase in injection pressure.
ACKNOWLEDGEMENTS

The authors would like to express their deep gratitude to the Department of Mechanical Engineering and University Polytechnic of Aligarh Muslim University (AMU), for providing the laboratory facilities and financial support.

REFERENCES
