

Structural Behaviour of Polypropylene and its Blend with Thermoplastic Elastomer Composites for Bumper Application

Kamatchi Hariharan.M

SRM Institute of Science & Technology

Thamilarasu.S

SRM Institute of Science & Technology

Raman.G

SRM Institute of Science & Technology

ABSTRACT

Bumper is a structural part or an integrated part attached to the motor vehicles in its front and rear side. The application of the bumper is to absorb the shock load if there is a case of minor collision. Generally the bumpers are made with modern plastics like thermoplastic olefins (TPOs), poly carbonates, polyesters, polypropylene, polyurethane, polyamides...etc. In this paper the structural behavior of polypropylene and its blend polypropylene with thermoplastic elastomer were compared. Multiple number of specimen were prepared for conducting the tests in Izod impact strength test, tensile strength test, heat deflection temperature test and the results are compared.

KEYWORDS Polypropylene, Thermoplastic olefins, Thermoplastic elastomer, Bumper Material..etc

EXPERIMENTATION

Specimens were prepared in dumbbell or dog bone shape in the size of 75X10X10 mm using injection molding process. Polypropylene pellets with the properties of 0.9-0.91 grams / cubic centimeter, molding shrinkage rate 2.5% and the molding temperature of 160-220 °C raw materials were used.

TENSILE STRENGTH

Test for finding the tensile strength was carried out with 6 specimens each three in polypropylene and its blend polypropylene mixed with 2% thermoplastic elastomer. Polypropylene specimens results in the average tensile strength of 26.82 MPa and its blend results in the average of 25.49 MPa which is slightly less below the polypropylene.

Table 1 Tensile Strength

Material	SAM1 MPa	SAM 2 MPa	SAM 3 MPa
Poly Propylene(PP)	31.89	22.18	26.39
Poly Propylene + Thermo Plastic Elastomer(TPE)	25.15	25.18	26.14

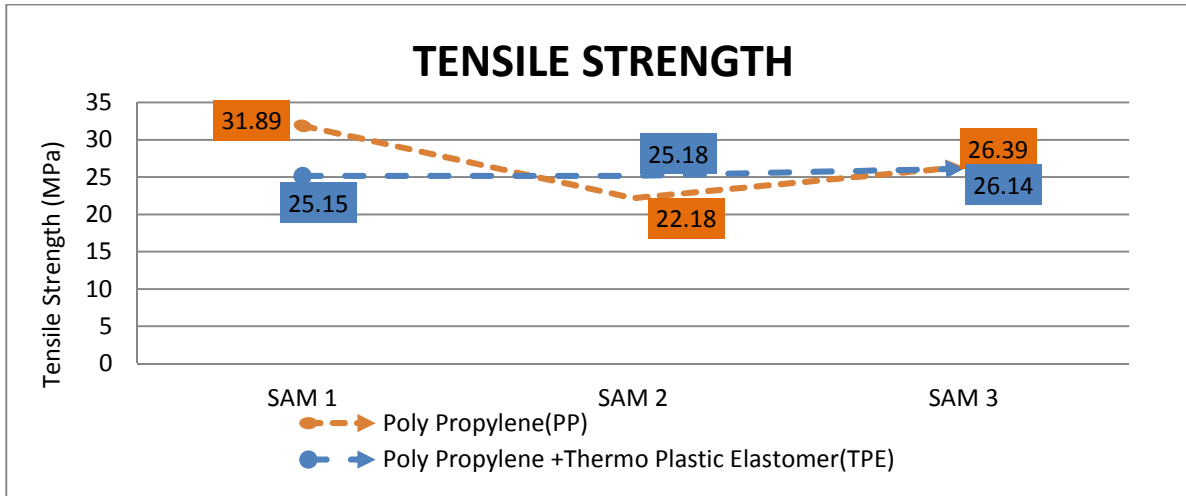


Figure 1 Tensile Strength For PP Vs PP + TPE

Before Testing Tensile Strength



Figure 2: Sample for PP



Figure 3: Sample for PP+TPE

TENSILE STRENGTH TESTED SAMPLE

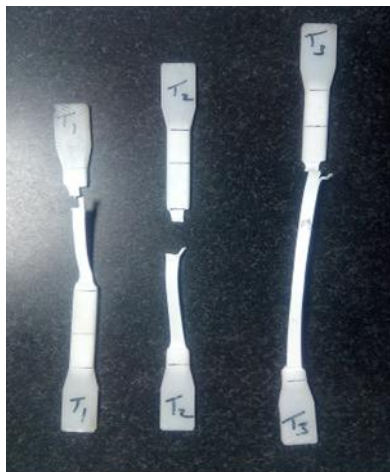


Figure 4 Sample for PP



Figure 5 Sample for PP+TPE

ELONGATION TEST

Elongation test was also carried out with 6 specimens each three in polypropylene and its blend polypropylene mixed with 2% thermoplastic elastomer. Polypropylene specimens results in the average elongation percentage of 162.36 % and its blend results in the average value of 263.9 which was much higher than the polypropylene.

Table 2 Elongation Test

Material	SAM 1 %	SAM 2 %	SAM 3 %
Poly Propylene(PP)	111.34	131.32	244.42
Poly Propylene +Thermo Plastic Elastomer(TPE)	272.64	223.24	286.84

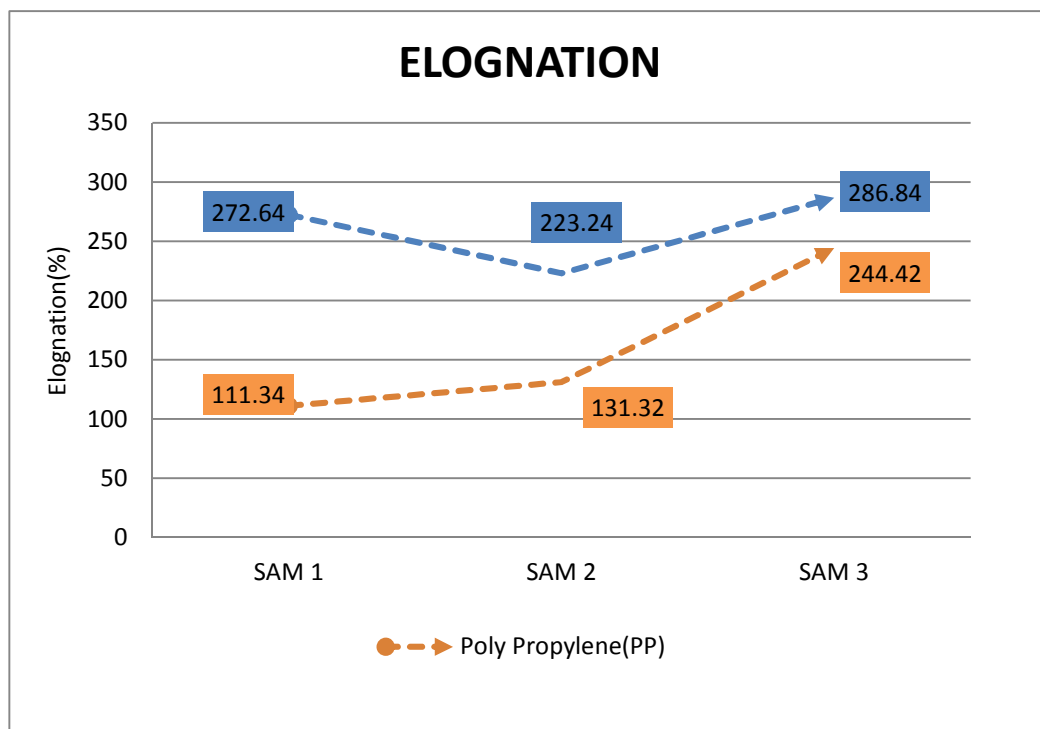


Figure 6 Elongation Test for PP Vs PP + TPE

IZOD IMPACT TEST

Impact strength was determined by conducting Izod impact test with the following specifications

Impact capacity = 164 joule

· Least count of capacity (dial) scale = 2 joule

- Weight of striking hammer = 18.7 kg.
- Swing diameter of hammer = 1600 mm.
- Angle of hammer before striking = 90°
- Distance between supports = 40 mm.
- Striking velocity of hammer = 5.6m /sec.
- Specimen size = 75x10x10 mm.
- Type of notch = V-notch
- Angle of notch = 45°
- Depth of notch = 2 mm.

All the specimens were resulted in same impact strength in 2 joules.

Table 3 Izod Impact test Table

Material	SAM 1 Joule	SAM 2 Joule	SAM 3 Joule
Poly Propylene(PP)	2	2	2
Poly Propylene +Thermo Plastic Elastomer(TPE)	2	2	2

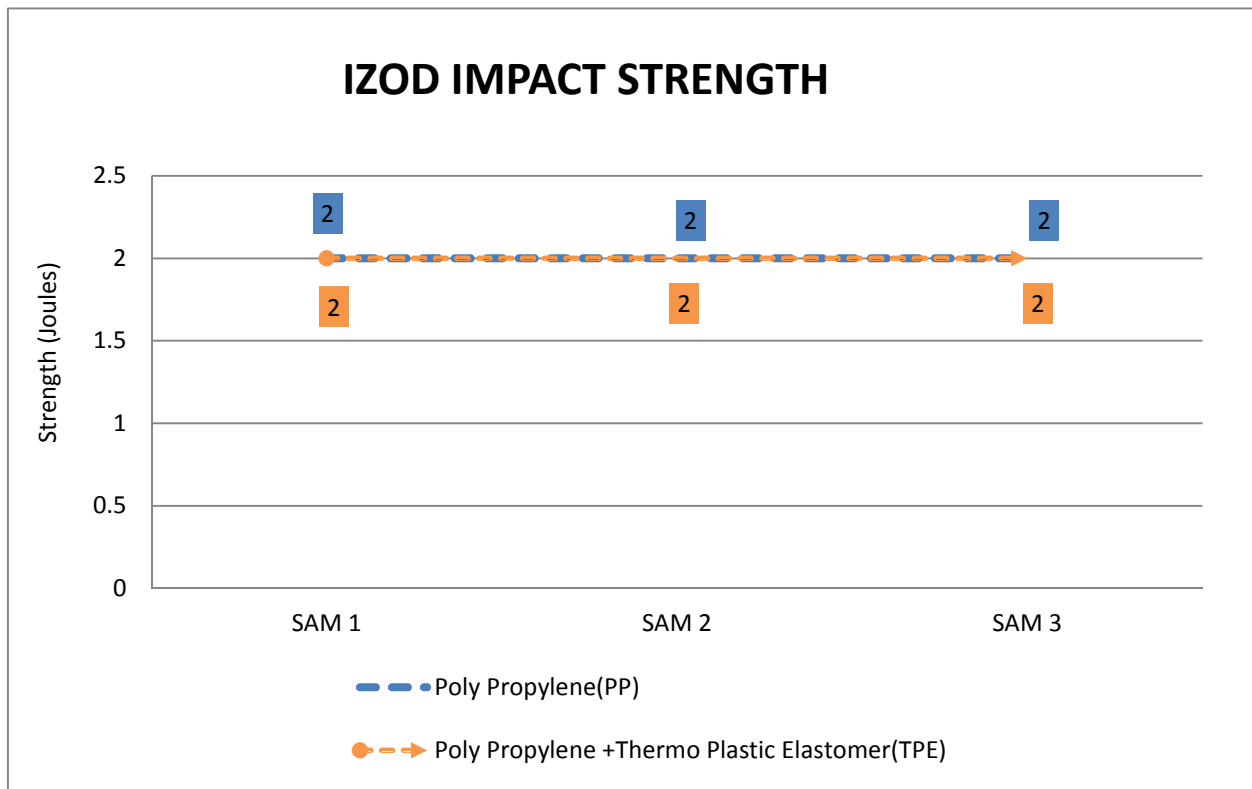


Figure 7 Izod Impact Test For PP Vs PP + TPE

BEFORE IZOD IMPACT STRENGTH



Figure 8 Sample for PP



Figure 9 Sample for PP+TPE



Figure 10 Sample for PP



Figure 11 Sample for PP+TPE

HEAT DEFLECTION TEMPERATURE TEST

Heat deflection temperature test was carried out with 2 specimens and polypropylene results with 137 °C and its blend results in 139 °C which is higher than the former.

Table 4 Heat deflection temperature test Table

Material	Poly Propylene °C	Poly Propylene + Thermo Plastic Elastomer °C
Temperature (°C)	137	139

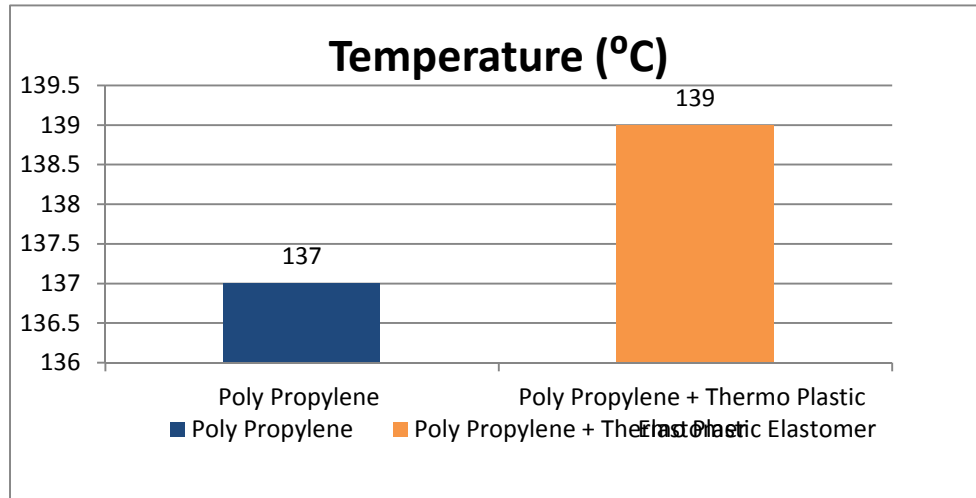


Figure12 Heat Deflection temperature Test for PP Vs PP + TPE

BEFORE TESTING HEAT DEFLECTION TEMPERATURE SAMPLES

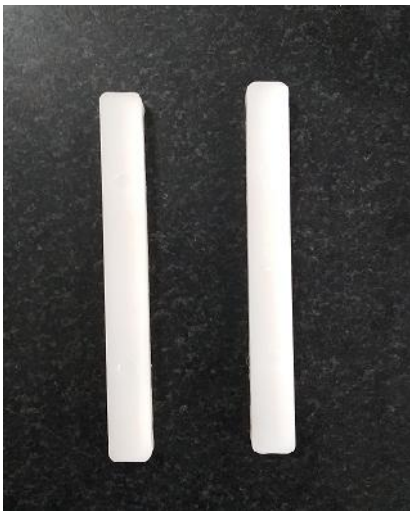


Figure 13:Sample for PP



Figure 14:Sample for PP+TPE

AFTERTESTING HEAT DEFLECTION TEMPERATURE SAMPLES



Figure15 Sample for PP

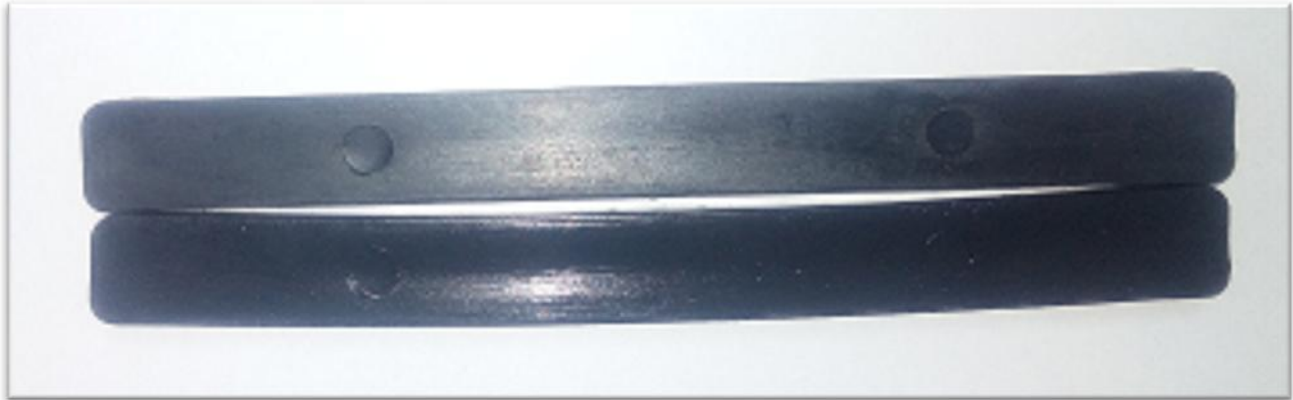


Figure 16 Sample for PP& PP+TPE

CONCLUSION:

Based on the comparative study of Polypropylene and Polypropylene+ thermoplastic elastomer, the following properties determined.

-) Tensile strength for PP - 26.82 MPa and for PP+TPE - 25.49 MPa
-) Elongation percentage for PP - 162.36 % and for PP+TPE – 260.90 %. The value of the blend results in high compared with existing PP.
-) Impact strength for PP - 2 joules and for PP+TPE - 2 Joules
-) Heat Deflection temperature for PP - 137 °C and for PP+TPE – 139 °C and the blend results in high value.

Based on the above findings the conventional polypropylene can be replaced by polypropylene with 2% thermoplastic elastomer. Thereby it reduces the operation time, functions as economical and provides the same effects.

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