PREPARATION AND CHARACTERIZATION OF TERNARY BLEND POLYSTYRENE, ACRYLONITRILE BUTADIENE STYRENE AND $CaCO_3$

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ABSTRACT

Polystyrene, acrylonitrile butadiene styrene and calcium carbonate blend was examined in this paper. Mechanical properties and thermal properties of polymers depend on a lot of parameters: properties, melt mixing, processing parameters. In this work, mainly devoted to polymer-filler interactions. The tensile strength, impact strength, differential scanning calorymetry (DSC) , melt flow index(MFI) characterization was studied in this paper. Polystyrene (PS), acrylonitrile butadiene styrene (ABS) blend was prepared through melt mixing by adding compatibilizer polystyrene grafted maleic anhydride (PS-g-MA). This blend is prepared in Twin Screw Extruder. Then calcium carbonate was added in this blend to analyze the change in properties. PS, ABS and calcium carbonate was added in different composition. It was shown from the experimental results that thermal and mechanical properties were improved as CaCO3 added. Viscosity of the blends was examined by MFI tester. DSC graphs of different compositions shows glass transition temperature. 5 wt% of calcium carbonate was showing good mechanical and thermal properties compare to other compositions. Impact strength was increasing by adding ABS because butadiene chains were attracting with PS chains. Water absorbing power of PS/ABS blend was very low. T he final result shows that the impact strength was increasing. Calcium carbonate is used to provide strength to the blend. This blend can be used in various automobile applications due to high impact strength. DSC shows good miscibility of blend of polystyrene and ABS.

Keyword: *polystyrene, acrylonitrile butadiene styrene, calcium carbonate, tensile strength, impact strength*

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1. INRODUCTION

Cost reduction is no longer the only or even the most important consideration for using filler in formulating blend[1] Polystyrene (PS) plastic is a naturally transparent thermoplastic that is available as both a typical solid plastic as well in the form of a rigid foam material. PS plastic is commonly used in a variety of consumer product applications and is also particularly useful for commercial packaging. General-purpose polystyrene is clear, hard, and rather brittle. Polystyrene can be naturally transparent, but can be colored with colorants. As a thermoplastic polymer polystyrene is in a solid (glassy) state at room temperature but flows if heated above about 100 °C, its glass transition temperature. It becomes rigid again when cooled. This temperature behavior is exploited for extrusion. Polystyrene is very slow to biodegrade.

ABS glass transition temperature is approximately 105 °C (221 °F). ABS is amorphous and therefore has no true melting point. ABS is a terpolymer made by polymerizing styrene and acrylonitrile in the presence of polybutadiene. The proportions can vary from 15 to 35% acrylonitrile, 5 to 30% butadiene and 40 to 60% styrene. For the majority of applications, ABS can be used between −20 and 80 °C (−4 and 176 °F) as its mechanical properties vary with temperature. The properties are created by rubber toughening, where fine particles of elastomer are distributed throughout the rigid matrix.

Adding calcium carbonate eases the polymer extrusion and also lowers the cost. It enhances the heat resistance, stiffness and hardness of the polymer.

2. MATERIALS AND TEST SPECIMEN PREPARATION

Different blends were prepared using polystyrene (PS) (density of 1.05g/cm^3) and acrylonitrile butadiene styrene (ABS) (density of 1.53 g/cm^3), ABSOLAC 920 and calcium carbonate (particle size: 3.5μm).

Samples for mechanical testing were prepared with a Automatic injection molding machine (screw dia-35mm). Polymer pellets were pre-mixed with $CaCO_3$. The DSC study indicated that the presence of CaCO3 filler influences the crystallization behavior of PS and ABS.

3. CHARACTERIZATION TECHNIQUES

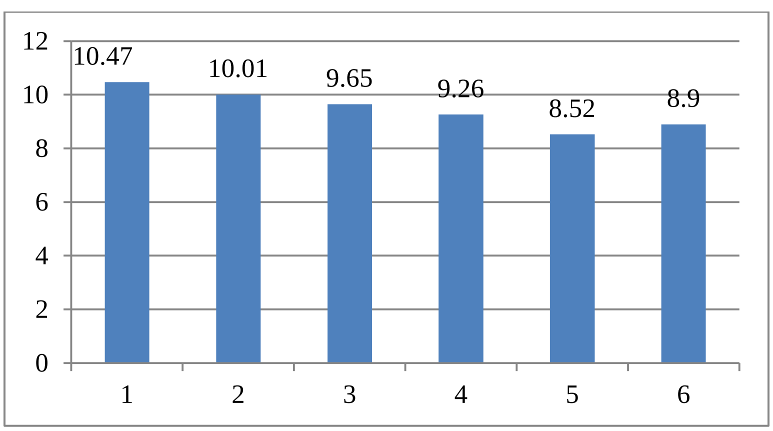
Physical properties were determined by using following instruments: pendulum impact testerCS137, differential scanning calorimeter (DSC).

Tensile properties for PS/ABS blend samples were determined using the ASTM D638-93 standard. Impact resistance of notched specimens was determined according to ASTM D256-93

4. RESULT AND DISCUSSION

4.1 MECHANICAL PROPERTIES

Fig.1 presents the result of tensile Observation of deformed specimens from blends shows that yield and plastic flow are accompanied by whitening of the blend samples in the necking zone. This suggests extensive debonding of particles from the matrix near yield point and confirms a state of low adhesion between components.



1. PS60/ABS40
2. PS50/ABS50
3. PS40/ABS60
4. PS50/ABS50+5%$CaCO_3$
5. PS50/ABS50+10%$CaCO_3$
6. PS50/ABS50+15%$CaCO_3$

Chart -1 Tensile strength

Tensile strength was decreased by adding calcium carbonate as filler. We got maximum tensile strength at PS60/PS40. But there was minor difference in values of tensile strength. Tensile strength of the unfilled polymer blend increased but energy absorption was reduced.

Fig.2 represents the result of impact strength observation of notched specimens.impact properties were studied in terms of shock absorber.

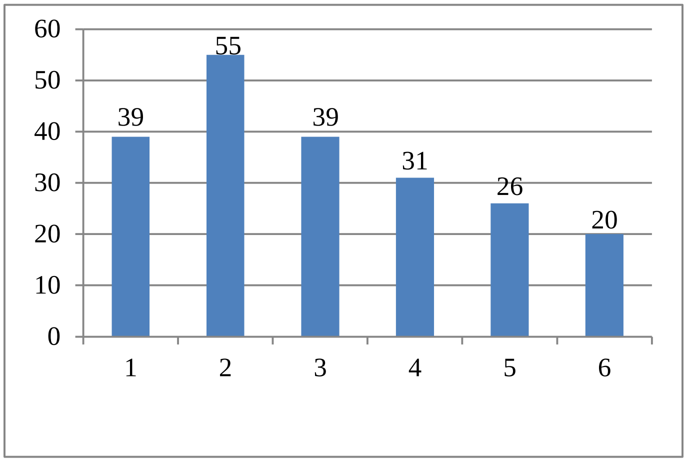


Chart .2 Impact strength

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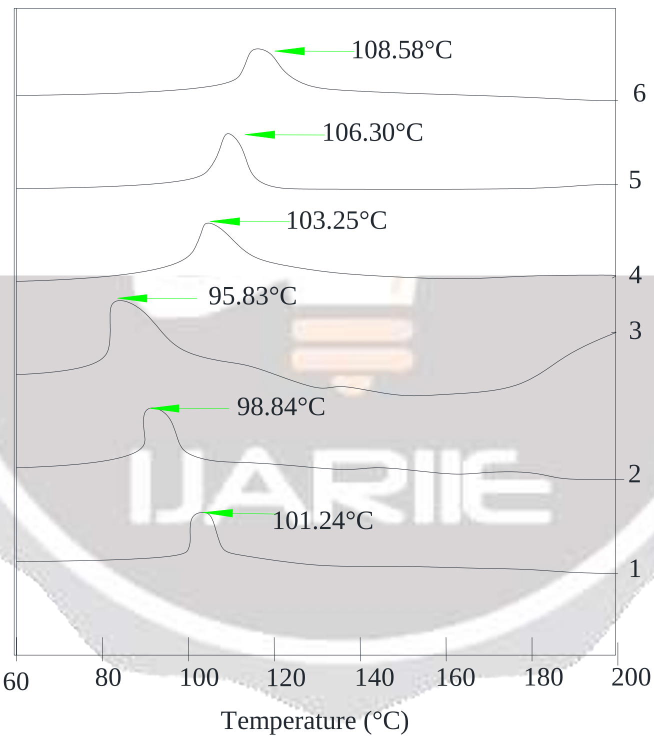

Chart 3 – DSC curve

DSC is used especially for discrimination between miscible and immiscible polymer blends. [2,3] DSC was used to measure the melting temperature of PS50/ABS50,PS40/ABS60,PS60/ABS40 PS/ABS50+5%$CaCO_3$,PS/ABS50+10% and PS/ABS50+15% ,which were respectively 101.24˚C, 98.84˚C, 95.83˚C, 103.25˚C, 106.30˚C, 108.58˚C.

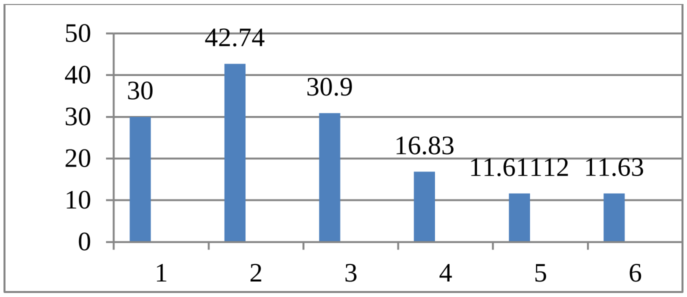

Chart-4 Melt flow index (MFI)

Melt flow index was determined by extrusion rate of material. Melt flow rate evaluates the fluidity in a static condition. Long chains of high molecular weight and more complex structure yield greater flow resistance or viscosity. The MFI 42.74 in the above chart indicates lower molecular weight than others. The effect of filler can not be observed via the melt flow rate. [6]

5. CONCLUSION

A simple process for making high strength PS/ABS blend was developed and investigated. The blend was prepared by mixing the components simultaneously gave higher impact strength compared to other blends. PS50/ABS50 gave higher impact strength. So we had added calcium carbonate into it. It gave toughness to the material.

6. REFERENCES

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