International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 05 | May-2018 www.irjet.net p-ISSN: 2395-0072

Compounding of Polypropylene with Wood Flour and Comparative Study of Mechanical Properties

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Abstract - *In this modern world the plastics has vital and scarier role in engineering and commercial application. The consumption of plastics is going high, when compared with other material, because the plastics has good moulding property and cheaper when compared to other materials. The report is made on compounding of polypropylene and wood flour as a filler which resulted in the reduction of cost and increase in the mechanical strength of the material when compared to the virgin material.*

Key Words: Compounding, Filler, Mechanical Property, Plastics, Wood Flour.

1. INTRODUCTION

1.1 Polypropylene:

Polypropylene is a thermoplastics polymer used in a wide variety of applications. An addition polymerisation made from the monomer propylene, it can be produced in a variety of structures giving rise to applications including packaging and labelling, textiles, plastic parts and reusable containers of various types, laboratory equipment, automotive components, and medical devices.

The properties of polypropylene are as follows:

Table 1:Mechanical Properties of Polypropylene

Sr. No.	Mechanical Properties	Units	Range
01	Tensile Strength	Psi	4500 to 6000
02	Tensile Modulus	Psi	16500 to 22500
03	Flexural Modulus	Psi	17000 to 25000
04	Impact Strength	Psi	0.4 to 1.4
05	Elongation at break	Not Applicable	100 600%

1.2 Wood flour-:

Wood flour is commonly used as a filler in thermosetting resins such as bakelite , and in linoleum floor coverings. Wood flour is also the main ingredient in wood/plastic composite building products such as decks and roofs. Large quantities of wood flour are frequently to be found in the waste from woodworking and furniture companies.

a. Compounding:

Compounding is a process of melt blending plastics with other additives. This process changes the physical, thermal, electrical or aesthetic characteristics of the plastic. The final product is called a compound or composite. Compounding starts with a base resin or polymer.

1.3.1 There are four basic methods

a) Dry Mixing.

b) Batch Mixing.

c) Continuous Mixing

d) Compounding By Screw Extruder

1. 3.2Twin Screw Extruder

Twin screw extrusion is used extensively for mixing, compounding, or reacting polymeric materials. The flexibility of twin screw extrusion equipment allows this operation to be designed specifically for the formulation being processed. . For example, the two screws may be co rotating or counter rotating, intermeshing or no intermeshing. In addition, the configurations of the screws themselves may be varied using forward conveying elements, reverse conveying elements, kneading blocks, and other designs in order to achieve particular mixing characteristics.

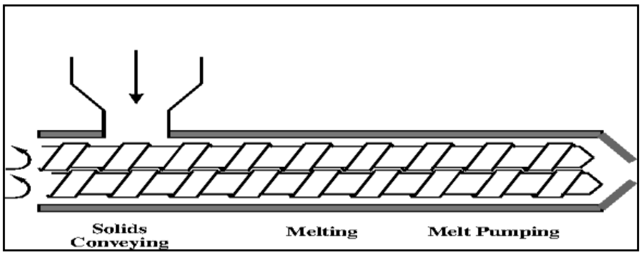


Figure 1: Twin Screw Extruder

1.4 Methodology

1) Determination of Mechanical Property of virgin PP.

2) Selection of Filler

3) Compounding of PP with Wood.

4) Determination of Mechanical Property of Compounded material.

1.5 Objective

1) To reduce the cost of Material.
2) To enhance the Mechanical properties like Tensile Strength, Flexural strength, etc.

2. LITERATURE REVIEW

2.1 Extrusion-based wood fibre–PP composites: Wood powder and pelletized wood fibres – a comparative study, P. Nygård , B.S. Tanem , T. Karlsen, P. Brachet B. Leinsvang,2008, 3418–3424, Journal of Composites Science and Technology in this paper The low-density state of wood fibres represents a feeding challenge when introduced as reinforcements in wood fibre–polymer composites manufactured by extruder-based processing. This challenge has prevented commercial use of wood fibres as reinforcements in various composite applications. In the present work, pelletizing of fluffy wallboard fibres and CTMP fibres into pellets was applied to realize a controlled feeding with loss-in-weight gravimetric equipment. The resulting reinforced composite materials were compared to composites filled with wood powders. The effect of two different coupling agents was furthermore examined, having a span in molecular weight and amount of grafted maleic anhydride. A significant improvement in tensile strength, elongation at break and impact strength was observed for the wood fibre reinforced composites compared to the wood powder-filled composites. These property improvements justifies the efforts of developing new feeding strategies that allow for non-destructive handling and feeding of wood fibres as reinforcements in wood fibre–polymer composites, developed by continuous extruder-based processing [1].

2.2 Pla/Wood Biocomposites: Improving Composite Strength By Chemical Treatment of the Fibers A Comparative Study, R. Csizmadia1, G. Faludi , K. Renner, J. Móczó And B. Pukánszky, Journal of Composites Part A: Applied Science and Manufacturing in this paper A resol type phenolic resin was prepared for the impregnation of wood particles used for the reinforcement of PLA. A preliminary study showed that the resin penetrates wood with rates depending on the concentration of the solution and on temperature. Treatment with a solution of 1 wt% resin resulted in a considerable increase of composite strength and decrease of water absorption. Composite strength improved as a result of in-creased inherent strength of the wood, but interfacial adhesion might be modified as well. When wood was treated with resin solutions of larger concentrations, the strength of the composites decreased, first slightly, then drastically to a very small value. A larger amount of resin results in a thick coating on wood with inferior mechanical properties. At large resin contents the mechanism of deformation changes; the thick coating breaks very easily leading to the catastrophic failure of the composites at very small loads[3].

3. COMPOUNDING PROCEDURE

a) Temperatures of different zones are set likewise, for zone1 it is 160℃, for zone2 it is 170℃, for zone 3 it is 180℃ which should be higher than other former zones preceding the die.
b) After the temperature of zones is reached the mixture of polypropylene and wood flour is fed into the hopper and the process is started.
c) The flexibility of twin screw extruder equipment allows this operation to be smoothly running the process and the strands come out of the die after completely homogeneous mixing.
d) The continues string are collected tighter and evenly so that can be processed in the injection moulding machine for specimen preparation.
e) Batch wise materials are collected. The material having 99% polypropylene concentration and 10% wood flour are grinded separately and like that all the materials having 20%,30%,40%,50% concentration of wood flour in the material are collected and grinded for specimen preparation.

4. TESTS CONDUCTED

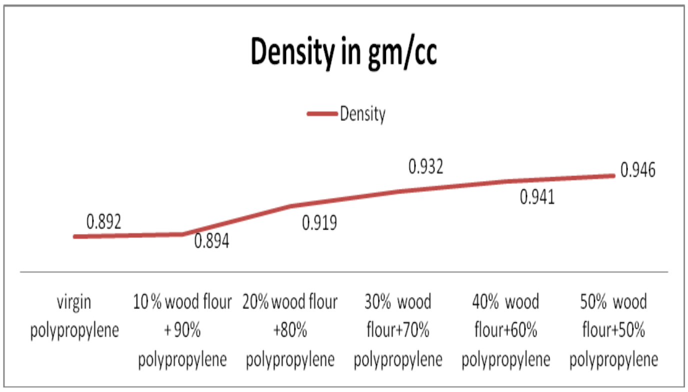
Table 2: Test Name and Test Method

Sr. No.	Name of the Test	Test method
01	Density	ISO792
02	MFI	ASTMD 1238
03	Tensile strength	ASTMD 638
04	Flexural strength	ASTMD 790

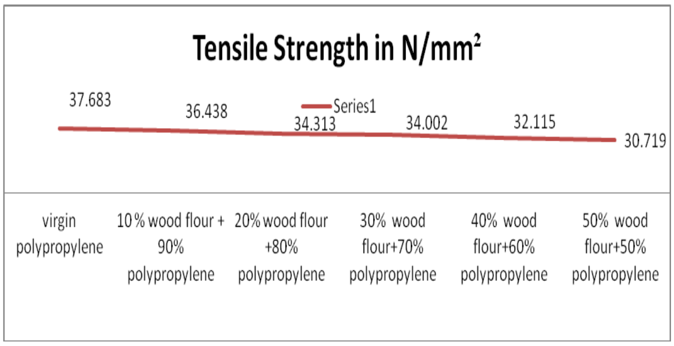
5. RESULTS

Table 3: Percentage of Compounding

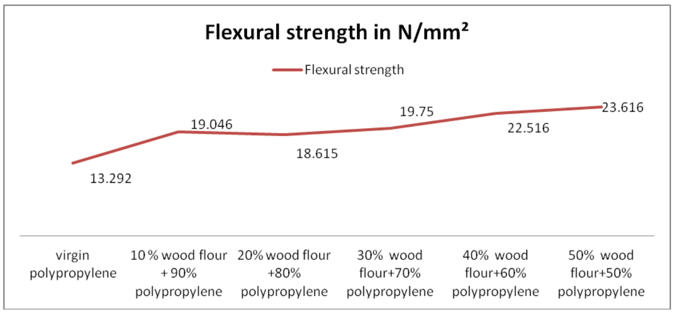
Sr. No.	Percentage of Compounded Material	Density gm/cc	Tensile strength N/mm2	Flexural strength N/mm2
1	Virgin Polypropylene	0.892	37.683	13.292
2	10 % Wood Flour + 90% Polypropylene	0.894	36.438	19.046
3	20% Wood Flour +80% Polypropylene	0.919	34.313	18.615
4	30% Wood Flour+70% Polypropylene	0.932	34.002	19.75
5	40% Wood Flour+60% Polypropylene	0.941	32.115	22.516
6	50% Wood Flour+50% Polypropylene	0.946	30.719	23.616



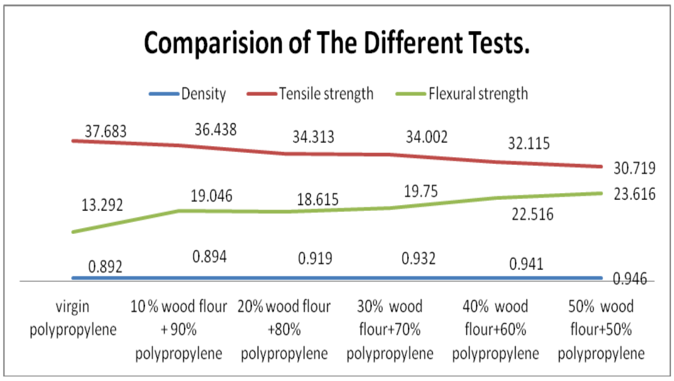
Graph 1: Densities of Different Percentage Of Compounded Material



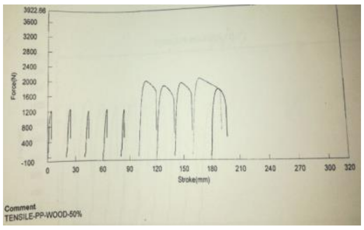
Graph 2: Tensile Strength of Different Compounded Material.



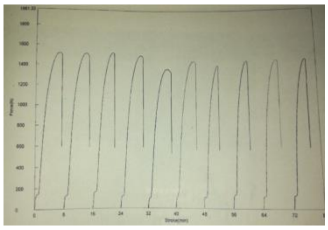
Graph 3: Flexural Strength of Different Compounded Material.



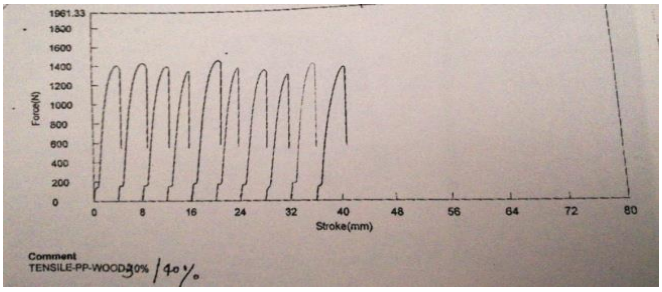
Graph 4: Comparison Chart of Different Tests Conducted



Graph 5: Tensile Strength Of Virgin Material And 50% Compounded Material.



Graph 6: Tensile Strength Of 10% And 20% Compounded Material.



Graph 7: Tensile Strength Of 30% And 40% Compounded Material.

6. CONCLUSIONS

1) Addition of wood flour with polypropylene material this has been observed that the density is increases gradually from 0.892 g/cc to 0.894 g/cc.
2) It will give high durability and good strength.
3) Flexural strength is also increasing so, where ever the high flexural strength material is required replace that PP material with compounded material.
4) The elongation of the compounded material is decreased which results in increase in the value of tensile strength after the increase in percentage of wood flour to the polypropylene.

REFERENCES

[1]. P. Nygård , B.S. Tanem , T. Karlsen, P. Brachet B. Leinsvang , Extrusion-based wood fibre–PP composites: Wood powder and pelletized wood fibres – a comparative study, ,2008, 3418–3424, Journal of Composites Science and Technology.

[2]. Keener TJ, Stuart RK, Brown TK. Maleated coupling agents for natural fibre composites. Compos A, Appl Sci Manufact 2004;35:357.

[3]. R. Csizmadia1, G. Faludi , K. Renner, J. Móczó And B. Pukánszky, Pla/Wood Biocomposites: Improving Composite Strength By Chemical Treatment of the Fibers A Comparative Study, Journal of Composites Part A: Applied Science and Manufacturing.

[4]. Bledzki AK, Faruk O. Creep and impact properties of wood fibre–polypropylene composites: Influence of temperature and moisture content. Composites Science and Technology, 2004;64:693.

[5]. Bhattacharyya D, Bowis M, Jayaraman K. Thermoforming wood fibre polypropylene composite sheets. Composites Science and Technology 2003;63:353.

[6]. Ichazo MN, Albano C, Gonzáles J, Perera R, Candal MV. Polypropylene/ wood flour composites: treatments and properties. Composite Structure 2001;54:207.