Wollastonite Wood Flour polypropylene Hybrid Composites

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Abstract: Abundantly available wood flour was used in polypropylene (PP) for making thermoplastics composites. Better Adhesion between PP and wood flour (WF) was obtained by using maleated poly propylene (MAPP) compatabilizer which enhanced the tensile strength of composite. Addition of wollastonite in small quantity enhanced the impact strength and hardness. Composites thus prepared have applications in building and automotive fields.
.**Keywords**: impact, polypropylene, wood flour wollastonite, tensile.

Introduction: Lingnocellulosic materials such as rice husk, bagasse, wood flour, sisal/jute fiber had become very popular for making thermoplastic composites due to low cost, light weight and biodegradable nature [1-2]. Addition of these materials in thermoplastics decreased the mechanical strength due to poor bonding [3]. Adhesion between the two was improved by using suitable compatabilizer and coupling agents. Due to better adhesion composites produced, have better tensile strength[4-6]. Use of glass fiber in small quantity produced hybrid composite with better impact strength.[7-11].

In the present study , glass fiber was replaced by wollastonite filler and composite have better finish and low cost. [12]. Detailed study of mechanical properties such as tensile, impact, flexural and hardness is attempted to explore new application in automotive and building fields.

Materials and Method:

MATERIALS:

Polypropylene: It was procured from M/S Reliance industries (Grade AM 120N) and following properties were measured:

- Moisture content (ASTM D789) : 0.039 %
- Viscosity average molecular weight (ASTM D 2857-95) : $26{,}592\times10^{-3}$ kg /mole
- Tacticity : 7.8%
- Melt Flow Index (ASTM D 1238): 19.92×10^{-5} kg /s
- Tensile strength at yield (ASTM D 638): 29.0×10^{6} kg/ms^{2}
- Hardness: SHORE D (ASTM D 2240): 63.75

Wood Flour: It was procured locally and some of the measured properties are :

- Bulk density (ASTM D1895) : 150 kg/m^{3}
- Ash content (ASTM D2584) : 9.59 %
- Moisture content (ASTM D789) : 9.02 %

MAPP Compatabilizer: Maleic anhydride grafted polypropylene (Grade P 406) compatibilizer was supplied by M/S Pluss Polymers Private Limited, Gurgaon
Wollastonite: It is a meta silicate and has the following properties.

- Aspect ratio; 3 to 20
- Mohr Hardness 4.5

METHOD: Wood flour was preheated in oven at 373 K to remove moisture. Polypropylene along with wood flour was fed in a single screw extruder and temperature setting was: 463 K, 473 K, 483 K, and 473 K. After getting the uniformly mixed granules from the extruder, the granules were kept in the mold. Mold halves were kept in compression molding machine at following process conditions:
Processing temperature: 473 K
Heating time: 900 sec
Cooling time: 1200 sec
Clamping pressure: 590.5×10^4 kg/m^2
After proper heating and cooling of the mold, it was opened and composite sheets of 0.155m × 0.155 m×0.003 m were produced. The sheets were cut to prepare samples for carrying out tensile (ASTM D 638):, impact (ASTM D 256) and flexural (ASTM D 790) tests.
Universal testing machine (UTM) [Capacity: 50 $\times10^3$ kg m/s^2) , supplied by M/S Ashian Engineers Company India, New Delhi was used for performing the tensile and flexural test. Gauge length was fixed at 50×10^{-3} m and testing speed was set at 83×10^{-5} m/s. The sample size in flexural test was 0.1550 m× 0.0127 m×0. 003m and test was performed on the same UTM by three point loading. Sample size used in impact test was 0.0635 m 0.0127× m×0.003 m. and was done by Izod method with un notched sample . The Shore D tester was used for hardness measurement and sheet of 0.155 m× 0.155 m× 0.003 m prepared by compression molding was used for this test.

- SG : 2.9 gm/cm^3
- Low moisture absorption
- Better scratch resistance

Results and Discussion:
In the Table 1, results for mechanical properties with wollastonite loading are reported. It is found that both properties (tensile, flexural) increase up to maximum level up to maximum level thereafter decrease .[13,14]. Therefore 1.5% is the optimum level required for good mechanical strength in WFPP composites.
Presence of wollastonite in powder form fills the voids and interspaces between WF and PP which reduce the stress concentration points causing impact to improve[`15] as shown in Figure 2. Higher density and hardness of wollastonite than PP gives better hardness in WFPP composites as seen in Figure 1.[16] Hadrness and impact strength increase lineally with loading of wollastonit

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Table1: Mechanical Properties of Wollastonite Wood Floor Polypropylene Composites

Wollastonite% (gm	Tensile Strength (MPa)	Flexural Strength (MPa)	Impact Strength (J/m)	Hardness
.50	14.80	7.60	3.00	85.30
1.0	15.26	7.68	3.40	86.90
1.5	15.52	7.92	4.66	88.02
2.0	14.98	7.58	4.92	88.96