

Study of Coupling Agent on the Properties of Talc Modified Calcium Carbonate/ Tamarind Seed Composites

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Abstract- In our study is to enhance the mechanical properties in hybrid composite laminates. The composite laminates will be prepared by Calcium Carbonate / Tamarind Seed talc was mixed in proportions on single screw extruder to obtain the plastic granules of uniform size and composition. These granules were processed on compression molding machine (semi automatic hydraulic press) at required temperature and pressure to obtain the composite sheet of size 155×155 mm². Specimens of required size and shape were cut from the sheet for analysis of various mechanical, thermal and chemical properties.

Keywords: Calcium Carbonate and Tamarind Seed, Talc, Mechanical properties.

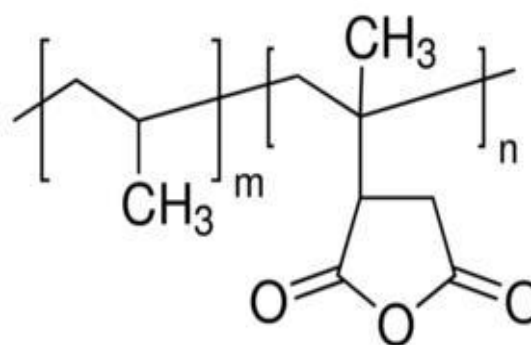


Figure: 1propylene grafted with maleic anhydride

1. INTRODUCTION

Composite materials play an important role in engineering. In that thermoset plastic materials are widely used in various engineering industries because of their superior performance and biodegradable properties. Though coupling agents are widely used in the fields polymers for highly biodegradable. The ethylene propylene grafted the with maleic anhydride are the most commonly used thermoset plastic in polymer matrix composites have a good mechanical properties [1]. It explore that the use of DPPI as a coupling agent for the composites of wheat straw/polyethylene (PE) increased its modulus properties significantly. [2] Maleated polyolefins such as m-PE and polypropylene (m-PP) were found efficient compatibilizers for improving mechanical properties of PE and PP filled with wood fibers. In our work upon all of these papers we concluded that DPPI have high in mechanical properties. So our studies are based on coupling agents.

2. MATERIALS & METHOD

2.1 Coupling Agents

A coupling agent is defined as a compound which provides a chemical bond between two dissimilar materials, usually an inorganic and an organic. The inorganic compatibility derives from alkoxy groups attached to the silicon atom.

The coupling material was ethylene propylene grafted with maleic anhydride (EP-g-MA, Exxelor VA 1803) with a glass transition temperature T_g of -57°C.

EPM is considered a valuable elastomer due to its useful chemical and physical properties; it is resistant to heat, oxidation, ozone and the weather

Property	EPM Property
Hardness	30-100
Tensile Strength	7-23
Elongation	100-550%
Compression	20-50%
Temperature range(°c)	-45 to +150

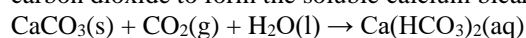
Table: 1 Properties of ethylene propylene

2.2 Calcium Carbonate

The molecular formula of calcium carbonate is CaCO₃ it is extracted from rock as a minerals calcite and aragonite. It is mainly in the form of shells of marine organism. The shell type calcium carbonate is reduced in to fine granuals with the help of crushing, grinding precipitation and classifying high purity white like talc for research purpose process.

It is medicinally used as a calcium supplement or as an antacid, but excessive consumption can be hazardous.

Calcium carbonate will react with water that is saturated with carbon dioxide to form the soluble calcium bicarbonate.



This reaction is important in the erosion of carbonate rock, forming caverns, and leads to hard water in many regions. An unusual form of calcium carbonate is the hexahydrate, ikaite, CaCO₃·6H₂O. Ikaite is stable only below 8 °C.

The thermodynamically stable form of CaCO₃ under normal conditions is hexagonal β-CaCO₃ (the mineral calcite) Other forms can be prepared, the denser (2.83 g/cm³) orthorhombic

λ -CaCO₃ (the mineral aragonite) and μ -CaCO₃, occurring as the mineral vaterite. The aragonite form can be prepared by precipitation at temperatures above 85 °C, the vaterite form can be prepared by precipitation at 60 °C. Calcite contains calcium atoms coordinated by six oxygen atoms, in aragonite they are coordinated by nine oxygen atoms. The vaterites structure is not fully understood. Magnesium carbonate (MgCO₃) has the calcite structure, whereas strontium carbonate and barium carbonate (SrCO₃ and BaCO₃) adopt the aragonite structure, reflecting their larger ionic radii.



Figure : 2 Calcium Carbonate

In which the CaCO₃ include the properties such as tabulated below:

pH (10% solution)	9
Hardness (Mohs scale)	1
Thermal conductivity (cal/cm s °C)	3.5×10^{-3}
Specific heat (cal/g °C)	0.208

Table 2: Properties and values of Talc CaCO₃

2.3 Tamarind Seed

Tamarind is the fruit of *Tamarindus indica* popularly used in Indian cuisine. Roasted tamarind seeds are a popular snack amongst the rural population. Tamarind seeds are shiny black in color and have numerous nutritional and health benefits. If the talc type tamarind seed is prepared by using the following process

- Soaked
- Tanned seed
- Dry in sunlight
- Powder (pulverize machine)

The excellent gelling cum adhesive characteristics of the decorticated seed powder can lead to several applications in the field of engineering



Figure: 3 Talc Tamarind Seed

3. METHODOLOGY

Compression molding machine was made on and required temperature was allowed to attain. Mold halves were cleaned and release agent (silicon) was applied on the mold surfaces. Plastic granules were kept in mold halves and mold was clamped in semi-automatic compression molding machine. Semi automatic hydraulic press used for making the composites is shown in Figure 4.

Different sets of experiments were conducted to get the sheet of minimum defects by varying the process parameters such as temperature and pressure. Following were the optimized conditions for getting good quality sheet of Calcium carbonate polypropylene composite.

- Processing temperature: 200°C
- Clamping pressure: 1.5 tons/in²
- Heating time: 15 minutes
- Cooling time : 30 minutes

After completion of heating cycle, mold was cooled by circulating water. Mold was taken out from the machine, and two halves were opened. Calcium carbonate polypropylene composite sheet was obtained.



Figure: 4 Photographic Representation of Compression Molding Machine

3. RESULTS & DISCUSSION

3.1 Tensile Test

ASTM D3039 tensile testing is used to measure the force required to break a polymer composite specimen and the extent to which the specimen stretches or elongates to that breaking point. The data is often used to specify a material, to design parts to withstand application of force and as a quality control check of materials. Since the physical properties of many materials at temperatures that simulate the intended end use environment.

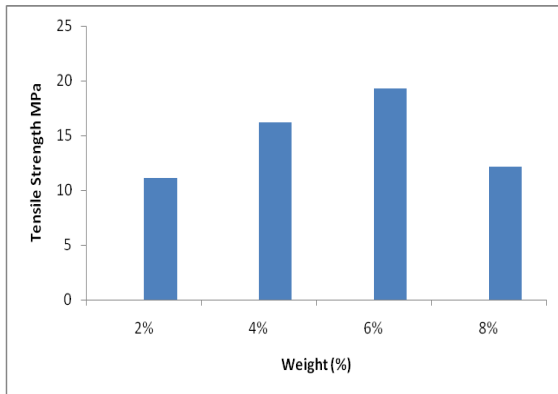


Figure: 5 Effect of CaCO_3 loading on the tensile Properties of Polypropylene composite

The most common specimen for ASTM D3039 has a constant rectangular cross section, 13mm wide and 165mm long. Optional tabs can be bonded to the ends of the specimen to prevent gripping damage.

3.2 Flexural Test

The flexural test was performed by the three point bending method according to ASTM D 790, and cross head speed of 1 mm/min. Four specimens were tested, and the average was calculated. The specimen was freely supported by a beam, the maximum load was applied in the middle of the specimen, and the flexural modules are calculated from the slope of the initial portion of the load deflection curve.

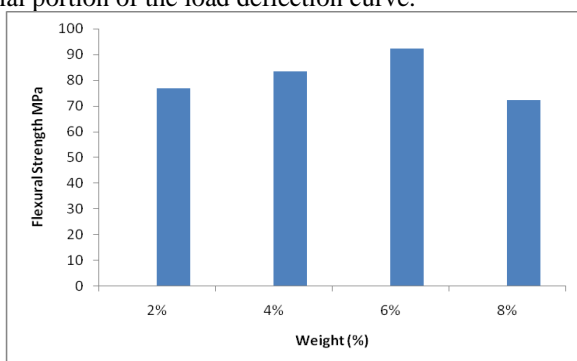


Figure 6. Effect of CaCO_3 loading on the flexural properties of Calcium carbonate /Polypropylene

3.3 Impact Test

Impact strength is ability of material to resist breaking under shock loading or to resist fracture under stress, applied at high speed. Notched sample of $63.5 \times 12.7 \times 3.2 \text{ mm}^3$ size was taken for conducting impact test.

Notch of 2.5 mm at an angle of 45 degree was prepared to promote the brittle fracture in material. Impact test was conducted by Izod impact tester (CEAST, Italy make), which has capacity of 50 Joule. Speed of pendulum was fixed at 3.5 m/s and striker elevation was 150° .

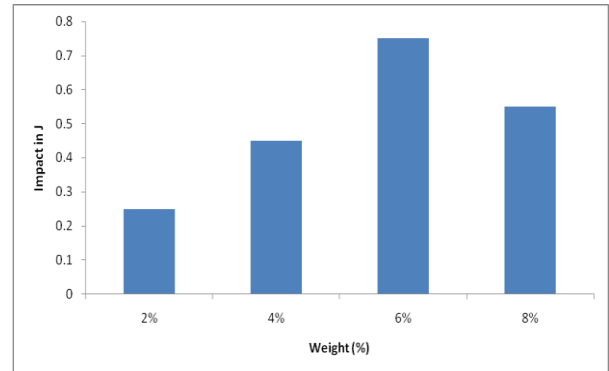


Figure: 7 Effect of CaCO_3 loading on the impact strength of Calcium carbonate /Tamarind composite

4. CONCLUSION

In our work, mechanical properties of Calcium carbonate /Tamarind, The tensile, and flexural and impact properties of the composites as a function of fiber content were analysed.

- The tensile strength of Calcium carbonate /Tamarind composite improved by increasing fiber loading up to 6wt.% and decreased by higher loading.
- The flexural strength of Calcium carbonate /Tamarind composite improved by increasing fiber loading up to 6 wt.% and decreased by higher loading
- More Addition of Calcium carbonate decreases the tensile, flexural, compression and increases the Impact properties of composites.
- Impact properties of hybrid Calcium carbonate /Tamarind are better than th coconut sheat and Calcium carbonate/Polypropylene composites.

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