"STUDY ON THERMO-MECHANICAL BEHAVIOR OF KENAF FIBER/POLYPROPYLENE (PP) NANOCOMPOSITES"

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ABSTRACT

Kenaf fibre is one of the potential candidates to be used with the thermoplastic to form bio-composites for application in automotive field. Thermal and Mechanical properties of hybrid composites which consist of polypropylene (PP), Nano-clay (NC) and kenaf fiber (K) have been investigated with or without coupling agent/ with or without alkali treatment of fiber. Polypropylene and Nano-clay were blended with the coupling agent coated fiber in a twin screw extruder and then injection molded. The weight fraction, Nano-clay varied between 1/3/5 wt%. The samples were characterized by tensile strength (TS), tensile modulus (TM), melt flow index (MFI), Impact strength, Differential scanning calorimetry and Heat deflection temperature. Morphology of the Nanocomposite is characterized by the Scanning Electron Microscopy.

1. EXPERIMENTAL WORK

1.1. Materials:-

Polypropylene Impact Copolymer (MI3530) provided by Reliance Industries Limited, Mumbai, and was used as a base material for the study. Nano-clay surface modified montmorillonite was procured from Sigma Aldrich (product code – 682632). It contains 0.5-5 wt. % aminopropyltriethoxysilane and 15-35 wt. % octadecylamine with a base of montmorillonite clay. Maleic Anhydrated grafted Polypropylene (OPTIM P-425) was provided by Pluss Polymers pvt Ltd and used as a coupling agent in the study.

1.2. Chemical Treatment:-

- **Alkali Treatment: -** Kenaf fiber was immersed in 6% NaOH aqueous solution for 2 h at room temperature. The fabric was removed from the alkali solution and then washed several times with fresh water and excess NaOH was neutralized with 1 % dilute acetic acid solution and followed by washing with distilled water. The fabric was then dried at room temperature for 2 h followed by oven drying at 70 °C for 24 hr.
- **Improve: -** To increasing surface roughness that results in better mechanical interlocking. It Increment the amount of cellulose exposed on the fibre surface increasing the number of reactive side.

2. COMPOUNDING AND SPECIMEN PREPARATION

Compounding (Twin Screw Extruder):- Twin screw extruder technique was used to prepare the Kenaf fiber (Treated & untreated) reinforced with Polypropylene Nano-composites. The operation conditions of the co-rotating twin-screw extruder compounding including extruder barrel temperature at different extruding zones, melt pressure, and screw speed employed for the compounding of both fibre and matrix (PP). Kenaf fiber + PP + MA-g-PP + Montmorillonite clay (1-3-5%) are fed through feeders at the extruder. The extruded strand coming out from the die head is then passed through a water bath and subsequently pelletized.

Sampling (Injection Molding):- Injection Molding is a manufacturing process for producing parts from pellets. The compounded material is fed into barrel, mixed and forced into mold where it cools and hardens to the configuration of mold cavity.

Table 1.1 Compositions of Batches

S. No.	Types	Composition (%)
1.	Virgin PPCP	100% PP GRADE OF MI3530
2.	Composite(Without Treated)	5% MAPP+ 30%K.F+ 65%PP of MI3530
3.	Composite(With Treated)	5% MAPP+ 30%K.F+ 65%PP of MI3530
4.	Composite(With Treated)	5% MAPP+ 30%K.F+ 64%PP of MI3530+ 1%N.C
5.	Composite(With Treated)	5% MAPP+ 30%K.F+ 62%PP of MI3530+ 3%N.C
6.	Composite(With Treated)	5% MAPP+ 30%K.F+ 60%PP of MI3530+ 5%N.C

3. RESULT AND DISCUSSION

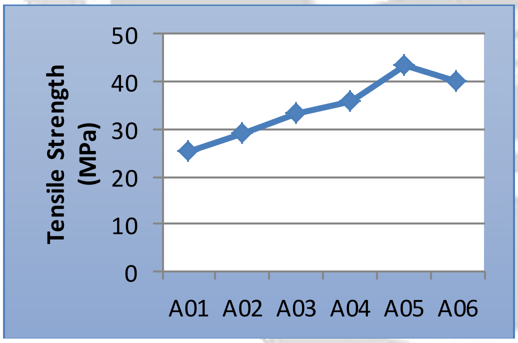

Fig. a.) Tensile strength (MPa)

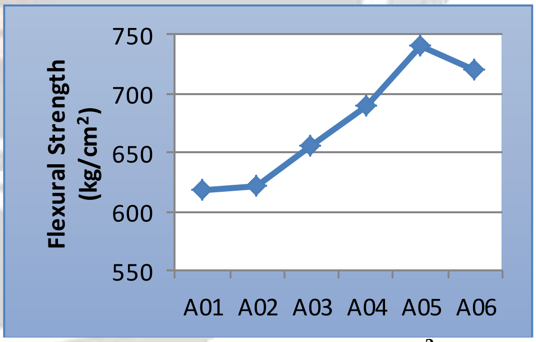

Fig. b.) Flexural strength (Kg/cm^2)

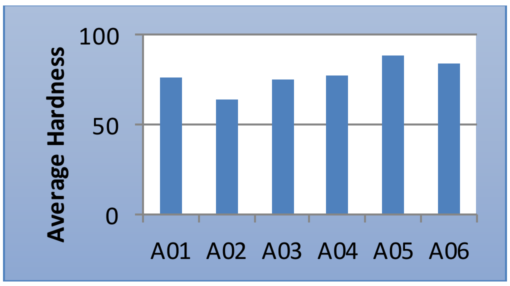

Fig. c.) Hardness of the composite (BHN)

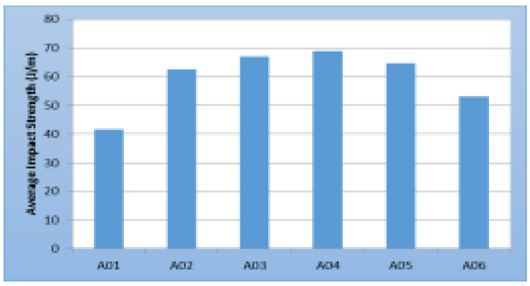

Fig. d.) Impact St. of the composite (J/m)

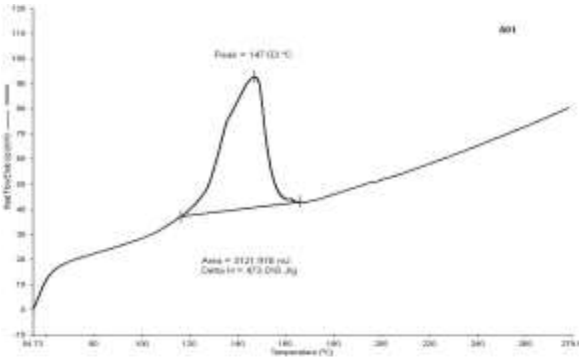

Fig. e.) DSC of Batch-A01

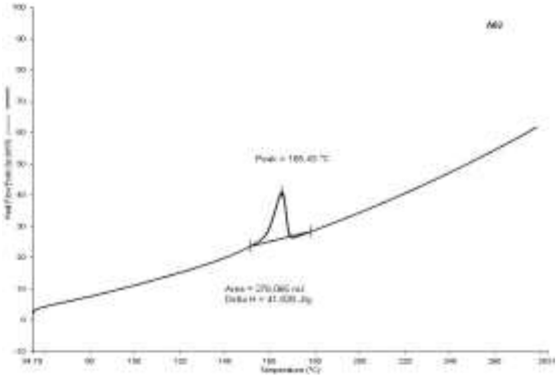

Fig. f.) DSC of Bathch-A02

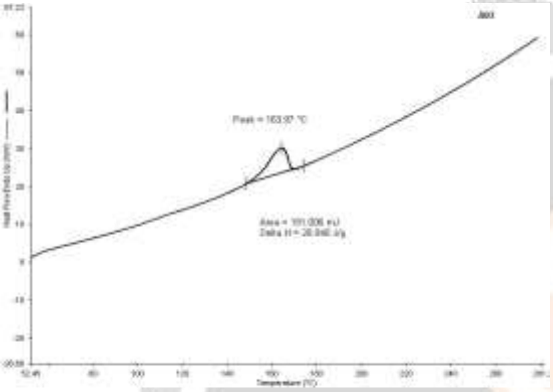

Fig. g.) DSC of Bathch-A03

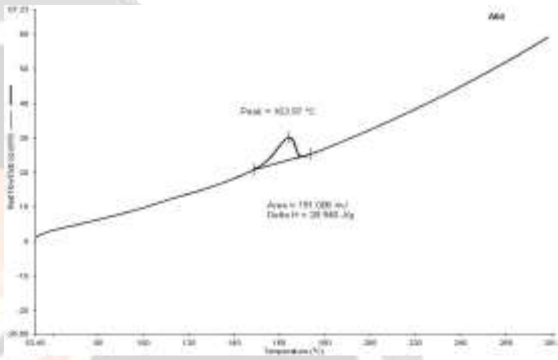

Fig. h.) DSC of Bathch-A04

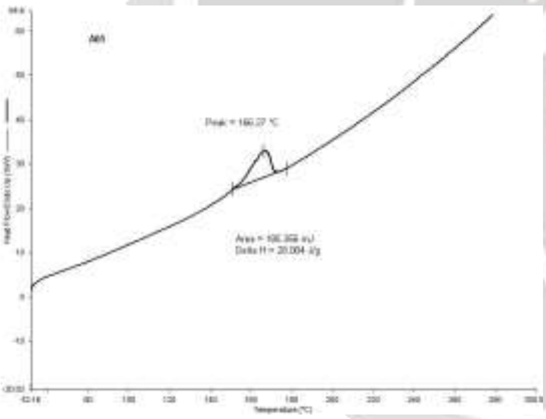

Fig. i.) DSC of Bathch-A05

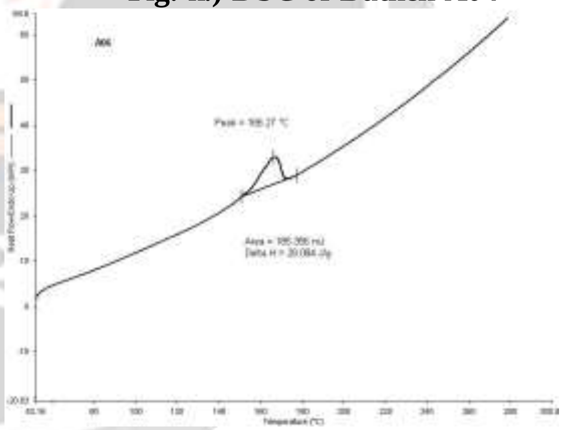

Fig. j.) DSC of Bathch-A06

Batch No.	Melting Temperature (^{0}C)
A01	147.03
A02	165.43
A03	163.97
A04	163.97
A05	166.27
A06	166.27

Figure a.) Shows the tensile strength of the composite were increased while treated with the NaOH and incorporation of Nano-clay loading. Tensile strength increases with increases in the Nano-clay loading, A05 shows good tensile strength of 43.5 MPa containing 3% Nano-clay and as increasing the Nano-clay loading the tensile strength is decreases at 5% Nano-clay of 40 MPa.

Figure b.) Shows the Flexural strength of the Polypropylene Nano-composite increase with increasing in the amount of Nano-filler loading. In this study A05 shows high hardness at the amount of 3% Nano-clay filler loading with treated kenaf fiber.

Figure c.) Shows Hardness of the Polypropylene Nano-composite increase with increasing in the amount of Nano-filler loading. In this study A05 shows high hardness at the amount of 3% Nano-clay filler loading with treated kenaf fiber.

Figure d.) Impact strength is increases at A04 sample in which Nano-clay filler loading is 1% with polypropylene nanocomposite reinforced with Kenaf fiber. But after that it decrease due to high filler agglomeration causes brittle fraction. So that as increasing in the Nano-clay filler loading impact strength decrease.

Figure e.) Shows as compare the DSC curve of virgin PP is low when reinforced with or without treatment of Kenaf fiber of fix loading of 30% and by incorporation of Nano-clay loading. A05 & A06 shows the maximum melting temperature of 166.27^0C which is an appropriate Melting temperature for PP material.

4. CONCLUSIONS

- The tensile strength of the composites were increased with increasing the Nano-lay amount the structure of composite become more stiff because the inherent properties of Kenaf fiber to make the composite stiffer. There is a major change in the composite while treatment of kenaf fiber and by adding the coupling agent
- Hardness of the composite increase with increasing in the amount of Nano-filler loading. In this study A05 shows high hardness at the amount of 3% Nano-clay filler loading with treated kenaf fiber
- Impact strength is increases at A04 sample in which Nano-clay filler loading is 1% with polypropylene nanocomposite reinforced with Kenaf fiber. But after that it decrease due to high filler agglomeration causes brittle fraction. So that as increasing in the Nano-clay filler loading impact strength decrease.
- The Heat Deflection Temperature of Polypropylene Nano-composites was increased with increasing in the Nano-clay filler loading.
- DSC curves shows that there is increase in the thermal stability by incorporation of fiber with Nano-clay filler into the matrix of the composite is increased.

5. REFERENCES

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