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# DYNAMIC MECHANICAL ANALYSIS ANDRECYCLING PROPERTIES OF GREEN COMPOSITES FOR AUTOMOTIVE STRUCTURAL BEAMS

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***Abstract***—

*Applications of natural fiber in the automotive components can provide the advantages of weight, cost reduction and recyclability, in addition to eco- efficiency and renewability compared to synthetic conventional materials. Main focus is on dynamic mechanical analysis and recycling properties of eco- friendly long fiber reinforced thermo plastics with natural kenaf fiber as bumper material. It is prepared by hot impregnation process to increase the desired mechanical properties of the automotive components. Thermoplastics have more recyclability compared to thermosetting plastics. Grinding and reprocessing is a general method to recycle thermoplastics. To analyze the recycling property, KLFRT(Kenaf long fiber reinforced thermoplastic), LFRT(Long fiber reinforced thermoplastic) materials went through a process of regrinding followed by injection moulding process. The values of the recycled tensile properties were compared with virgin values of the composite.*

***Keywords***— *Natural Fiber, Kenaf, Dynamic Mechanical Analysis, Recycling Process*

## 1. INTRODUCTION

The application of the Long fiber reinforced thermoplastics (LFRT) materials in automotive industry is emergent rapidly due to their high performance in terms of mechanical properties, low cost, processing advantages and low density .The tradition of the LFRT plastics unlimited up to the bumper beams, front end modules, instrument panel career, and door modules and under body shields of the automobiles. They have an edge over traditional materials such as steel and aluminium due to their high specific strength, good damping capacity, simple manufacturing process, recyclablity and corrosion resistance. The matrix in thermo plastic composites is generally comprised of poly propylene (PP), polyethylene (PE), nylon or other inexpensive polymers. E glass fiber is a commonly used reinforcement material [1]. To augment the eco-friendly plastics in automotives the usage of the natural fibers were essential to enhance the degradability and recycling. The Accessibility of kenaf plant source is plenty in Indian rural areas so that we can consume this sustainable source to improve ecological compatibility [2].

The main advantages of using the natural kenaf bast fibers in thermoplastics along with polypropylene (pp) is it's high mechanical properties, thermal properties and recyclability[3] .The natural fiber based bumper beams automobile components shows good impact and flexural properties compared to natural fiber thermoplastics[4,5].While using short fibers in the composites the efficiency and performance is less compared with long fiber composites due to the fiber orientation and distribution of fibers. Considering automotive safety legislation, crash worthy ness and safety more focus should be given for material selection. To poise the cost and performance of the thermoplastic composites kenaf fiber was chosen as reinforcement in thermoplastics.

The kenaf fiber having demanding mechanical properties and thermal properties compared to the other types of natural fibers[6]. Natural fibers in thermoplastics withstand high temperature during processing and has good moisture absorption. Main focus is given for developing long fiber thermoplastics with kenaf fiber composite material to be used for automotive applications [7]. The dynamic mechanical properties and important environment factor such as recyclability were found and compared with commercial long fiber thermoplastics (LFRT) which is used by the automotive industry. (Vasanthy and Jeganathan 2007, Vasanthy et.al., 2008, Raajasubramanian et.al., 2011, Jeganathan et.al., 2012, 2014, Sridhar et.al., 2012, Gunaselvi et.al., 2014, Premalatha et.al., 2015, Seshadri et.al., 2015, Shakila et.al., 2015, Ashok et.al., 2016, Satheesh

Kumar et.al., 2016).

## 2. MATERIALS AND METHODS

The raw materials used in this research were

1. 40% wt of twisted kenaf fiber + polypropylene + compatibillizer; KLFRT.
2. 40% wt of twisted jute fiber +polypropylene + compatibillizer; JLFRT.
3. 40% wt of twisted sisal fiber + polypropylene + compatibillizer; SLFRT.
4. 40% long glass fiber filled, (GF-PP), which is available commercially; LFRT.

Hot impregnation process was used to get the long fiber pellets[8].Dynamic Mechanical Analysis (DMA), is a technique where a small deformation is applied to a sample in a cyclic manner. The sample shown in Fig.1 is clamped into a frame of measurement head and is heated by the furnace . The sample in the furnace is applied stress from the force generator via probe. To make the strain amplitude constant, the stress was applied in sinusoidal form.DMA measures storage modulus (E') and loss modulus(E'') which is a measure of stiffness and damping capacity.

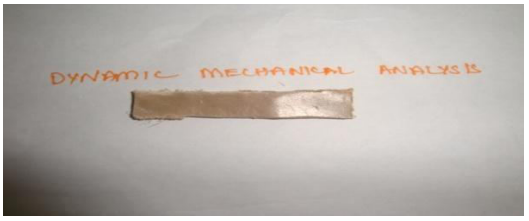


Figure 1: DMA test specimen

To analyse the recycling property KLFRT and LFRT materials was regrind followed by injection moulding process. The regrinding and injection moulding process was repeated twice for better comparison of properties like tensile properties. The recycled tensile properties values were compared with virgin values of composite.

## 3. RESULTS AND DISCUSSIONS

composites. The increased value of storage modulus for KLFRT was due to the good interfacial adhesion, and bond strength between matrix and fiber. (Manikandan et.al., 2016, Sethuraman et.al., 2016, Senthil Thambi et.al., 2016, Ashok et.al., 2018, Senthilkumar et.al., 2018).

## 4. RECYCLING OF COMPOSITES

Recycling of the automotive thermoplastics has major impact on environment. It is very important to compare the recycling property like retention strength after regrinding process of the thermoplastic composites .The percentage retention in tensile properties of LFRT, HYBRID PP and KLFRT in Fig.4. It is clear that strength of KLFRT after regrinding and further injection molding did not alter or deteriorate, while incorporation of glass fibers alter the recyclability .Strength of glass fibers decreased after the first regrinding (100 to 84%) itself and showed further decrease (70%) after second regrinding and may due to glass degradation during the grinding process. Modulus of the KLFRT improved after regrinding and injection molding while KLFRT composites showed a lower value compared to the original composites. These results indicate the superiority of the natural fiber KLFRT over LFRT and HYBRID PP with respect to recyclability.

## CONCLUSION

This study focused on the mechanical and recycling properties of a kenaf natural reinforced composites for consumption in automotive components. A twisted KFLRT, which is fabricated by hot impregnation method present a superior mechanical and thermal properties compared to the commercial LFRT material. This implies that natural kenaf reinforced material could be utilized in automotive structural components such as bumper beams and front end modules of automobiles. More over impact properties of KLFRT could be enhanced by optimizing the structural design parameters. It can also replace the LFRT material whenever the stiffness and strength is required.

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