Finite Element Simulation of Noise Reduction in IC Engine Cover by using Kapok Fruit Fiber Materials

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Abstract— The main objective of this project is the noise reduction in the IC engine cover by using natural kapok fruit fiber material, conventionally nylon material and polypropylene material is used for making engine cover, CATIA software is used for making the car engine cover and ANSYS-Workbench software is used for modal analysis and kapok fruit fiber material is also go for vibration analysis in experimentally by using accelerometer as the vibration excitation were considered to describe the actual loading condition. Natural frequencies of the system were extracted considering the damping effect of the structure. Dynamic analysis was performed based on the extracted natural frequency of the system.

Key words: FEA, IC Engine, Kapok Fruit Fibre

I. Introduction

Today's ever increasing demand for newer, lighter materials with higher strength, greater stiffness, and better reliability has led to wide research on development of thermo plastic materials. These materials offer a combination of strength and modulus that are either comparable to or better than many traditional materials such as metals. Because of their low specific gravities, the strength-to-weight ratios as well as specific modulus make these materials more superior to those of metallic materials. In addition, fatigue strength-to-weight ratios as well as fatigue damage tolerances of many polymers are excellent and make them feasible candidates for many applications. The use of advanced materials has primarily been limited to high performance aerospace and sporting applications. However, with the development need for materials with superior properties from the private sector, composites are now making their way into more common applications. However study on the static and dynamic mechanical behavior, long term durability, and environmental stability of these materials are limited.

Thermoplastics have been extensively used in automotive applications for the last few decades and are most visibly seen in automobile bumpers and interiors. Under-the-bonnet applications came later with the more widespread availability of high performance thermoplastics (referred to as 'engineering plastics') and contributed significantly to cost and weight reduction in the engine compartment, initially in applications that could be regarded as less critical to performance and safety, such as cooling fans, shrouds and header tanks, fixations, radiator grills, etc. Recently it has been seen engineering plastics are used in critical components on the vehicle itself as well as into safety critical components such as brakes, steering and air bag systems. The driving force behind this trend has been the growing confidence of automotive engineers in the capabilities of thermoplastics and engineering plastics. Engineering plastics have performed very well in each new demanding application. This successfully has raised awareness about plastic materials. Beyond this automotive engineers also studied different characters to judge the thermo plastic materials. They suggested that their characteristics are quite different to those of the metals that have been used for generations.

II. Literature Survey

Based on raw kapok fiber, two kinds of oil absorbers with high sorption capacity were prepared by a facile solution–immersion process. The coated polymer with low surface energy and rough fiber surface play important role in the retention of oil. The as-prepared fiber can quickly absorb gasoline, diesel, soybean oil, and paraffin oil up to above 74.5%, 66.8%, 64.4% and 47.8% of oil sorption capacity of raw fiber, respectively.

Sound absorption properties of natural kapok fibers have been investigated. Kapok fibrous assemblies with different bulk density, thickness, fiber length and orientation were manufactured, and their acoustical performances were evaluated by using an impedance tube instrument.

The hollowed-out tubular carbon@MnO_2 hybrid composites with hierarchical morphology have been successfully prepared via the redox reaction between MnO_4 and tubular carbonized kapok fiber. The morphology and electrochemical performance of the as-prepared hybrid composites can be facilely controlled by adjusting the concentration of MnO_4.

III. Modeling

The Modeling of the engine cover is done in CATIA 3D modeling software with the commands of sketcher, pad, pocket, pattern and fillet commands are used.

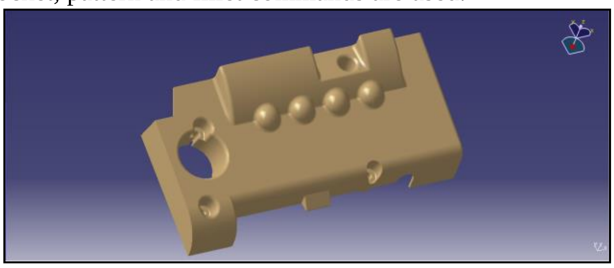

Fig. 1: 3D Modeling of Engine Cover

IV. Finite Element Analysis

The finite element analysis of the engine is compare with the different suggested polymer and fiber materials like Nylon, Polypropolyne and Kapok Fruit fiber the analysis include the structural analysis and model analysis of the engine cover in ANSYS Workbench Software. Meshing of the engine cover is done with Tetrahetrones elements with 31166 Nodes and 15581 Elements. The boundary conditions of this cover is fixed support and inside the cover 1.4 Bar pressure value is applied.

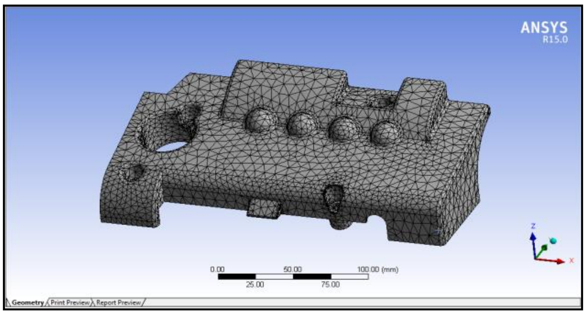

Fig. 2: Mesh Model of Engine Cover

Statistics	
Nodes	31166
Elements	15581
Mesh Metric	None

Fig. 3: Mesh Details

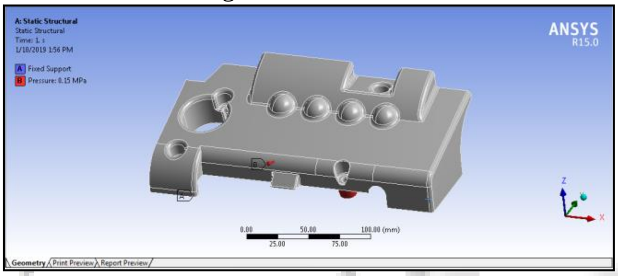

Fig. 4: Boundary Conditions for Modal Analysis

MATERIAL PROPERTIES	KAPOK FRUIT FIBRE	POLY PROPOLYNE	NYLON
DENSITY (KG/M3)	1300	905	1400
YOUNG'S MODULUS (GPA)	4	3.553	7.5
POISSON'S RATIO	0.38	0.4	0.34

Fig. 5: Material Properties for Engine Cover Suggested Materials

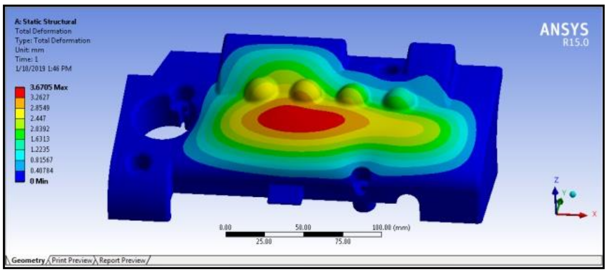

Fig. 6: Deformation of Engine Cover

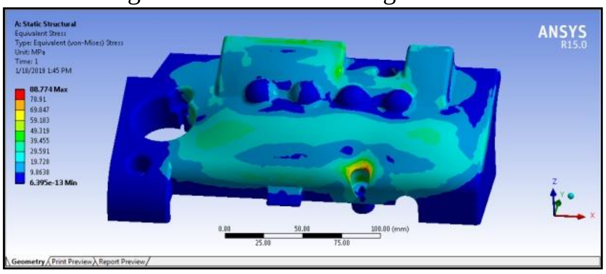

Fig. 7: Stress Results of Engine Cover

V. RESULTS

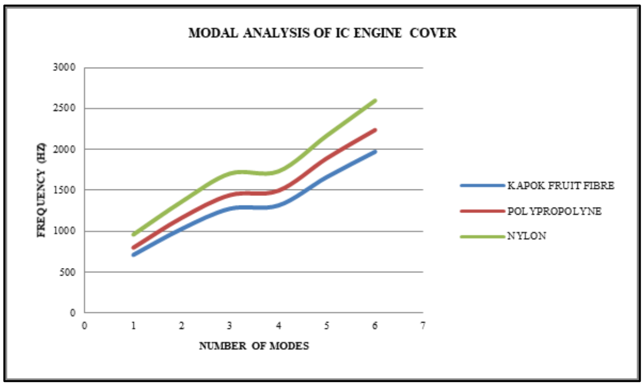

Fig. 8: Comparison Graph with Different Materials

The above Figure shows the comparative analysis of the natural frequency of the engine cover with the Nylon, Poly propolyne and Kapok fruit fiber materials comparison of this three material Kapok fruit fiber material give the very less frequency in the engine running conditions.

VI. CONCLUSION

From this project IC engine cover was modeled in CATIA software and modal analysis was done in ANSYS - Workbench software and get the results of mode shape of cover and frequency value of free vibration with Kapok Fruit fiber, Nylon and polypropylene materials from the comparison kapok fruit fiber material give the less vibration and noise compare to other materials so new material identified for IC engine cover is kapok fruit fiber material

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