INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title:		**Design and Development of Low Cost Cement Reinforced Polymeric Composite Material for Fabrication of Automotive Parts**
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SHORT ABSTRACT

In the last few decades composite materials and the design and development technology have received great attention due to their numerous advantages over metallic materials. The major advantages of polymeric composite materials such as low cost, ease of fabrication, high strength and modulus, reasonable fatigue and fracture resistance properties with respect to their density and excellent formability make them suitable for structural application substituting the need of metallic materials. Past researches indicate that spectacular enhancement and improvement in mechanical properties are achievable by varying small amount of filler particles concentration. In this work, several experiments are conducted to study the topographical features, dispersion of fillers into the matrix and thermal characteristics of the composite. A new type of polymeric composite material spur gear is designed and fabricated using the proposed composite material followed by injection molding technique. Several experiments are conducted with different percentages of cement materials with the polypropylene to optimize the composite material for gear fabrication. Further, experiments are conducted to study the composite gear failure mechanism and resulting stress distribution along the contact surface. A theoretical model is thus developed applying the Hertz's contact theorem that describes the stress profile along the contact surface.

The dynamic performance of the spur gear is evaluated under variable loads and speeds. For this, a gear-testing rig setup with accessories is modified and developed. The subsequent studies correlate the effect of temperature on the gear materials and its performance. In dynamic condition, the gear pair runs at a number of speeds with different loading conditions and subsequently results have been extensively studied to understand its feasibility. In addition, the composite spur gear material is subjected to friction and wear test both in adhesive and abrasive wear modes and the wear characteristics of the materials have been studied. Further, weight loss of the spur gear tooth owing to wear is quantified through direct measurement under a specific load and running condition.

An in-depth analysis and understanding of vibration characteristics of the proposed material is essential before designing any product using this class of material for structural and automotive applications. For this, composite material is subjected to free and forced vibration tests using the laser assisted vibrometer (LAV) to evaluate and characterize the damping at low frequency. The time response and Fast Fourier transformation (FFT) analysis of the materials have been carried out and subsequently the damping and loss factor of the materials are obtained. The effects of crack with respect to its position and depth on the composite beam samples have also been studied experimentally.

In addition, metal skinned sandwich panel with cement filled composite as core material was fabricated and underwent experimentation to estimate its performance for structural applications. An in-depth forced vibration characteristic and mechanical properties such as bending and tensile properties of the sandwich panel with both galvanized iron (GI) and aluminum (Al) skins have been assessed. The thesis work results in design and development of a very low cost cement reinforced polymeric composite material. The proposed material is recyclable, durable and possesses excellent fatigue and corrosion resistant properties. A complex shaped, damage tolerant composite material spur gear has been designed and fabricated using the material for automotive industrial application. The primary benefit of using this low cost cement reinforced polymeric composite material gear is that a large weight saving can be obtained compared to metals. Further, on selecting large series of production of these gears, large cost saving seem also feasible. In addition, the work boasts the idea to use cement particles as a cheaper, very effective strengthening filler materials with polypropylene as matrix material to fabricate composites without significant chemical and physical modifications for specific application.

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