INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

In this dissertation, a viscoelastic particulate composite (VEPC) is proposed for the improved constrained layer damping (CLD) treatment of structural vibration/dynamic instability. This VEPC is comprised of micro-sized graphite particles that are dispersedly distributed within the Butyl rubber matrix. The effective material properties of this VEPC are estimated using a differential scheme and the elastic-viscoelastic correspondence principle. The corresponding results reveal increased effective storage modulus and decreased effective loss factor of a viscoelastic medium for the inclusion of graphite particles. With these material characteristics of the VEPC, its damping capability is investigated in the active/passive constrained layer damping (ACLD/PCLD) treatment of the structures such as beams and plates. Further, the study on the VEPC based ACLD treatment is carried out using either extensional or shear mode piezoelectric actuators. The analysis in each of the PCLD and ACLD cases is performed using finite element procedure. The results reveal that the inclusion of graphite particles not only causes an improved transfer of active action from the piezoelectric actuator layer to the substrate layer but also enhances the energy-dissipation capability of the constrained viscoelastic layer. Therefore, the passive, active and active-passive damping in the structures increase significantly for the inclusion of graphite particles within the viscoelastic damping layer. However, there is an optimal volume fraction of graphite particles in the VEPC damping layer for the maximum damping capability of the PCLD/ACLD treatment. Besides, a new strategy in passive control of parametric instability is introduced by the use of the constrained VEPC layer, where the instability region not only reduces but also shifts aside from the operating frequency range depending on the volume fraction of inclusion in the VEPC layer. Endmost, the performance of the present VEPC layer in the CLD/ACLD treatment is compared to that for an existing viscoelastic composite by the name of 0-3 viscoelastic composite. The overall study in this thesis presents a novel viscoelastic particulate composite layer for the improved CLD/ACLD treatment of structural vibration.