



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI

**SHORT ABSTRACT OF THESIS**

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Programme of Study: **Ph. D** Thesis submitted to Department/Center: **Chemical Engineering**

Title of Ph.D thesis: **Preparation and Characterization of Organomodified Co-Al and Ni-Al Layered Double Hydroxides (LDHs) Reinforced Polystyrene (PS) Nanocomposites**

Name of the Thesis Supervisor: **Prof. G. Pugazhenti**

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LDH reinforced PS nanocomposites were fabricated using solvent blending and melt blending methods. Co-Al LDH and Ni-Al LDH nanofillers were prepared using co-precipitation method. The obtained nanocomposites have been analyzed using x-ray diffraction (XRD), Fourier transmission infrared spectroscopy (FTIR), transmission electron microscopy (TEM), thermo gravimetric analysis (TGA), differential scanning calorimetry (DSC). Integral procedural decomposition temperature (IPDT) and Coats-Redfern method based activation energy analysis were carried out to evaluate the characterization parameters of said nanocomposites in comparison with pristine PS. Criado method was ultimately used to evaluate the decomposition reaction mechanism of the nanocomposites. Also, storage modulus, loss modulus and complex viscosity data were obtained by melt rheology analysis of the nanocomposites.

Among PS/Co-Al LDH and PS/Ni-Al LDH nanocomposites, 7 wt% nanofiller provided optimal performance with  $T_g$  value enhancement to 74.8 and 75 °C, respectively. Incidentally,  $T_g$  of pristine PS is 69.3 °C. The obtained IPDT and activation energy data (obtained from Coats-Redfern method) are in very good agreement with the inference drawn from TGA data that inferred enhanced thermal stability of the nanocomposites. Compared to the pristine PS values, the 1 wt.% Co-Al LDH nanocomposite prepared with melt intercalation method possessed maximum improvement in mechanical properties such as tensile strength (32%), flexural strength (21.2%) and impact strength (19%). The tensile strength enhancement for the nanocomposite is due to exfoliation of rigid LDH nanolayers in PS polymer and significant interfacial interactions between PS and LDH materials. The reduction in mechanical properties at higher loading is due to formation of agglomerates at higher loading of fillers. Apart from XRD, TEM and FTIR studies, power absorption gear tests (1.5 Nm torque, 800 rpm and 1 h conditions) have been carried out for the said materials. In comparison with pristine PS values, for 1 wt.% Co-Al LDH and 1 wt.% Ni-Al LDH nanocomposites, the transmission efficiency enhanced by 1.4 and 2.6%, respectively. Tooth surfaces of worn-out gears observed using digital and scanning electron microscope also conveyed better wear out durability of the PS nanocomposites. In summary, the Ph.D. thesis has been instrumental to provide additional knowledge in the chosen field of research. Thereby, it is expected that the results reported in this work could serve as benchmark for the enhanced application of PS/Co-Al LDH and PS/Ni-Al LDH nanocomposites.