ABSTRACT

Polyurethane represents an interesting class of polymeric materials composed by chain of repeating units joined together by urethane linkages. It has a wide spread of application and can be tailored as per the suitability of the application. In this thesis, specialty polyurethane based on isophorone diisocyanate, an aliphatic diisocyanate and its clay nanocomposite was prepared. The material was characterized by ^{1}HNMR, FT-IR, TGA, DSC, WAXS, UV-VIS analyses. UV-Vis analysis showed that the synthesized polyurethane has 96 % transparency towards the visible light. Nanoclay was incorporated into the polyurethane matrix by solution blending technique. Dispersion of nanoclay in the composite was studied by TEM analysis. The crystallinity of the synthesized polyurethane and its nanocomposite was evaluated by WAXS analysis. The prepared nanocomposite showed enhanced mechanical and thermal stability. The optimum mechanical and thermal property was achieved with 3 wt% of nanoclay loading. To further enhance the thermal stability, dihydroxy terminated poly dimethyl siloxane (PDMS) based polyurethane was synthesized. The PDMS based polyurethane was characterized by ^{1}HNMR and FT-IR analyses. TGA analysis confirmed the improvement in thermal stability. Organically modified layered double hydroxide (LDH) was incorporated in the PDMS based polyurethane matrix through solution blending technique. PU/LDH composite showed better thermal properties with an increase in residual char content.

Polyurethane based on polycaprolactone diol (PCL) was also synthesized. Octahydroxy butyl polyhedral oligomeric silsesquioxane (POSS) – Polyurethane (PU) composite material developed by both *in-situ* and *ex-situ* method. POSS-PU composite material prepared via *in-situ* method showed better properties than POSS/PU composite prepared via *ex-situ* method. Hydrophobicity of the composite increased with incorporation of POSS. AFM study showed that surface roughness was highest for the POSS/PU *ex-situ* composite and lowest for the pristine polyurethane.

Thermoplastic polyurethane (TPU)/fumed silica nanocomposite was prepared by melt mixing technique. Dispersion of the filler in the TPU matrix was studied by SEM and TEM analyses. Composite containing 2 wt% fumed silica showed agglomeration. With incorporation of the fumed silica physico-mechanical property improved. Composite containing 1 wt% of fumed silica exhibited highest tensile strength.

Keywords: *polyurethane, aliphatic diisocyanate, nanocomposite, nanoclay, POSS, fumed silica.*