ABSTRACT

Taguchi methodology has been used to optimize the processing parameters for the melt blending of thermoplastic polyurethane (TPU) and polydimethylsiloxane rubber (PDMS) to achieve better mechanical properties. Effect of processing parameters on the phase morphology has been thoroughly investigated using a novel image processing technique and its subsequent effect on the mechanical properties has been studied. TPU-PDMS rubber blends at various blend ratios were prepared by melt blending technique under the optimum processing conditions and characterization of the blends have been carried out. Compatibilization of TPU-PDMS rubber blends has been achieved by reactive blending with ethylene methyl acrylate (EMA), a polymeric chemical compatibilizer which undergoes chemical interaction with PDMS rubber and specific interaction with TPU. Optimization of the compatibilizer level has been carried out throughout the composition level. The effect of compatibilization on phase morphology, mechanical, dynamic-mechanical properties, thermal, adhesion and rheological properties have been studied. Nanohydroxyapatite and polypropylene glycol (PPG)-wrapped nanohydroxyapatite have been prepared by sol-gel techniques and the nanoparticles have been characterized by Fourier transform infrared spectroscopy (FTIR), Transmission electron microscopy (TEM) and X-ray diffraction technique (XRD). TPU-PDMS-nanohydroxyapatite nanocomposites have been prepared by melt mixing technique. The nanocomposites are characterized by universal testing machine (UTM), scanning electron microscopy (SEM), TEM, Dynamic mechanical analyzer (DMA) and Thermogravimetric analyzer (TGA). PPG-wrapped nanohydroxyapatite gave better dispersion of nanofillers and good tensile properties. The optimum level of PPG-wrapped nanohydroxyapatite in the TPU-PDMS rubber blend nanocomposites is found to be 3 phr and further addition of nanofiller leads to agglomeration of fillers and reduction in tensile properties. Long term stress relaxation and creep properties of blends and nanocomposites have been predicted from short term data by using time-temperature superposition principle and found that PPG-wrapped nanohydroxyapatite filled nanocomposites show lower reduction in the stress relaxation modulus and lower strain during stress relaxation and creep respectively with respect to the neat blends and the unmodified nanohydroxyapatite filled composites.

Keywords: thermoplastic polyurethane, polydimethylsiloxane rubber, compatibilization, nanohydroxyapatite, nanocomposites, phase morphology.