ABSTRACT

New thermoplastic elastomers (TPEs) comprising of poly (ethylene-*co*-methyl acrylate) (EMA) / poly(acrylonitrile-*co*-butadiene) rubber (NBR) have been prepared by melt blending procedure. Taguchi methodology with criteria based on the statistical design of experiment (DOE) was used to optimize the process conditions such as mixing temperature, mixing time and rotor speed for blends of EMA/NBR. It has been found that the optimal processing parameter for the preparation EMA/NBR (50:50) blends is 140°C, 80 rpm and 10 minutes. The influence of blend ratio over a composition range varying from 100:0 (Neat EMA) to 0:100 (Neat NBR) were studied on the structure property correlation of EMA/NBR blends. Rheological characteristics of various EMA/NBR blends have been evaluated to understand flow properties. Blends exhibited rheological behavior of non-Newtonian fluid. The rheology of EMA/NBR blends registered a good correlation in regard to the viscous vs. elastic response. The complex viscosity (η*) of the blends are found to be intermediate to those of individual blend constituents (EMA and NBR) and agree with that of the additive rule indicating partial miscibility and compatibility attributed to polar-polar interaction between the blend constituents. The rheological parameters have also been correlated with the developed morphology under different conditions. The compatibility has been further judged on the basis of physico-mechanical, morphology, oil swelling, dynamic mechanical and thermal properties of the blends throughout the composition range. Rubbery nature of the blend increased with increase in NBR content in the blend and blends having EMA 60 wt% and above showed thermoplastic elastomeric behavior (tension set < 40%). Optimum proportion has been found to be 60:40 EMA:NBR blends. SEM study clearly shows that blends exhibit smooth surface finish. In addition, organic-inorganic hybrid nano-composites, with the objective of achieving an improved balance between stiffness and toughness, based on EMA/NBR blend and MMT were prepared. The compression molded samples were utilized to evaluate the morphology and properties like physico-mechanical, thermal, electrical and processing characteristics. Morphological studies showed montmorillonite (MMT) was more properly dispersed in the polymer matrix and mostly located in the dispersed EMA phase. An appreciable improvement in the impact strength and tension set properties is observed for MMT nanocomposites. Addition of MMT increased the modulus moderately for all TPE nanocomposites. The thermogravimetric analysis revealed that thermal stability of the EMA/NBR blend nanocomposite was improved by addition of MMT. The mould flow analysis of EMA/NBR/MMT nanocomposite shows processing parameters such as weld line, air traps and so on that will affects the quality of the finished product. It can also effectively help to determine optimal process parameter settings and achieve competitive advantages of product quality and costs. These EMA/NBR blends can be used as potential thermoplastic elastomers (TPEs). They can supplant high cost rubbers in engineering applications involving both oil and weather resistance particularly under low temperature conditions.

Keywords: *poly(ethylene-co-methyl acrylate polymer, poly(acrylonitrile-co-butadiene) rubber, organoclay, nanocomposites, morphology, rheology and physico-mechanical properties*