ABSTRACT

Taguchi methodology has been used to optimize the process conditions for blends of linear low-density polyethylene (LLDPE) and poly dimethyl siloxane (PDMS) rubber. The optimum processing conditions are found to be a temperature of 200°C, rotor speed of 100 rpm and time of 8 minutes. The effect of electron beam irradiation on the blends over a composition range varying from 70:30 to 30:70 were studied on exposure to radiation doses from 50 to 300 kGy. Percent gel in neat LLDPE, PDMS and their blends increase with increase in the dose of electron beam radiation due to co-crosslinking within the blend matrix. Dynamic properties, thermal stability and dielectric properties of the neat LLDPE, neat PDMS as well as their blends have been evaluated before and after exposure to electron beam irradiation at 100 kGy. The complex viscosity (η*) of the blends are found to be intermediate to those of individual blend constituents (LLDPE & PDMS) but fall below that of the additive rule indicating immiscibility. On electron beam radiation, the η* decreases upto 30 wt% of LLDPE, beyond which it increases above that of additive rule due to synergistic effect attributed to formation of intermolecular, intramolecular and interfacial crosslink between the blend constituents. The blends are compatibilized by using EMA copolymer as the polymeric reactive compatibilizer. The compatibilizer level for each blend ratio has been optimized. The compatibility has been judged on the basis of physicomechanical, dynamic mechanical, thermal properties and morphology of the blends throughout the composition range. Optimum proportion of the compatibilizer has been found to be 10 wt% for 70:30, 12 wt% for 50:50 and 14 wt% of EMA copolymer for 30:70 blends. Percent gel of compatibilized LLDPE/PDMS rubber blends increase with increase in radiation dose upto 100 kGy. The structure property relationships of the blends have been evaluated before and after compatibilization and before as well as after irradiation for the entire composition range. The *E'* increases in case of compatibilized irradiated blends at 100 kGy as compared to irradiated but uncompatibilized blend. Thermal stability of compatibilized and irradiated blend increases by 4% as compared to irradiated and uncompatibilized blend. Microscopic study using SEM shows a clear phase separation and two phase matrix-domain morphology for the unirradiated binary blend. However, upon electron beam irradiation, the blend morphology changes towards a single phase because of co-crosslinking between the phases. Maximum percent gel has been observed at 1.5 wt% of DCP in the matrix when chemically crosslinked. Thermal stability of compatibilized and irradiated blend increases up to 7% as compared to that of compatibilized and chemically crosslinked blend. SEM study clearly shows that compatibilized and irradiated blends exhibit smooth surface finish as compared to that observed for compatibilized and chemical crosslinked blends. Dielectric properties of compatibilized and irradiated blends have been found to be better compared to those with compatibilized and chemically crosslinked blend.

Keywords: linear low density polyethylene, polydimethyl siloxane rubber, electron beam irradiation, dielectric properties, phase morphology and miscibility