ANTISTATIC AND FLAME RETARDANT ROTOMOULDABLE POLYMER GRAPHITE NANOCOMPOSITES

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ABSTRACT

The overall objective of this study is to develop cost-effective flame retarded and antistatic polyethylene compounds with good thermal conductivity suitable for rotational moulding (rotomoulding). The end use is found in underground mining applications such as fuel tanks and ventilation ducts. Previous studies[1] showed that at natural flake graphite loadings of 10 wt. % in polyethylene, antistaticity and significantly improved ignition times[2] are obtained. However a drastic deterioration in mechanical properties is observed, particularly the impact strength. In this contribution, liquid phase exfoliation has been successfully utilised to obtain graphite nanoplatelets. Various rotomoulding techniques viz. dry blending, melt compounding and multilayer moulding were used in an attempt to obtain antistatic nanocomposites at the lowest loading which still retains useful mechanical properties, particularly the impact strength. Five commercial compatiblizers were also used in these nanocomposites. By using dry blending, the nanocomposites were antistatic at 0.25 wt.% and fully conductive at 1 wt.%. Melt compounded nanocomposites are not conductive up to 2 wt. %. The impact strength of dry blended nanocomposites deteriorates by more than 90% at 0.25 wt.% nanographite content. The impact strength of melt compounded nanocomposites drops by less than 30% up to 0.50 wt.% nanographite content, thereafter it deteriorates drastically. However, multilayer moulding appears to be a possible compromise. At 0.25 wt.%, the deterioration in impact strength in double layer moulded nanocomposites is about 50%, whilst the conductivity is retained. The impact strength of the double layer moulded nanocomposites plateaus at about 33% of the neat polyethylene, with subsequent increasing graphite nanocomposites. Initial results indicate that the use of ethylene vinyl acetate (EVA) as an outer layer which contains the nanographite in multilayer moulding might yield nanocomposites with superior impact strength. The effect of the compatiblizers and flammability is yet to be evaluated.

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