Enhanced Properties of Thermoplastic Halogen Free Flame Retardant Compounds via On-Line Low Energy Electron Beam Irradiation

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Abstract

Halogen-free flame retardant (HFFR) compounds are commonly found as layers on cables to provide mechanical protection in combination with enhanced resistance to burning and smoke generation as required for specific applications. However, there are some applications that call for further improvement in the resistance of those cables to other physical, environmental or chemical stresses. Whereas one might be able to crosslink certain materials for property enhancement using either peroxide initiated or moisture cure methods, those techniques are challenging when in the presence of typical mineral-based HFFR fillers, and there is often an interest to retain flexibility in the cables found with the use of fully thermoplastic systems. As a result, we have explored the use of controlled levels of irradiation during the processing of these flame retardant compounds using electron beam techniques.

Electron beam (e-beam) systems are generally classified as high, medium or low voltage. High energy accelerators achieve million electron volt (MeV) levels in the range from 2.0 MeV to 10 MeV, and medium energy accelerators achieve MeV levels in the range from 0.300 MeV to 2.0 MeV. Low energy accelerators achieve MeV levels only as high as 0.3 MeV, and consequently, require significantly less shielding, and therefore, are significantly lower in both variable and capital costs. Results confirmed that low energy e-beam technology will increase melt strength, zero shear viscosity, and other properties of thermoplastics materials, such as HFFR thermoplastic products. Continuing, on-line low energy e-beam technology is cost competitive with peroxide, silane, azide and/or other crosslinking technologies.

The results of our designed experiments to quantify the effects of e- beam generated structure modifications, as quantified with certain small-scale rheological measurement, are presented.