Potential of irradiated high density polyethylene/ethylene propylene rubber-carbon nanotube nanocomposite as shoe sole

ABSTRACT

The material selection for shoe soles is important as it determines the long-term performance of sports shoes, especially the performances of athletes' shoes with respect to comfort during walking, running and jumping. An effective approach is developed to establish a strong interface between the carbon nanotube and high-density polyethylene/ethylene propylene rubber matrix by introducing electron beam radiation to the nanocomposite as a crosslinking technique. This study focuses on the carbon nanotube variation in the polymer matrix of high-density polyethylene and ethylene propylene rubber. The mechanical properties of high-density polyethylene/ethylene propylene rubber–carbon nanotube nanocomposites with different carbon nanotube contents were investigated at 0.5, 1, 3 and 5 wt% of carbon nanotube content. The combinations of nanofillers and polymer matrix stimulate the performance of sports shoes soles since each of them exhibits superior properties. The aim of this article is to find the optimum carbon nanotube content over the mechanical properties of electron beam–irradiated high-density polyethylene/ethylene propylene rubber nanocomposite for shoe soles. These irradiated nanocomposites are melt blended before compression moulding of the specimens. The specimens were then irradiated under electron beams at 100 kGy. The irradiated nanocomposites were tested for their tensile, impact, hardness and wear properties. The morphology of the tensile failure fracture was analysed under a field emission scanning electron microscope. The addition of carbon nanotubes improved the mechanical properties of the samples for both unirradiated and irradiated nanocomposites; however, they dropped after 3 wt% of carbon nanotube content. The carbon nanotube content at 3 wt% was found to be the most effective in enhancing the mechanical properties, particularly wear in irradiated nanocomposite, due to the better crosslinking and carbon nanotube dispersion.

Keyword: High density; Polyethylene; Ethylene; Rubber-carbon; Nanotube; Nanocomposite; Shoe sole