The Effect of Bis-(3-triethoxysilylpropyl)-Tetrasulfane and Polyethylene Glycol on the Properties of Natural Rubber/ Mica Composites

E.D.S. Edirisinghe[1], Y.R. Somarathna[2*], N.S. Withanage[1], H.M.H. Dhanukamalee[2], I.H.K. Samarasinghe[2] and S. Siriwardena[2]

[1]Department of Export Agriculture, Uva Wellassa University of Sri Lanka, Badulla
[2]Polymer Chemistry Department, Rubber Research Institute of Sri Lanka, Rathmalana
**Corresponding Author E-mail: yasho32291@gmail.com, TP: +94778883556*

The bis-(3-triethoxysilylpropyl)-tetrasulfane (Si69) is widely applied as a coupling agent to rubber-filler interactions in silica filled rubber composites. In this study, the effect of bis-(3-triethoxysilylpropyl)-tetrasulfane (Si69) and polyethylene glycol (PEG) on the properties of natural rubber (NR)/mica composites has been studied. The mica loading and the total weigh of Si69/PEG were kept constant at 30 phr and 2 phr, respectively. A composite free from Si69/PEG (SP00) was used as the control, while ratios of the above chemicals (Si69: PEG) were varied as 1:0, 0:1 and 1:1 in the other composites. These three systems were denoted SP10, SP01 and SP11, respectively. Curing characteristics, physico-mechanical properties and thermal degradation of NR/mica composites were investigated. The maximum cure time (T_{c90}) and scorch time (T_{S2}) were exhibited in the SP10 compound. However, introduction of PEG into the system with Si69 in SP11 composite yield a reduction in T_{c90} and T_{S2}, which were comparable with the control (SP00). Maximum tensile strength and elongation at break were observed in Si69 treated NR/mica composite (SP10). This could be attributed to the improved rubber-filler interactions caused by incorporation of higher amounts of Si69 (2 phr). Further, the composite treated with both Si69 and PEG (SP11) with 1 phr each, has shown the second highest tensile strength among candidate composites. However, the enhanced moduli values at 100%, 300% and 500% elongation indicated better rubber-filler interactions in SP11 composite than SP10. The same reason may have resulted the highest hardness and resilience values in SP11 composite. The thermogravimetric analysis indicated that the application of Si69 and/or PEG have no significant impact on the thermal degradability of NR/mica composites. It was also found that SP01 exhibited the highest swelling ratio among all samples. Therefore, overall results indicated that PEG/Si69 treated system (SP11) could be employed more effectively than individual use of Si69 and PEG to optimize the cure characteristics, while improving the physico-mechancial properties of NR/mica composites.

Keywords: Mica; Natural rubber composites; Polyethylene glycol; Coupling agent; Rubber-filler interactions