

Ceramic Waste-Based Natural Rubber Composites: An Exciting Way for Improving Mechanical Properties

Y.G. Kondrage¹, H.M.J.C. Pitawala¹, K. Thangavel¹, D. Edirisinghe², T.N.B. Etampawala^{3*}

¹*Department of Science and Technology, Faculty of Science and Technology, Uva Wellassa University, Sri Lanka*

²*Department of Rubber Technology and Development, Rubber Research Institute, Sri Lanka*

³*Instrument Center, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka*

Large amounts of fired ceramic waste produced in ceramic industry do not have a proper method to reuse and dumped into landfills. These solid wastes have a major environmental and economic concern. Thus, a proper management of such solid wastes is eminent. Since fired ceramics have already been sintered, their utilization as a raw material is limited. This research is dedicated to evaluating the possibility of using such ceramic waste as a low-cost filler material in the manufacture of natural rubber based composites. Ceramic particles smaller than 125 μm were selected for the preparation of our initial composites. For the latter part of the study, particles in sub-micrometer length scales were used. Elemental analysis and composition of the phases of the ceramic particles were determined by x-ray fluorescence and diffraction, respectively. The average particle size was characterized by scanning electron microscope (SEM) and digital particle size analyzer. The surfaces of the sub micrometer size ceramic particles were modified using *Silane69* coupling agent and Oleic acid. The surface modification was confirmed by fourier-transform infrared spectroscopy, thermogravimetric analysis and SEM coupled with energy-dispersive x-ray spectroscopy. Natural rubber based composites were prepared with different levels of ceramic filler loadings. The mechanical properties of the composites such as hardness, resilience, compression set, abrasion volume loss and tensile properties were evaluated. These properties of the composites were compared with those of the composites prepared according to the same formulation except the ceramic filler (pristine rubber sample). The composites were found to have an exciting enhancement of mechanical properties with respect to the pristine rubber sample. The mechanical property improvement is higher when the ball milled sub-micrometer size ceramic filler is used and it is even better when surface modified ceramic particles are used.

Keywords: Waste ceramic, Surface modification, Rubber composite