Effect of Nano-CaCO3 on Aging and Flame Retarding Properties of Natural Rubber

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Natural rubber nano-composite was prepared by reinforcing natural rubber with nano-CaCO3. A nanosize CaCO3 filler was synthesized by in situ deposition technique. Natural rubber (NR) was filled with 2-30 wt% nano-CaCO3 and compounded on a two roll mill. The rubber compounds were then molded with a compression molding machine. The effect of loading nano-CaCO3 in NR on mechanical properties, swelling index, flame retardancy, aging properties, and thermal stability were investigated and compared to composites filled with commercial CaCO3. Introduction of nanosize CaCO3 into NR yielded dramatic improvements in the mechanical properties. The tensile strength increased with nano-CaCO3 content and it was found that the highest tensile strength (22.8 MPa) was achieved at 20 wt% loading as compared to 12.5 MPa achieved at similar loadings of commercial CaCO3 in NR. The elongation at break also increased up to 904% when nano-CaCO3 was added at only 5wt%. It is interesting to note that even after aging the rubber compounding at 100oC for 22 hrs, the mechanical properties of NR- nano-CaCO3 were still superior to those filled with commercial CaCO3. The tensile strength and elongation at break of NR reinforced with 20wt% nano-CaCO3 were 8.2 MPa and 716 %, respectively while NR filled with commercial CaCO3 achieved only 2.0 MPa and 194%, respectively. The reduction in size of CaCO3 could have contributed towards maintaining a uniform filler dispersion in the rubber matrix, which lead to the improvement of mechanical properties. From TGA and flame redundancy results, it was also observed that larger CaCO3 size reduces the thermal stability of the composites as compared to pristine NR.