TITLE PROPERTIES OF NATURAL RUBBER FILLED WITH KEVLAR FIBER AND CARBON BLACK OR SILICA
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ABSTRACT In this research, the effects of Kevlar content, and ratios of Kevlar/CB and Kevlar/silica on the mechanical and thermal properties of NR vulcanizates were studied. The Kevlar used was in the form of Kevlar/NR masterbatch. The amounts of Kevlar were varied from 0 to 16 parts per hundred parts of rubber (phr), while the total loading of the mixed fillers was kept constant at 30 phr. The tensile and tear specimens were cut from the vulcanized sheets such that the effect of milling directions, machine direction (MD) and transverse direction (TD), on these properties could be studied. Then, the effect of the amount of bonding agents, Cohedur RS and Cohedur A, on the swelling resistance, mechanical and thermal properties of the vulcanizates having 4 phr of Kevlar was also investigated. The results revealed that hardness, 100% modulus, abrasion resistance, heat build-up and dynamic compression set of the vulcanizates filled with Kevlar (NK), Kevlar/CB (CK), Kevlar/silica (SK) and, Kevlar/silica with Si-69 (SK_Si69) increase with increasing Kevlar content while elongation at break decreases. Moreover, tensile strength of the vulcanizates decreases with increasing Kevlar content up to 8 phr for NK and 10 phr for others, and then it tends to increase with further increasing Kevlar content. It is also found that tear strength of NK vulcanizates increases when Kevlar content is increased, while that of CK, SK and SK_Si69 decreases. These results indicate that Kevlar can obstruct the tear path when there is no CB or silica. Additionally, 100% modulus of all vulcanizates in MD is obviously higher than those in TD when Kevlar is added. This is because most of the fibers in the samples punched in MD align parallel to the applied force corresponding with the SEM results. Thus, MD samples are more difficult to deform than the TD samples. When the bonding agents are incorporated, the swelling resistance, hardness, abrasion resistance, heat build-up and dynamic compression set of the vulcanizates slightly increase while their elongation at break decreases. The optimum amount of Cohedur RS/Cohedur A for achieving the highest tensile and tear strength are 0.2/0.06 and 0.1/0.03 phr, respectively. However, thermal stability of the vulcanizates is not improved with increasing either the amount of Kevlar or bonding agents.