DETERMINATION OF OPTIMUM ANTIOXIDANT RATIO FOR EFFECTIVE RESISTANCE ON AGING OF NATURAL RUBBER BASED SOLID TIRE TREAD COMPOUND

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ABSTRACT

Tread of a solid tyre is degraded in static and dynamic conditions as it is exposed to the external environment. Oxygen is the principal external environment factor, which causes adverse influence on the durability of polymer products. Antioxidants are highly effective ingredients and have a dramatic impact on the service life of the rubber product although being present at extremely low concentrations. The purpose of this research was to find out the optimum antioxidant ratio for effective resistance on thermo-oxidative aging of natural rubber based solid tire tread compound. Five tread compounds were prepared by varying the n-(1,3-dimethylbutyl)-n'-phenyl-p-phenylenediamine (6ppd) and 2,2,4-Trimethyl-1,2-dihydroquinoline (TMQ) antioxidant (AO) ratios (AO_1-AO free, AO_2 - 2:1, AO_3 - 1.5:1.5, AO_4-1:2, AO_5-2:2). AO_5 was designed to test the effect of over dosage of antioxidants. Physio-mechanical properties such as tensile properties, tear strength, hardness, and abrasion resistance of five compounds were investigated before and after thermo-oxidative aging at temperature 70 °C for 72 and 168 hours according to the ASTM standards. Density and rebound resilience of five compounds were also investigated. According to the results obtained, percentage change in hardness, tensile strength, elongation at break and modulus at 300% of AO_3, AO_2, AO_3, AO_4 and AO_5 were (1%, 16.22%, 25.26%, 100%), (3%, 5.54%, 13.74%, -16.32%), (2%, -1.40%, 5.59%, -12.17%), (3%, 1.94%, 12.64%, -21.55%) and (3%, 7.72%, 10.18%, -20.00%) respectively. Hardness, modulus at 300% and abrasion resistance increases as the heat-aging time increases. The rate of decrease of tensile strength and elongation at break was higher after aging. Density of all five compounds were same. In conclusion as the percentage changing was minimum in AO_3 and it is the best among five ratios under 168 hours aging condition.

Keywords: Antioxidant, Hardness, Natural Rubber, Tensile properties, Thermal-Aging