COMPARISON OF ELECTRICAL CONDUCTIVITY, RHEOLOGICAL AND DISPERSION PROPERTIES CARBON BLACK - SG, BDR NR COMPOSITES

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ABSTRACT:

Background: Carbon black – silicon (SG), butadiene (BDR) and natural rubber (NR) nanocomposites are under consideration for medical applications involving tremor mitigation as well as general therapeutic applications involving muscle relaxation therapy.

Methods: Carbon black (CB) filled silicon, butadiene and natural rubber composites containing 40 – 100 phr (per hundred) carbon black were investigated for their electrical conductivity under different loads over time. Rheological experiments involving evaluations of the storage moduli, G′ for the composites were also performed to infer rate and strain dependence of the composites' conductivity under compressive loads.

Dispersion of CB in the CB-SG, CB-BDR and CB-NR composites were investigated with Reflected Light Microscope (DISPERS GRADER). Images of cross section of composite samples were recorded and degrees of dispersion of CB into SG, BDR and NR were measured.

Results: Due to the high deformability of silicon, butadiene and natural rubber, the percolation thresholds for carbon black–silicon,butadiene and natural composites were shown to be a function of compressive loads applied on them. Conductivity of such composites increased with time and compressive load levels applied. The rheological experiments revealed that strain level and frequency can also indirectly affect the resistivity/conductivity levels in carbon black-filled silicon, butadiene and natural rubber composites,with the storage modulus increasing monotonically with increasing frequency (rate), and the stiffness of the carbon black /silicon rubber composite decreasing with increasing strain levels. Thus, it becomes easier to compact the nanocomposite further at higher strain levels and we would expect the rate of decay in resistivity to be lower at higher rates of pressure application. According to data, degrees of dispersion of CB in the CB-SG and CB-NR composites increased with amount of CB uniformly up to 80 PHR.

Conclusion: Our experimental results reveal that the two important service parameters, strain level and loading rate can be used for controlling the resistivity/conductivity levels in carbon black-filled silicon rubber, butadiene rubber and natural rubber composites. It was understood that electrical conductivity and disperison degree of composites changed with the type of rubbers.