Carbon Fiber Networked Nano Carbon Black as a Novel Conductive Filler to Enhance the Thermal Conductivity of Natural Rubber Composites

J.M.A.R.B. Jayasinghe[1,2], R. T. De Silva[2*], K.M.N. de Silva[1,2], W.R.M De Silva', M.M.M.G.P.G. Mantilaka[2]

'Department of Chenlisny, University of Colombo, Colombo 3, Sri Lanka
[2]Sri Lanka Institute of Nanotechnology (SLINTEC), Nanotechnology and Science Park, Pitipana, Homagama, Sri Lanka

Thermal conductivity of natural rubber (NR) was enhanced by incorporating a novel conductive hybrid nano filler, namely carbon fiber (CF) networked spherical carbon black (CB) nanoparticles. The CF/CB hybrid fillers were artificially generated *in-situ* in the rubber matrix by means of melt mixing, where the carbon black nanoparticles initially dispersed in natural rubber matrix with aid of rubber processing oil (polycyclic aromatic oil (PCA)) and hereafter, it was added CF to interconnect the CB domains. The preparation of master batch and final batch were done through the melt mixing in internal mixture where CF/CB total filler loading was kept at 40 parts per hundred of rubber (phr). Thermal conductivity of prepared composites were measured using lees disc method and the value of CF/CB rubber composite was 0.45 $Wm^{-1}K^{-1}$ and it was significantly improved compared to the control (0.25 $Wm^{-1}K^{-1}$). The neat carbon black (CB) composite was also prepared (at 40 phr) for comparison purposes and the thermal conductivity value deemed to be 0.35 $Win^{-1}K^{-1}$. The higher conductivity of CF/CB composite suggests that the presence of CF network within CB nanoparticles has significantly contributed to enhance the thermal conductivity compared to that of the neat CB rubber composite. Thermal stability of the prepared CF/CB composites were enhanced significantly compared to control and the neat CB composite. Scanning electron micro photo graphs confirmed the generated network of CF onto the spherical CB nanoparticles and interconnected morphology of CF/CB hybrid fillers. The enhanced thermal conductivity of the compounds can be related to produce industrial applications such as tyres.

Keywords: Natural rubber nanocomposites, Thermal conductivity, Carbon fibers, Carbon black