Carbon Soot Derived from Wasted Rubber: An Additive in Lubricating Oil for Efficient Friction and Wear Reduction

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Abstract

Ball bearings have been used widely to reduce friction and support easy sliding of surfaces. In our study to replicate the ball bearing mechanism at nanoscale 50-100 nm-sized carbon soot particles with sphere-like morphology are prepared by regulated decomposition and subsequent heat-treatment of wasted rubber-tyre tubes. The waste tubes pose threat to the environment as non-biodegradable landfill waste (polluting soil and water bodies). The crystallinity studies made using x-ray diffraction exhibited that the soot particles had a mixture of crystalline and amorphous characteristics. Disordered graphitic layers in heliocentric arrangement were seen under TEM. The soot particles are dispersed in an additive-free base oil (BO), and the soot-based lubricant along with BO were studied using a rotational rheometer and a 4-ball tester for rheological and tribological properties respectively. The soot particles when dispersed reduced the internal shear stress under applied shear rate in the BO eventually lowering the viscosity but also improved the viscosity retention at higher temperatures. The soot-based lubricant outperformed the base oil frictional properties showing a better CoF reduction by 16.67% at room temperature and by 32.14% at 70 ℃. Wear resistance was also improved with a wear scar diameter (WSD) reduction by 56% as compared to BO at room temperature and by 7% at 70 ℃. The developed soot particles when used in optimized concentrations in lubricating media can serve as multifunctional additive filler material and enhance the tribological characteristics of lubricating oils

Keywords: Carbon soot, friction, wear, lubrication, viscosity

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