Abstract

The research objective of this work is to reuse graphite rods recovered from used batteries and utilize them as an additive in SAE20W40 oil to improve the engine parts' lubrication ability and wear resistance. The graphite rods are grated to obtain ultra-fine particles and then chemically exfoliated using an Improved Hummer's process that results in graphene oxide. Then, it is thermally reduced at 350 °C to yield reduced graphene oxide. Different ratios (0.25, 0.50, 0.75, and 1.00 wt.%) of as-grated graphite particles and reduced graphene oxide were dispersed in the above oil to form a colloidal solution and then used for tribological studies. The graphite particles and synthesized reduced graphene oxide were characterized using X-ray diffraction, Raman spectroscopy, and high-resolution transmission electron microscopy. X-ray diffraction data confirms the presence of graphite, graphene oxide, and reduced graphene oxide in the prepared powders and matches with the standard files. High-resolution transmission electron microscopy images reveal the presence of multilayer sheets with an interplanar distance of 0.34 nm having wrinkles, folds, and gas holes. The G and D band positions of Raman spectra prove the formation of oxygenated functional groups, and the I_D/I_G ratio confirms the defects in graphene oxide and reduced graphene oxide. The viscosity of prepared lubricant increases by 35% and 21% for graphite and reduced graphene oxide, respectively. The results of tribological studies with 0.25 wt.% graphite and 0.5 wt.% reduced graphene oxide lubricants showed improvement in coefficient of friction by 32% and 36%, respectively. At these optimal concentrations, the specific wear rate dropped by 51% for reduced graphene oxide. Scanning electron microscopy/energy dispersive spectroscopy, images show that the nanolubricant's mending effect over the worn surface improves reduced graphene oxide added SAE20W40 oil tribological characteristics. From the results, reduced graphene oxide synthesized from as-