An experimental study on characterization and properties of eco-friendly nanolubricant containing polyaniline (PANI) nanotubes blended in RBD palm olein oil

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Abstract:
Polyaniline nanotubes (PANI NTs) blended in refned, bleached and deodorized palm olein (RBDL) nanolubricants were prepared via a two-step method. Initially, the synthesized PANI NTs were characterized to investigate the morphology and elemental composition of the obtained PANI NTs. The obtained image from transmission electron microscopy clearly showed the presence of fake-like structure of PANI NTs. The presence of these PANI NTs was further afrmed with energy dispersive X-ray analysis, which shows the presence of high carbon atoms (the main element for PANI NTs). The formulated surfactant-free nanolubricants were stabilized using ultrasonication with volume concentrations of 0.01, 0.03, 0.05, 0.1, 0.3 and 0.5%. The dispersion behavior of nanolubricants was investigated using visual sedimentation capturing, UV–Vis spectrophotometer and dynamic light scattering (DLS) method. The sedimentation observation of the nanolubricants over the duration of almost 1 month showed there was no sedimentation of the nanoparticles. UV–Vis spectra indicated that all the prepared PANI/RBDL nanolubricants followed Beer–Lambert law. The value of absorbance was found to be slightly decreased, with respect to the duration of time after sample preparation. The dispersion stability analysis supported by DLS method revealed that the amount of particles agglomeration increased after 1 month of preparation. The chemico-physical properties of prepared PANI/RBDL nanolubricants were further investigated by analyzing the chemical bonding using Fou rier-transform infrared spectroscopy (FTIR). Additionally, this study intends to investigate the infuence of PANI NTs toward the life cycle of base oil via thermogravimetric (TG) analysis. FTIR analysis showed that nanolubricants were chemically stable as there were only physical interactions between PANI additives and RBDL base oil, while the degradation behavior in TG curve demonstrated that the nanolubricants could withstand higher temperature as the volume concentration of nano additives increased. Rheology and thermal conductivity properties of PANI/RBDL nanolubricants were performed by using rheometer and thermal properties analyzer, respectively. Viscosity measurement revealed that PANI/RBDL nanolubricants exhibited Newtonian behavior. Also, viscosity was found to have been increased with a volume concentration of PANI NTs but decreases with the increase in temperature. From the thermal conductivity measurement, it is proven that the PANI NTs dispersed in the RBDL palm base oil support the thermal properties enhancement. The 0.5% PANI/RBDL nanolubricants

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