ENHANCING OF CUO NANOLUBRICANT PERFORMANCE USING ORGANIC DISPERSANTS

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ABSTRACT
In this paper will be exposed to the influences of the use of organic dispersants agents to avoid agglomeration of tiny CuO nanoparticles in the synthetic oil, developing nanolubricants with good stability at low concentration of oxides. The stability of the suspensions, state dispersive of the nanoparticles, morphology and size distribution will be reported. The tiny nanoparticles (2.5, 4.4 and 8.6 nm) were added to PAO oil with the aid of three organic dispersants in PAO oil at a low concentration of 0.1wt%. The tribological performance of nanolubricant was evaluated under boundary lubrication conditions. The dispersion results showed more uniform size distribution of the NNP dispersed in lubricant oil when toluene was used as the dispersant. Furthermore, this dispersant provided a substantial decrease of the friction and lower losses by wear. A good dispersion provides friction coefficient and wear reductions.

INTRODUCTION
The main challenge in using nanoparticles in lubricants is related to their dispersion in liquids because the metal nanoparticles easily agglomerate due to their high surface tension. This agglomeration results in many problems, such as clogging and contact starvation [1]. This problem can be solved by surface modification technique or using organic dispersants. In the first technique, it is common the use of a coating with high molecular weight hydrocarbons, like oleic acid. Also, toluene, ethylene glycol, and hexane have been used as organic dispersant [2-3]. The tiny nanoparticles are more susceptible to increase antiwear property and reduce friction [3]. Therefore, nanoparticles agglomeration can act negatively in lubrication [4]. This study aims to evaluate the nanolubricant with tiny CuO NNP of three sizes and its performance improvement using organic dispersants.

METHODOLOGY
CuO nanoparticles were prepared by an alcothermal method using copper nitrate, sodium hydroxide, and ethanol as starting materials in microwave reactor. Three sizes of nanoparticles were produced (2.5, 4.4 and 8.6 nm). They were characterized by DRX and MET. After that, the nanoparticles were covered with oleic acid for surface modification and added to PAO with the aid of three dispersant agents (Toluene, Hexane and Ethylene Glycol) at 0.1wt % of concentration. The nanolubricant stability was measured by visual analysis and characterization by UV-visible, zeta potential analysis, and small angle X-ray scattering- SAX). Tribological tests were performed in tribometer HFRR using a highly stressed ball against a disc. The ball slides against the disc fully submerged in 2 mL of lubricant under a 1 mm stroke length at a frequency of 20 Hz at a normal load of 10 N m/s for 60 min. The wear was analyzed by scanning electron microscopy (SEM). After, the suspensions were collected and analyzed chemical, morphology and stability changes.

RESULTS AND DISCUSSION
Considering good stability and tribological performance (Friction coefficient reduction) the best results were found to Toluene, followed by Hexane and Ethylene Glycol. Also, an important observation was that no changes in nanoparticle geometry and the stability were verified after the tribological test when Toluene was used as dispersant agent by UV visible analysis.

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