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Evaluation of Dispersion Stability of Al_2O_3 Nanoparticles in *Jatropha curcas* Oil

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Nowadays the lubricants functions are reducing wear, controlling friction and satisfying environmental standards. The use of bio lubricants is an alternative, due to their technical advantages over typical petroleum-based ones, such as: high lubricity, high VI, high flash point and low evaporative losses [1], so characteristics like being renewable and their biodegradability nature have made them important alternatives in different applications. However, vegetable oils have some disadvantages: low oxidation stability, low-temperatures limitations, among others [1]. In recent years, nanoparticles have started to play more important roles as lubricant additives for their potential in emission reduction and improving fuel economy [2], their characteristics size, normally less than 100 nm, allow them to enter the contact region, nanoparticles are considered thermal stable at elevated temperatures that makes them favorable as lubricant additive [2,3]. There are physical characteristics of nanoparticles that could affect the interaction with the lubricant and the contact surface as particle size and morphology [2-4]. The role of dispersion stability is very important, the nanoparticles in suspension may stick together and form agglomerates, which by gravity effect they tend to settle, if there is no good dispersion stability of nanoparticles, there will be a poor wear protection and friction reduction ability [3,5].

In the present work Al_2O_3 nanoparticles were mixed in *Jatropha curcas* vegetable oil (JC), three different amounts of nanoparticles were mixed: 1.0 wt%, 0.5 wt% and 0.25 wt%. The JC oil without nanoparticles was used as a reference. The nanoparticles were dispersed by ultrasonication for 30 minutes, these were characterized by SEM in a JEOL JSM-7800F microscope and the stability dispersion of nanoparticles were evaluated in a Cary 5000 UV-Vis-NIR Spectrophotometer.

Figure 1 shows the morphology of Al_2O_3 nanoparticles, a) agglomerated material with different sizes and forms, b) a close up where it was possible to observe nanostructures, and c) indicated with a white arrow, the spherical morphology of the particles, their size is 40-80 nm approximately. The curvettes with nanolubricants samples are shown in Figure 2 a), where is observed the oil with the different concentration of Al_2O_3 nanoparticles, the photo shows the sedimentation after fifty days from preparing. The image shows that a great deal of nanoparticles precipitated onto the curvettes, indicated with a white arrow. In the curvette with 1.0 wt% of nanoparticles, it is noted a cloudier appearance. The Figure 2 b), shows the dispersibility of Al_2O_3 particles evaluated by the optical absorbance spectrum versus time.

The results show that the agglomerated phenomenon is present in the nanolubricants, the one mixed with 1.0 wt% of nanoparticles shows better dispersion than 0.25 wt% and 0.5 wt% mixtures [6].

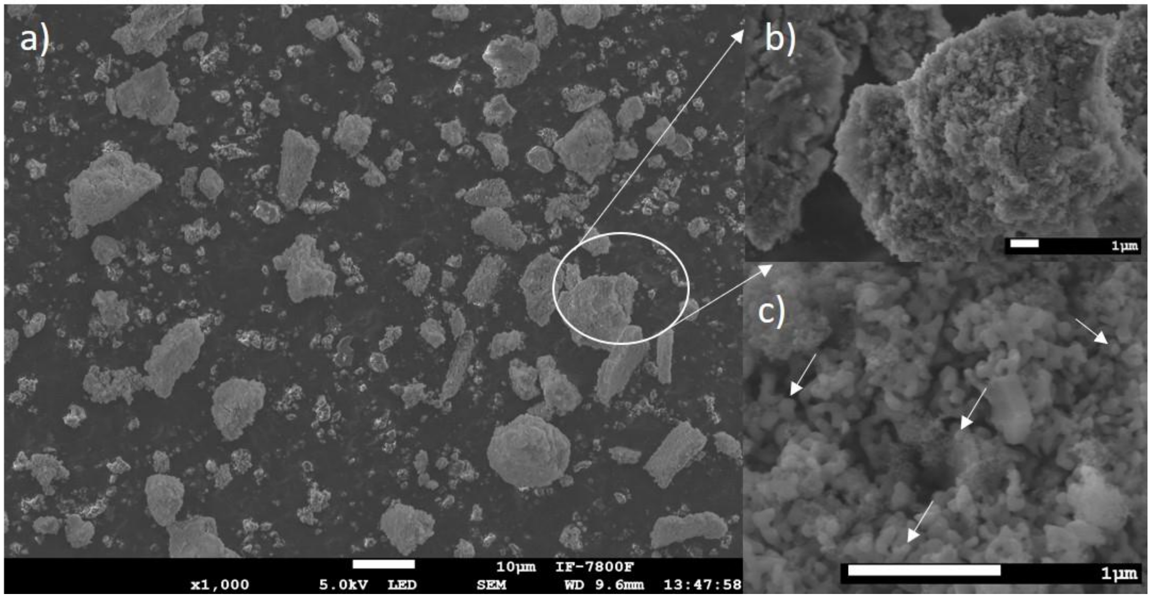

Figure 1. SEM image sequence of Al2O3 nanoparticles. a) Agglomerated material, b) Close up of agglomerate, and c) spherical nanoparticles.

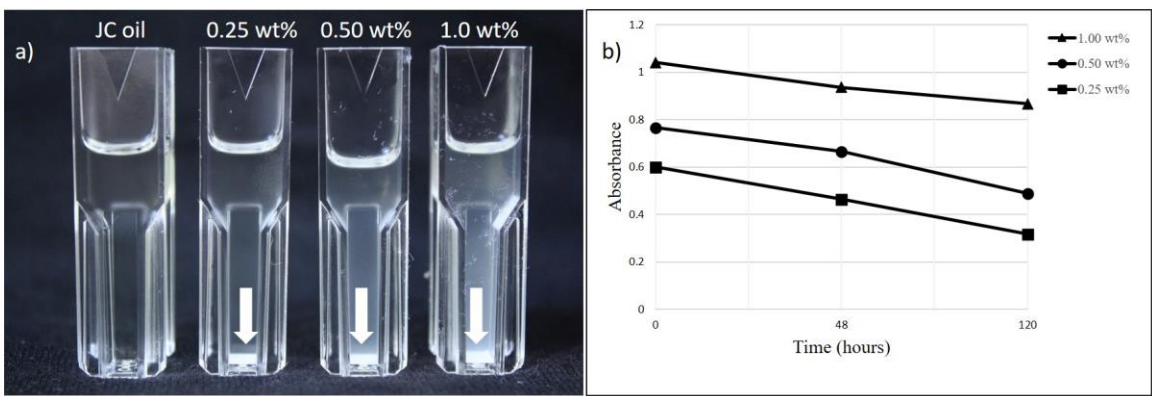

Figure 2. Dispersion stability analysis. a) Curvettes with lubricant samples and b) Optical absorbance profiles curves .

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