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**P13****Electrorheological behavior of nanofluids based on used cooking oil and cellulose nanocrystals for smart lubrication**

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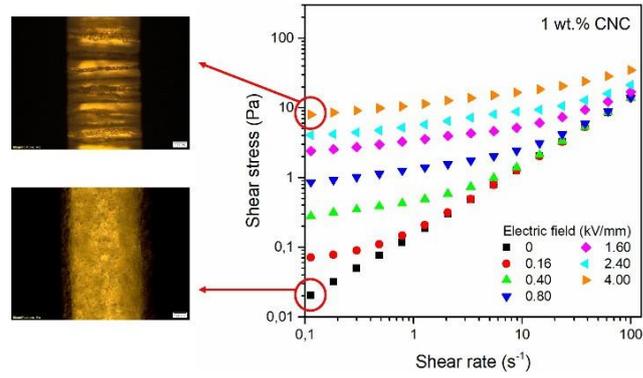
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This study explores the electrorheological (ER) behavior of nanofluids formulated with used cooking oil (UCO) and cellulose nanocrystals (CNCs), aiming to evaluate their suitability as smart lubricants. The ER effect arises from the electric field-induced alignment of polarizable particles into chain-like structures, which increase flow resistance and significantly alter the fluid's rheological response. This reversible electro-modulation of the rheological properties offers a pathway to adapt the lubricant viscosity to changing operating conditions (such as speed or load) and, thus, actively control the friction behavior in a tribological contact.

Nanofluids were prepared by dispersing CNCs at 0.5, 1, 2, and 4 wt.% in UCO sourced from a deep-fried food establishment, previously studied elsewhere [1]. Viscous flow curves were obtained at 25 °C under electric field strengths ranging from 0 to 4 kV/mm. At zero electric field, all samples exhibited Newtonian behavior. Upon applying an external voltage, the shear stress curve developed a plateau-like region at low shear rates, indicative of the structuring of the nanoparticles. The increment in shear stress was larger with increasing electric field and CNC concentration. However, at higher shear rates, the nanofluids shifted toward a Newtonian regime, suggesting the disruption of the ER structures by hydrodynamic forces. The organization of CNCs in chains was further confirmed via optical microscopy in a setup where the nanofluid was confined between two parallel electrodes and subjected to varying electric fields, in the absence of flow (see Fig. 1).

The study of the leak current intensity provided an additional insight into how the structures might have been affected by shear. While the current generally decreased slowly with increasing shear rates, a more abrupt decay was observed at moderate-to-high fields, particularly for lower concentrations, hinting a possible reconfiguration of the CNC arrangements.

These preliminary findings support the feasibility of using CNC to endow UCO with an ER behavior, with a view to their application in smart lubrication systems. Beyond its rheological characterization, the potential of reusing UCO as a base oil for lubricants is also highlighted, thereby contributing to sustainability and circular economy strategies in lubrication.



**Fig. 1.** Viscous flow curves at 25 °C for 1 wt.% CNC dispersion in UCO at different electric field intensities and optical micrographs of the nanofluid at 0 and 4 kV/mm.

## Referencias

- [1] Fernández-Silva, S.D.; Delgado, M.A.; Ruiz-Méndez, M.V.; Giráldez, I.; García-Morales (2022), Ind. Crops Prod., 185, 115109.