CHARCATERIZATION OF GREASE AGING BASED ON CHEMICAL AND MECHANICAL DEGRADATIONS

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ABSTRACT
Greases used for rolling bearings lubrication are subjected to high thermal and mechanical solicitations [1] that can lead to the loss of grease lubricating properties. [2] It causes wear, serious materiel damage and safety hazards for users. The aim of this work is to develop an empirical model of grease aging based on chemical and mechanical degradations.

A series of experiments on fresh greases was first conducted in order to reproduce their real aging conditions. The impact of mechanical degradation was studied by the shearing action of a grease worker (155 to 180 rpm at 105 °C, NF ISO 2137). The chemical degradation by oxidation was evaluated on air at 130 °C.

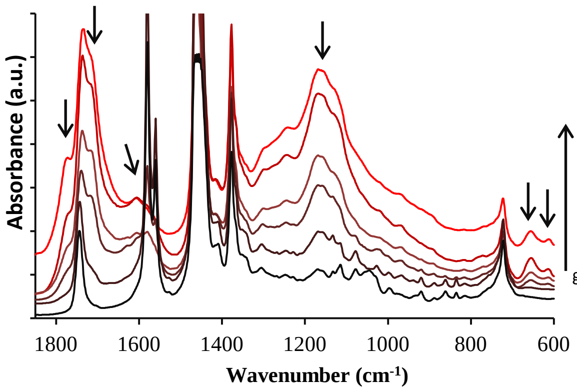

Fig.1. IR spectra of fresh grease oxized from 200 to 1250h at 130 °C from 600 to 1800 cm^{-1}

The chemical structure of the grease is clearly modified by oxidation as seen by IR spectroscopy (Fig. 1). From 200 to 1250h of oxidation, in comparison with fresh grease, several new bands for example located between 1780 and 1700 cm^{-1} appear corresponding to new carbonyl species (aldehydes or ketones). [3] In addition, the thickening carboxyl bands located at 1580 and 1560 cm^{-1} disappear after an oxidation time of 500h. [4].

Grease oxidation and shearing affect its ability to lubricate (Fig. 2) as seen in rheology with the drastic flow point decrease from 24h of shearing from 1328 to 238 Pa.s. These degradations are confirmed by Scanning Electron Microscopy (SEM) (Fig. 3) for the thickener separated from the oil. The grease thickener is a matrix of fibers characterized by a large surface area. Oil is held in the holes formed in the matrix. Long twisted fibers are observed for fresh thickener. But oxidized fibers soften and tend to aggregate and sheared fibers are broken. The degradations by oxidation and shearing impact the thickener/oil chemical interactions, the morphology and the mechanical stability of greases that cause the oil bleeding.

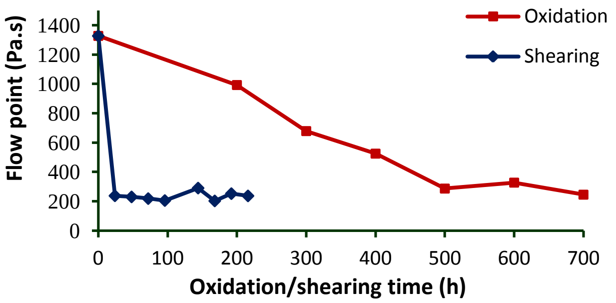

Fig. 2. Impact of churning time on fresh grease flow point

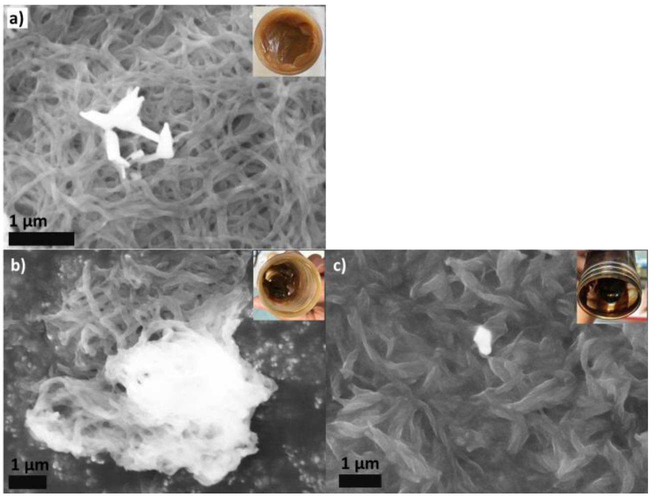

Fig. 3. SEM images of: a) fresh thickener, b) oxidized thickener c) sheared thickener

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