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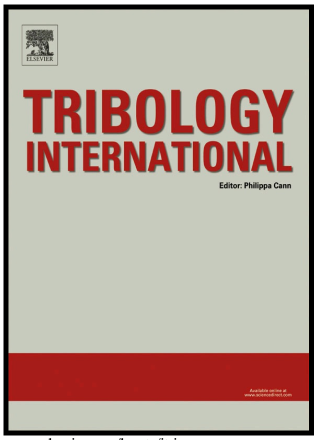

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LIPOPHILIC MAGNETITE NANOPARTICLES COATED WITH STEARIC ACID: A POTENTIAL AGENT FOR FRICTION AND WEAR REDUCTION

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ABSTRACT

Lipophilic magnetite nanoparticles (MagNP; d≈10 nm) functionalized with stearic acid were synthetized and tested as additive in polyalphaolefin synthetic base oil (PAO8) in a model system. The thermal properties of the starting base oil and of the base oil mixed with nanoparticles were evaluated using TG/DTA under inert and oxidizing atmosphere. The frictional response of the lubricants was evaluated under a broad range of operating conditions at the boundary lubrication regime using a 10 mm AISI 52100 bearing steel ball against the flat face of an AISI H13 steel disc. The results showed that: i) MagNP improved the thermal stability of the base oil; ii) reduced the friction values, mostly during load step transition; iii) reduced significantly the wear marks.

Keywords: Magnetite nanoparticles; Nanolubricants; Boundary lubrication; anti-wear agent

1. INTRODUCTION

Historically, a great variety of engineering solutions has been used to reduce friction and control the wear of matching surfaces. Nowadays, the development of more efficient ways to achieve such goals is of utmost importance, considering the current efforts to reach a sustainable technology with low energy consumption and reduced environmental impact. Governments are now imposing stringent environmental regulations on original equipment manufacturers (OEMs) for emission control and fuel economy. The automotive industry has fulfilled some of these requirements by reducing car friction losses with ultra-low viscosity oils among other alternatives. Accordingly, most of the components performance is now operating under boundary and mixed lubrication conditions. An effective strategy to deal with contact asperities is by using additives, as extreme pressure (EP) and anti-wear (AW) agents. Sulfur, chlorine, and phosphorous containing compounds have been traditionally employed, in order to form easily sheared layers for preventing severe wear and seizure [1,2]. However, the use of chlorine and phosphorus compounds is currently in the focus of environmental concerns [2]. Furthermore, some well-known friction modifier (FM)/AW additives, such as MoS_2, are prone to oxidation and degradation, impacting their performance in short time [3]. In addition, oxidative processes lead to the formation of hazardous substances such as molybdenum trioxide, which is regulated by OSHA (Occupational Safety and Health Administration) and classified by ACGIH (American Conference of Governmental Industrial Hygienists), DEP (New Jersey Department of Environmental Protection) and EPA (Environmental Protection Agency) as a risk agent for health [4].

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