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INFLUENCE OF THE AMOUNT OF METAL-CONTAINING ADDITIVE ON PERFORMANCE CHARACTERISTICS OF LUBRICANT BASED ON RAPESEED OIL

Mara KANDEVA[1,2,*], Zhecho KALITCHIN[3], Elena ZADOROZHNAYA[2], Aleksandar VENCL[4,2]
[1]Technical University of Sofia, Faculty of Industrial Technology, Sofia, Bulgaria
[2]South Ural State University, Chelyabinsk, Russia
[3]SciBulCom Ltd., Sofia, Bulgaria
[4]University of Belgrade, Faculty of Mechanical Engineering, Belgrade, Serbia
*Corresponding author: kandevam@gmail.com

The paper exposes experimental results of the performance characteristics (coefficient of friction, contact temperature and wear) of the biolubricant based on rapeseed oil. The amount of commercial metal-containing additive in formulated lubricant was 1, 1.5, 3 and 5 %. All results were compared with the results obtained for the base rapeseed oil. They showed that the metal-containing additive in rapeseed oil reduced all characteristics (coefficient of friction, contact temperature and wear). It was also found that the dependence of all characteristics on the amount of additive is nonlinear and that there is an optimal value of it.

Keywords: *rapeseed oil, metal-containing additive, coefficient of coefficient, contact temperature, wear.*

1. INTRODUCTION

Owing to growing environmental concerns, vegetable oil-based lubricants and other biodegradable lubricants are expanding their area of application [1]. They provide significant environmental advantages concerning resource renewability, non-toxicity and biodegradability. Unfavourable properties of vegetable oils could be improved through selective plant breeding or genetic modification, but no matter what they steel need appropriate additives.

Lubricant additives can be separated as chemically active or chemically inert. Chemically active are dispersants, detergents, antiwear and extreme-pressure, oxidation inhibitors, and rust and corrosion inhibitors. These additives interact chemically with metals and form protective layers, as well as with products of oxidation and degradation, making them harmless. Chemically inert are emulsifiers, demulsifiers, pour point depressants, foam inhibitors and viscosity improvers. These additives are used to improve the physical properties that are critical to the performance of the lubricant [2].

The first goal of this study was to investigate the biobased (rapeseed) oil with the addition of different amounts of metal-containing additive. The second goal was to find the optimal value of the additive.

2. EXPERIMENTAL DETAILS

The metal-containing additive is added to the commercially available rapeseed oil. The additive have good solubility in mineral and synthetic oils and greases [3,4]. It contains metal salts of organic and inorganic acids and should reduce friction, prolong scuffing and improve oxidation resistance through the formation of a multifunctional layer on contact surfaces [5]. In dependence on the used chemical components, the metal film consists of copper or different metals and is up to 1 – 2 μm thick. It is porous and has a low amount of

dislocations and a high amount of vacancies, which provide a low shear strength of the formed layer, and thus low friction (Fig. 1).

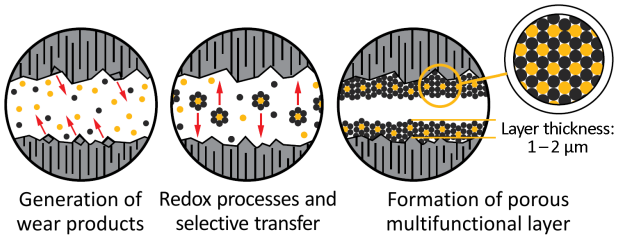

Figure 1. Mechanism of multifunctional layer formation through the selective transfer; adopted from [6]

Two different tribometers were used for the performance characteristics determination. However, tribological systems were the same in both cases and consisted of the bronze test sample and steel counter-body lubricated with formulated biolubricants. Coefficients of friction experiments were performed under four different normal loads and fixed sliding speed and time. On the other hand, contact temperature and wear were continuously monitored in conditions of fixed normal load and sliding speed.

3. RESULTS AND DISCUSSION

Experimental results of the coefficient of friction are shown as a function of normal load and as a function of the amount of metal-containing additive. Values of the coefficient of friction were corresponding to the lubrication condition. It could be noticed that the base oil (rapeseed oil) dependence of the coefficient of friction from normal load fits the Stribeck curve in the area of mixed lubrication (Fig. 2). The addition of metal-containing additive decreased friction, regardless of the quantity of additive.

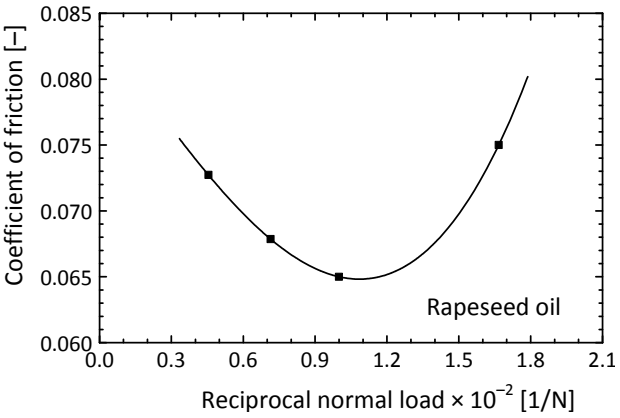

Figure 2. Rapeseed oil coefficient of friction values for different normal loads

The obtained results of the mass loss and contact temperature increase, for different lubricants, are shown as a function of sliding time, in the form of the comparative wear curves. Contact temperature values were in correlation with the coefficient of friction values, while the addition of metal-containing additive decreased wear regardless of the quantity of additive, as in the case of friction tests.

4. CONCLUSIONS

The metal-containing additive, which is already proved as an addition to mineral and synthetic base oils, was successfully used for the formulation of lubricants based on rapeseed oil.

All investigated characteristics (coefficient of friction, contact temperature and wear) were improved with the addition of a metal-containing additive to rapeseed oil.

The dependence of all characteristics on the amount of additive was nonlinear, pointing to 3 % as an optimal amount of additive.

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