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Brief communication

Comparative Study of Rapeseed oil with Hydraulic oil

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ABSTRACT

This article presents the comparative study of rapeseed oil with hydraulic oil (η depending on the γ and η depending on the temperature) for a vegetable oil and a hydraulic oil between temperatures of 40 and 90^{O}C celsius. The two oils were studied with the Haake VT 550 viscometer with VH_1 sensor. The obtained curves show an exponential decrease of the dynamic viscosity with temperature. The two oils have a non-Newtonian behavior in the temperature range in which they were studied.

Keywords: Rheology, Vegetable oil, Biodegradable.

INTRODUCTION

Gradually, with the advent of internal combustion engines, these lubricants, based on vegetable oils and animal fats, were replaced by mineral oils. The main reason for this choice was the better stability of mineral oils over time (reduced aging over time)[1].

Biodegradable oils are currently a high-performance achievement in the field of lubrication of equipment and machines that work mainly in conditions that make it possible to pollute the environment. This refers to machinery and equipment in agriculture, the construction industry, the marine industry, forestry, the printing industry, drilling wells, railways, the automotive industry, the food industry, where the problem of reducing environmental pollution arises, following loss of lubricants on the ground or in water.

The performance of biodegradable oils is comparable, in some cases even better than that of mineral oils used for the same applications.

The ecological advantages of biodegradable lubricants over mineral oil based lubricants consist in a high and fast biodegradability and low toxicity values[1].

The biological decomposition of biodegradable lubricants is aerobic (with oxygen) and anaerobic (without oxygen). Algae, some plants, sponges, fungi and even pond fleas in reactions with oxygen and salts can promote biological decomposition. In the absence of oxygen, the decomposition of microorganisms takes place in all possible microbial directions. Compared to mineral oils, ester oils, due to its specific molecular bonds, favor the breaking of the molecule by microbial attack.

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Also, the decomposition of products based on mineral oils is much more difficult because the decomposition products can act again on microorganisms preventing their further development, a situation that is not the case with the structures of natural oils (rapeseed oil, sunflower oil). In the latter case, by decomposition, nutrients are obtained for microorganisms favoring the development of the place.

The entry of these biodegradable lubricants on the market is done differently depending on the field of applicability. In the case of lubrication of tribosystems with lubricant losses (such as the chainsaw) we can speak of an almost complete substitution of products based on mineral oils with non-polluting substances. Also, in the case of oils used in open mechanisms we can speak of a substantial increase of biodegradable products. In the case of closed lubrication systems with long lubrication, even in the case of hydraulic circuits, the products offered on the market are fewer. Currently, as base oils for biodegradable lubricants can be used: polyglycols, synthetic ester oils and vegetable oils.

The research carried out in the last 15 years for the realization of some products and the use of some technological processes neutral from the point of view of the influence on the environment, have brought back to the actuality the vegetable oils, producing practically a rebirth of these lubricants.

A market study shows that the share of non-polluting hydraulic fluids based on vegetable oils increased in 2000 to 10%[2]. If a continuous development is assumed, the substitution percentage can reach up to 50%, a situation in which, of course, both the ecological advantages and the technical and economic competitiveness in relation to the products based on mineral oils will be taken into account[3,4]

Strengths are biodegradability, ecological character (non-polluting or environmentally friendly), extraction from renewable resources (even for a period of 100 years), or the possibility of the lubricant being recycled or reused, high viscosity index, flash points and higher self-ignition[5-10].

Weaknesses are lower viscosity compared to mineral and synthetic oils, oxidation, shorter temperature range than mineral and synthetic oils, many of the properties are more time dependent compared to mineral and synthetic oils, properties at low temperatures which are weaker for vegetable oils compared to other lubricants[10-13].

MATERIAL AND METHODS

The rapeseed and hydraulic oils have been studied with the Haake VT 550 viscometer with VH_1 sensor at t=40 -100°C over the entire range of shear speeds.

RESULTS AND DISCUSSION

Figures 1-3 show the dependence of η with γ for rapeseed oil on the hydraulic oil at temperatures 40°C and 90°C.

The dynamic viscosity decreases with increasing temperature and shear rate due to the orientation of the molecules in rapeseed oil but also in hydraulic oil. The decrease is more pronounced in hydraulic oil compared to rapeseed oil.

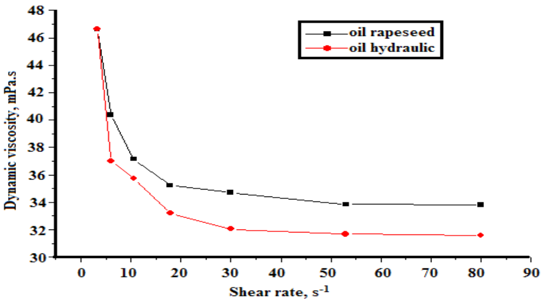

Fig. 1. The dependence η depending on γ at temperature 40°C for rapeseed oil and hydraulic oil

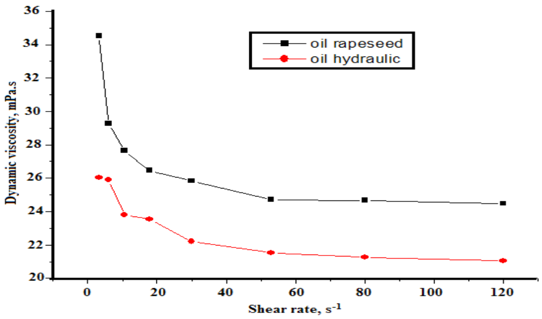

Fig. 2. The dependence η depending on γ at temperature 50°C for rapeseed oil and hydraulic oil

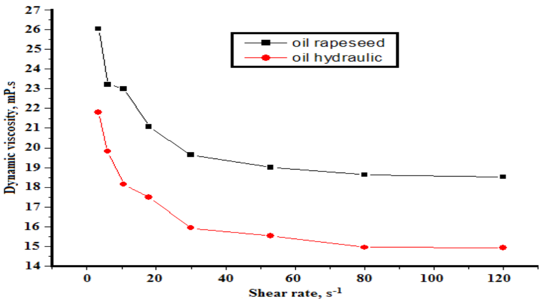

Fig. 3. The dependence η depending on γ at temperature 60°C for rapeseed oil and hydraulic oil

Figures 4 -5 show the dependence dynamic viscosity of the temperature at the shear rate of 3.3 s^{-1} and 6 s^{-1}. As can be seen from the graphs, two straight lines with different slopes are obtained. For rapeseed oil the slope of the straight is higher compared to the slope of the hydraulic oil.

From the graphic representation of the dependence of the shear rate with temperatures it is found that rapeseed oil has a more pronounced decrease in viscosity compared to hydraulic oil in proportion of 73.89% at shear speed of 3.3 s^{-1}.

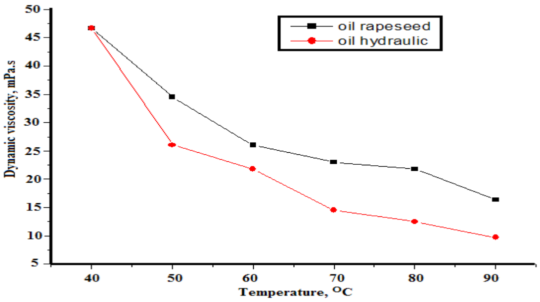

Fig. 4. Rheogram at shear rate 3.3 s^{-1} for rapeseed oil and hydraulic oil

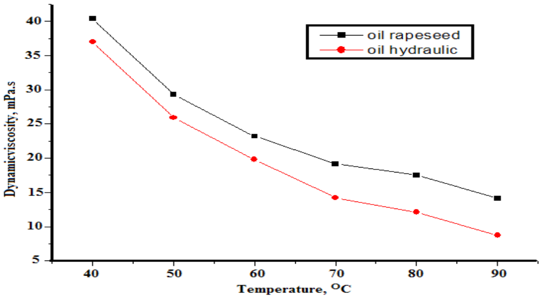

Fig. 5. Rheogram at shear rate at shear rate 6 s^{-1} for rapeseed oil and hydraulic oil

CONCLUSION

This article presents comparative study of rapeseed oil compared to hydraulic oil used as biodegradable lubricants in the temperature range 40-90°C celsius. The two oils have a non-Newtonian behavior at the studied temperatures.

ACKNOWLEDGMENT

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Conflicts of Interest

The authors declare no conflict of interest.

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