Tribological properties of waste cooking oil and possibilities for its improvement

Juozas Padgurskas[1)], Darius Volskis[1)], Raimundas Rukuiža[1)*] and Svajus Asadauskas[2)]

[1)] Institute of Power and Transport Machinery Engineering, Vytautas Magnus University, Lithuania
[2)] Institute of Chemistry, Center for Physical Sciences and Technology, Lithuania
*Corresponding author: raimundas.rukuiza@vdu.lt

The use of waste cooking oil as a lubricant can reduce the environmental pollution and solve the recycling problems. Required tribological properties of such lubricating compositions can be achieved using the environmentally friendly additives which are efficient for different composition waste cooking oil lubricants.

Keywords (from 3 to 5 max): waste cooking oil, biodegradability, friction, wear

1. Introduction

Waste cooking oils (WCO) as an outcome of food industry can be base material for the production of bio-diesel, bio-sorbents for pollutants [1], but more efficient way for the use of WCO is production of environmentally friendly lubricating oils. It is a renewable source and easily degradable raw material in natural environment. Open air lubrication is used in many types of equipment. One of them is used for lubrication of chain saw blades and is therefore particularly relevant in forest sectors where environmental protection is a constant concern. Taking into consideration those environmental issues the vegetable base oil is wide spreading and recently growing in European forestry industry [2]. However the use of WCO as lubricating oils could pass the solving of two environmental problems: a) recycling use of WCO; b) use of biodegradable material in environmentally sensitive machinery application.
The aim of this work is to investigate the tribological properties of lubricating compositions made from waste cooking oils used in the food industry by modifying them with environmentally friendly functional additives.

2. Methods

The tested WCO samples have different origin. The samples WCOhtan had higher kinematic viscosity and total acid number comparing to WCOltan samples. Preparation of test samples includes WCO filtering and modification of half of it with functional Lubrizol anti-friction and anti-wear additives. The additives are suitable for use in environmentally friendly oils.
Comparative tribological tests of WCO samples were performed to evaluate their suitability to produce bio-oil for the lubrication of chain saw blades. Those lubricating compositions were compared with commercial chain cutting lubricating reference bio-oil, which is based on vegetable oils and is environmentally friendly.

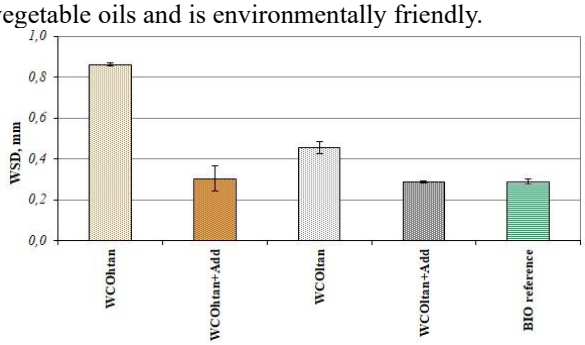
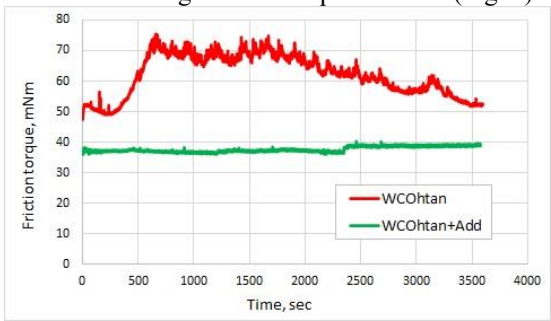


Figure 1: Wear scar diameter of the testing specimens.

Tribological tests were performed according to the standard DIN 51 350 with a modernized four-ball friction machine MAST-1. Wear resistance ability of WCO samples were evaluated according to the wear scar diameter of ball specimens after the 4 ball tests (fig. 1) and friction reduction ability of WCO samples were measured according friction torque in mNm (Fig. 2).

a)



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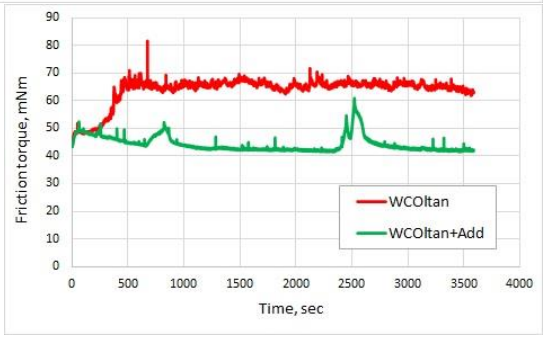

Figure 2: Friction torque measurements: a) WCOhtan samples; b) WCOltan samples

3. Discussion

The results show that the wear resistance efficiency of commercial oils can be easily reached using the environmentally friendly functional additives for WCO lubricants. The measurements of friction torque show that the additives not only reduce the friction losses, but also improve the stability of friction coefficient. They can efficiently improve tribological performance also for WCO lubricants of higher viscosity and acidity.

4. References

[1] Mannu, A. et al., “Innovative applications of waste cooking oil as raw material”, Science Progress, 102, 2, 2019, 153-160.
[2] Nowak, P. et al., “Ecological and health effects of lubricant oils emitted into the environment”, Int. J. Environ. Res. Public Health, 16, 3002, 2019, 1-13.