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Alternative Lubricants with Increased Biodegradability Based On Safflower Oil

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ABSTRACT: It is of interest to use compositions based on vegetable safflower oil as alternative lubricants with increased biodegradability, which along with such obvious advantages as biodegradability and renewability, in its physicochemical parameters meets the basic requirements for mineral lubricating oils.

KEY WORDS: Lubricating Oils, Biodegradability, Vegetable Oils, Rapeseed, Safflower, Additives, Viscosity Index, Kinematic Viscosity

I.INTRODUCTION

Solving current environmental problems requires the search for alternative sources of raw materials and energy. This is due not only to the need to reduce environmental pollution, but also to the importance of the transition from exhaustible raw materials to the expanded use of renewable resources.
Work in this direction has long been underway around the world. In the field of the use of renewable raw materials, the leading role belongs to bioresources, primarily to oilseed crops, since vegetable oils are an acceptable alternative to petroleum raw materials for the production of fuels and lubricants.
The renewability of raw materials and the relative cheapness compared with biodegradable, environmentally friendly synthetic products currently determine the feasibility of expanding the use of vegetable oils in technology. The high cost and scarcity of synthetic ester oils with almost the same biodegradability as vegetable oils (85-90%) significantly limit their use. It is very important that the use of fats, as well as waste from their processing, is possible not only in the production of almost all types of lubricants, but also fuels - gasoline, diesel, boiler. The latter opens up the possibility of using machines and mechanisms that work exclusively on products of plant origin.
In the lubrication systems of machines operating with huge and prolonged pressure, petroleum oils have several advantages over vegetable oils, primarily due to their high stability. However, compositions based on plant products have the best viscosity-temperature characteristics in contrast to petroleum oils, meet modern requirements for lubricating and hydraulic oils in terms of lubricity, corrosion protection of alloys of iron and non-ferrous metals, anti-foam, deaeration and demulsifying properties.

II. LITERATURE SURVEY

It is known from literary sources that in world practice, lubricants produced from vegetable, renewable and biodegradable raw materials such as rapeseed oil have been widely and successfully used for a long time[1, 2].
Type of oilseed crop such as safflower grows in the sharply continental climate of Uzbekistan, located in the center of Central Asia and included in the arid zone of the Earth, with mainly gray-earth soils, represented by “rainfed” - non-irrigated type of agriculture in the mountain and foothill regions of the republic.
Dyeing safflower, American saffron, wild saffron, dyeing thistle (lat. Carthamustinctorius) - an annual plant; a species of the genus Safflower of the family Asteraceae, or Compositae. Ancient oil and dye culture. Safflower is an annual drought tolerant oilseed plant of Indian or Ethiopian origin. It has long been cultivated in Egypt, India, Afghanistan, Central Asia and the Caucasus. Oil was extracted from its seeds (25-32%), which is close to sunflower in quality, and

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dye for silk from its flowers. Now they are cultivated not very widely, mainly in Asia for the sake of oil. The cultivated area of safflower in Uzbekistan is about 7 thousand hectares.
Taking into account that in world practice the use of rapeseed oil as a substitute for mineral and synthetic petroleum oils as a biodegradable lubricant, has taken the main character, we believe that safflower oil can be taken as one of the rapeseed alternatives. Since safflower is more drought-tolerant, high-yielding, it is easier on agrotechnical and soil-climatic requirements in the conditions of the Republic of Uzbekistan [3].

III. METHODS

The aim of this work was to study the possibility of using vegetable oils, such as safflower and rapeseed in the composition for the preparation of biodegradable lubricating oils, instead of petroleum.
Preliminarily, the used oils, after removal of the smallest particles of impurities, are subjected to purification processes, which are one of the important factors for obtaining high-quality oils with enhanced performance characteristics [4]. The studied oils were purified by chemical refining methods, which consisted in treating fats with water (40-50 °C), hydration with a weak 0.5-1% aqueous or aqueous-alcoholic alkali solution (alkaline refining). Then, adsorption purification was carried out using activated carbon, which had undergone preliminary activation for 6 hours at a temperature of 160 °C.

IV. RESULTS

After alkaline refining, the physicochemical parameters of the refined oils were determined to match the parameters for base oils according to State Standard 8581-78. Physicochemical parameters of oils (rapeseed, safflower) such as refractive index, density, kinematic viscosity at different temperatures were determined. Their comparative characteristic is shown in Table 1.

Table 1
Comparative physicochemical characteristics of oils after alkaline refining

№	Indicators	Rapeseed oil original	Safflower oil original	Purified rapeseed oil	Purified safflower oil
1.	Refractive index, n	1.4750	1.4790	1.4720	1.4750
2.	Density, ρ, g/cm^3	0.910	0.919	0.907	0.917
3.	Kinematic viscosity, ν at 100°C, mm^2/s at 40°C, mm^2/s at 20°C, mm^2/s	 6.57 24.65 47.36	 5.82 22.10 40.21	 5.60 21.19 47.17	 5.46 10.52 15.25

Basis for lubricants was obtained as a result of the purification of vegetable oils, with characteristics to be further improved in order to meet the technical requirements for the use in units of agricultural machinery.
For further research, three biodegradable lubricant compositions were formulated based on refined oils. Moreover, as noted above, in view of the fact that the operational properties of the obtained base did not quite meet the requirements for lubricants it is necessary to introduce a complex of additives.
Biodegradable engine oil compositions were prepared based on safflower and rapeseed oils using additives of various types of action, such as:
1. Kamid - in the form of an anti-corrosion additive, a condensation product of distilled fatty acids with alkyl amines;
2. K-61 - thickening additive for oils and greases, granular copolymer of ethylene with propylene;
3. K-110 - depressant polymethylmethacrylate additive, used to reduce the pour point of oils;
4. Highly dispersed graphite - product of the second flotation treatment of graphite ore with a carbon content of 31%, was added in order to increase the antifriction characteristics of the obtained lubricating oil (sizes in the range of 50-60 nm);

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5. Sulfurized cottonseed oil (SCO) - anti-friction additive;
6. Salomas - residual product of hydrogenation of oil and fat production;
7. PMS-200A - antifoam additive, polymethylsiloxane liquid.

The component composition of the formulations of the prepared oil compositions are presented in Table 2.

Table 2

The composition of the formulations of compositions based on vegetable oils

№	Components	Formulation, %		
		№1	№2	№3
1.	Safflower oil after alkaline refining	95.355	79.48	-
2.	Rapeseed oil after alkaline refining	-	-	94.98
3.	Additive "Kamid"	-	0.5	-
4.	Sulfurized Cottonseed Oil (SCO)	-	10	-
5.	Salomas	2.5	-	-
6.	Graphite	0.125	-	0.005
7.	Additive K-61	1	5	2.5
8.	Additive K-110	1	5	2.5
9.	PMS-200A	0.02	0.02	0.02
10.	**Total:**	**100**	**100**	**100**

The physicochemical parameters of the obtained compositions were determined, the positive results of which indicate an improvement in the lubricity of the compositions, since one of the most important indicators of oil is its viscosity. Physicochemical characteristics of the obtained compositions of lubricating oils based on vegetable oils are presented in Table 3.

Table 3

Comparative physicochemical characteristics of vegetable-based lubricants

№	The name of indicators	Sample Compositions			Petroleum oil M-8G_2	Test Method
		№1	№2	№3		
1.	Kinematic viscosity, mm^2/s, at 100°C at 40°C	7.69 30.84	9.56 40.09	9.08 39.26	8.05 -	According to State Standard 31391-2009
2.	Viscosity index, not less	168	163	162	85	According to State Standard 25371-97
3.	Flash point, in an open crucible, ° C, not lower	242	216	204	200	According to State Standard 4333-87 or 12.1.044-89
4.	Alkaline number, mg KOH/g oil, not less	0.065	-	0.19	6.0	According to State Standard 11362-96
5.	Acid number, mg KOH per 1 g. oils	3.37	3.85	3.71	-	According to State Standard 5985
6.	Pour point, ° C, not higher	-25	-19	-27	-25	According to State Standard 20287-91
7.	Color on the CNT colorimeter with dilution in the ratio of 15:85, units of the CNT, no more	0.5	1.0	1.5	4.5	According to State Standard 20284-74
8.	Density at 20°C, g/cm^3, no more	914	915	909	905	According to State Standard 3900-85
9.	Color on the CNT colorimeter, CNT units	2.0	3.0	3.5	-	According to State Standard 20284-74

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V. CONCLUSION

Based on the results of the analyzes, it can be noted that according to one of the main characterizing indicators of lubricating oils as the viscosity index the newly studied biodegradable lubricating compositions are two times superior in this indicator to mineral oil M-8G_2. The kinematic viscosity of vegetable oils was able to bring to normalized values due to the introduction of a thickening additive K-61 into the composition. The pour points of biodegradable compositions also meet the requirements of State Standard. Therefore, according to the main physicochemical parameters, the proposed compositions fully meet the requirements of State Standard, except for the indicator "acid number", however, the increased value of the acid number is not so critical and fits into the acceptable range. Thus, based on the results obtained, it can be considered that rapeseed and safflower oils can be considered the most acceptable for the production of biodegradable motor oils from vegetable raw materials, since they meet the basic requirements for mineral lubricants used in agricultural machinery.

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