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ALTERNATIVE LUBRICATING OILS

A. F. Khuzhakulov,
K. Sh. Khotamov
Bukhara Institute of Engineering and Technology, Bukhara

Abstract
This paper presents the results of a study of alternative lubricating oils. To solve the problems of preventing environmental pollution and import-substituting alternative fuels and lubricants based on local raw materials with the involvement of additives of plant origin.

Keywords: mineral oils, waste oils, raw materials, additive, impurities, vegetable oils, chemical analysis, temperature biofuel, biodegradability.

Introduction

The increasing threat of a global environmental crisis requires a fundamentally new approach to solving the problems of preventing environmental pollution and import-substituting alternative fuels and lubricants based on local raw materials involving additives of plant origin.

An alternative in this case can be non-toxic vegetable oils and their processed products with high biodegradability (up to 100%). The use of these products is possible for the production of all types of lubricants - oils, greases and additives. An important argument in favor of the use of vegetable oils is the limited oil resources. In this case, the renewable nature of raw materials plays a significant role, which increases the importance of the development of this direction.

In recent years, vegetable oils, due to the aggravated environmental and economic problems of consumption of petroleum products, have become worthy of attention in many countries of the world. In the developed countries of Europe and America, interest in natural oils and fats, products and waste of their processing as bases and components of vegetable lubricants and biofuels is reviving. Fats have high (100%) biodegradability, are non–toxic, have excellent tribotechnical characteristics, but most importantly - fats have renewable resources, which is extremely important in the context of the global environmental crisis, one of the features of which is the depletion of non-renewable resources (oil, gas, and other minerals) [1].

Lubricants based on products of plant and animal origin have been widely used in technology since the Bronze Age and up to the mid-40s of the last century. Vegetable oils were used, as well as ghee and animal fat.

There are known studies on the use of rapeseed oil and its mixtures as fuels for diesel engines. There are known studies on the use of sunflower oil as an additive to fuel (in regions with intensive sunflower production), on the use of coconut, palm oil (in countries with appropriate climatic conditions) [2].

Back in 1900 , at the World 's Fair in Paris , R.Diesel demonstrated a stationary engine. Powered by peanut butter. In 1983 in the USA (Chicago)A symposium on the use of vegetable oils as alternative fuels was held [3].

Engine and transmission oils, as well as fuel based on rapeseed raffinate, have been successfully tested in Austria in the so-called "bioautomobile". After 30 thousand km of engine mileage, no noticeable negative phenomena, in particular, an increase in wear, were noted.

The German branch of British Petroleum has developed hydraulic oil BP Biohyde 32/46, oil for saw chains BP Bioforst 2000 and some other lubricants based on rapeseed oil.

The company "Hencel Coup" (USA) has developed Emery2 818-A oil containing up to 75% of esters obtained from animal and vegetable fats, in the latter case – mainly from coconut oil. It is designed for two-stroke gasoline engines with water cooling. [4] This product, which has been used since 1992, is biodegradable, non-toxic and corresponds to other lubricants in terms of operational characteristics. The main field of application of the new product is hydraulic and circulation systems of hydroelectric power plants, mining and port equipment [2].

Motorex Oekohedro-3268 oil has been developed in France on the basis of vegetable raw materials, which is used as a hydraulic fluid and lubricant in engines, mechanisms and machines.

Table №1 Properties of petroleum and wax-based motor oils

Oil sample	Wear scar diameter, mm	Teaser temperature *, ^{0}C	Carbonization, % (mass.)
Oil:			
1	0,750	170	0,57
2	0,875	160	0,30
3	0,894	161	0,27
Wax based hahobs:	0,54	180	0,21
1	4,49	170	0,16
2	0,50	165	0,55
3			

* The temperature of the beginning of the growth of the moment of friction forces between two counter-rotating disks made of aluminum alloy (piston material in the engine) and cast iron (cylinder material). Methodology of the Indian Petroleum Institute.

Commercial motor oils have been created on the basis of castor oil from Castrol companies. They are designed for two–stroke (Castrol R40), and two- four-stroke small-sized (Castrol M) and racing engines of BMW-type cars (Castrol PRODUKT B 353) [4].

In India, which depends on oil imports, engine oils for two-stroke engines are being created on the basis of liquid hohoba wax, which is well mixed with gasoline. [23; C. 180] This wax is also characterized by better anti-wear properties than petroleum oil, usually used for these purposes. The coking ability of hohoba oil in a mixture with 10-20% brightstock is not higher than that of commercial petroleum oil, with the same content of a high-viscosity component (Table 2).

Based on rapeseed oil, Calgene Inc (USA) produces a series of lubricants with specially selected additive packages, as well as the base oil, biodegradable and non-toxic. In terms of performance, the new products are identical to oil-based oils.

The main technical advantages of vegetable oils in comparison with petroleum oils are the best viscosity and tribological properties. This circumstance significantly increases the favorability of using vegetable oils from an ecological standpoint, since in some cases it makes it possible to limit the use of often toxic additives, and sometimes completely abandon their use. The main disadvantages of vegetable oils include low stability and, in most cases, poor low-temperature characteristics. These disadvantages are eliminated both by using a complex of additives and by mixing vegetable oils with petroleum oils. [4]

For comparison, Table No. 1 presents the physico-chemical characteristics of vegetable and basic bases of petroleum oils (M-8 and MS-20). It can be seen that the studied vegetable oils, with the exception of castor oil, are very close in viscosity, which is in the range of 7.21...8.62 mm^2/s at 100 ^{0}C. Their viscosity index and flash point are in the range of 151.172 and 224.320 ^{0}C, respectively.

Table №2 Physico-chemical properties of vegetable and petroleum oils

Oil	Density at 20 ^{0}C, kg/m^3	Viscosity at 1000C, mm^2/s	ИВ	Acid number, mg KOH/g	Carbonization % (mass)	Temperature, ^{0}C		Index refraction	Color, CNT
						outbreaks	solidification		
Cotton	918,8	7,69	166,0	4,25	0,231	316	–18	1,4758	1,5
Sunflower	927,5	7,93	167,0	2,44	0,505	320	–16	1,4754	2,0
Rapeseed	906,1	8,09	155,4	6,40	0,465	224	–3	1,4718	4,0
olive	911,3	8,43	155,4	5,90	0,198	285	–12	1,4710	1,5
soybean	923,7	7,67	166,0	0,03	0,438	318	–12	1,4732	1,0
Palm	917,6	8,62	151,0	0,17	0,120	315	130	1,4786	1,5
castor	1068,7	19,88	90,7	1,18	0,193	296	–27	1,4796	1,5
Almond	915,8	8,25	158,5	0,76	0,710	260	–29	1,4729	1,5
Walnut (from hazelnuts)	909,3	8,76	158,7	6,30	0,562	262	–22	1,4690	1,5
Walnut (from walnut)	923,0	7,13	177,6	0,09	0,291	262	–29	1,4835	1,5
Grape (from bones)	921,0	7,21	169,7	0,05	–	257	–16	1,4010	2,0
Oil M-8-B	877,8	7,53	89,0	0,015	0,150	203	–15	1,4800	3,0
Oil MS-20	897,0	20,50	92,0	0,03	0,270	270	–18	1,5070	7,0

The viscosity of castor oil is 19.88 mm^2/s at 100^0C. Its viscosity index flash point is 90.7 and 296^0C, respectively. These oils correspond to petroleum oils in terms of individual physico-chemical characteristics, and in terms of viscosity index and flash and solidification temperatures, with the exception of palm oil, they significantly exceed them. The acidic number of vegetable oils is high.

Vegetable oils are the most acceptable for these purposes from an ecological and economic point of view: rapeseed, sunflower (in Europe), soy, corn (in the USA), palm and palm kernel (in Asia and Africa) [5]. A number of Western countries have already successfully tested "bioautomables" that work exclusively on plant products.

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