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Vegetable Oils and Polyglycols as the Base for Liquid Dispersive Systems in Boundary Conditions of the Dynamic Contact

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The vegetable oils, mineral, naphtene and polyglycol oils, synthetic liquids as lubricating materials for metal surfaces have been considered.

Keywords: vegetable oils, polyglycols, friction, wear, lubricant, naphtene, hydrodynamic effect loading capacity.

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Introduction

Mineral, naphtene and polyglycol oils, synthetic liquids are used for the lubrication of solid state. The review of sources shows that vegetable oils are considered as alternative (to carbonic, mineral oils, synthetic liquids) lubricants, such as. Row base, physical and chemical, ecological, antifriction, viscous-temperature properties, chemical modification and using of mineral, naphtene, polyglycol and vegetable oils, synthetic liquids have been investigated.

I. Experimental methods

The methods of investigations of the viscous-temperature, antifriction properties, thickness of lubricating layer of mineral, naphtene, polyglycol and vegetable oils were used. Assessment of hydrodynamic effects and estimation of films thickness have been done by:

$$S_{h0} = \frac{\eta_{0t}\upsilon\left(d_{\text{г}}\right)^3}{N_i} = \frac{\nu_{0t}\rho_t\upsilon(d_{\text{г}})^3}{N_i}\left[м^2\right], \quad (1)$$

$$S_{h\tau} = \frac{\eta_\tau\upsilon\left(d_{\text{з}}\right)^3}{N_i} = \frac{\nu_t\rho_t\upsilon(d_{\text{з}})^3}{N_i}\left[м^2\right], \quad (2)$$

$$h_0 = \left(\frac{S_{h0}}{20{,}3465}\right)^{12}, \quad (3)$$

$$h_\tau = \left(\frac{S_{h\tau}}{\mathbf{20,3465}}\right)^{12}. \quad (4)$$

II. Results and discussion

The viscous-temperature properties of oils for ethylene high-pressure compressors have been discussed (fig 1). The new correlations of viscous-temperature properties of large class of the naphtene, polybutene and polyglycol oils are represented. For the first time the complex assessment of the viscous and thermal properties of oils by 11 coefficients is used. It is shown that the polyglycol oils are the most effective comparing with the naphtene and polybutene oils [1, 16].

The problems of selection of lubricants for ethylene high-pressure compressors and statement of a question of selection of lubricants for high-pressure compressors have been considered.

Results of investigation of antifriction properties of naphtene and polyglycol oils during low loading with lubrication of pair bronze-BK-6(BK-11) and graphelon-20-BK-6 (BK-11) are represented. It is shown that wearing of the samples made from the bronze during lubrication with polyglycol oils 1,31-5,86 times in friction on BK-11 and 1,11-4,84 times in friction on BK-6 bigger than with naphtene oil [2].

The methods that determine the hydrodynamic effects have been researched. Estimation methods of lubrication nanofilms when solids surfaces contact have been considering [3]. Estimations of lubricating layer thickness of mineral oils – aviation MC-20, compressor-12M, industrial-20, Vaseline (medicine) – and dependence films thickness of mineral oils on loading

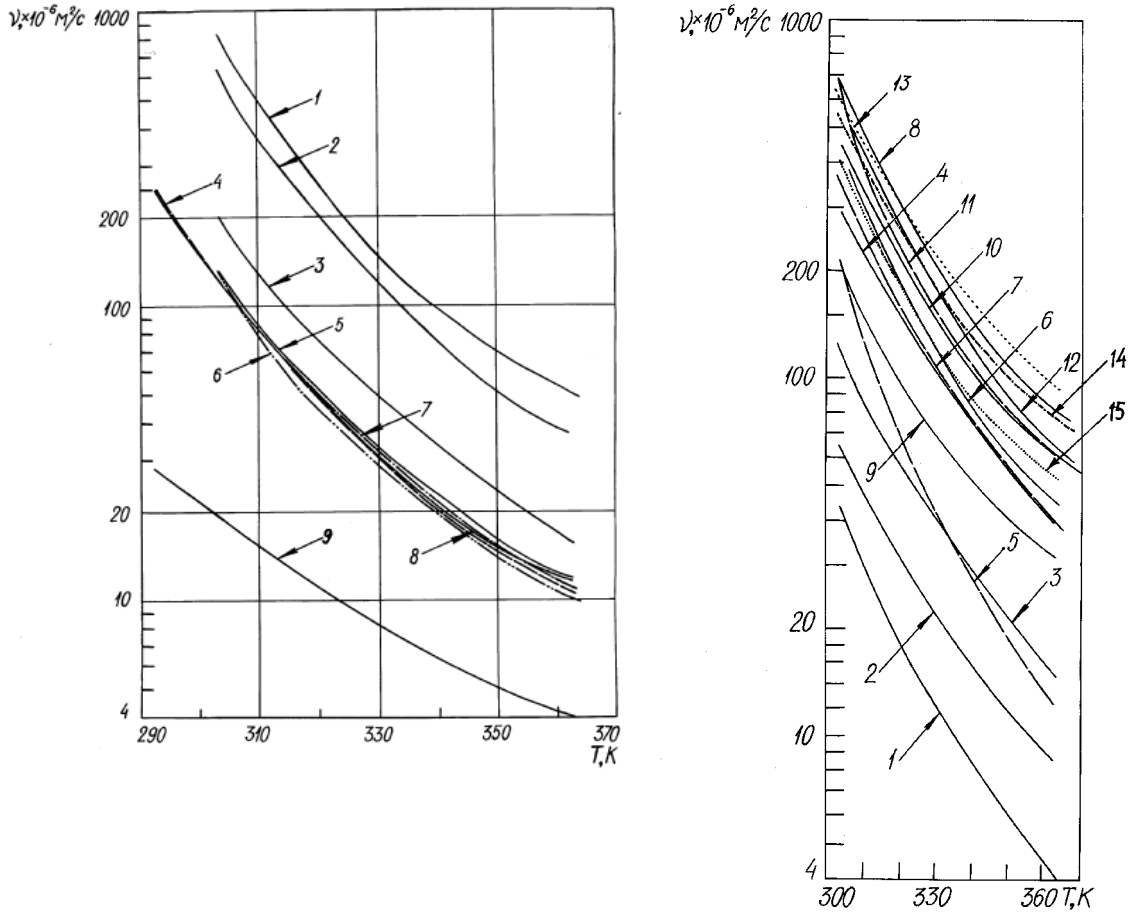

Fig. 1. Viscous-and-thermal characteristics

a)of naphtene oils

1 – Risella -33 + 50% of polybutene "Tredkat-99";
2 – Risella 33 + 30% of polybutene for succynimide additives; 3 – NKM-70; 4 – Risella 33; 5 – X (Japan);
6 – Vitorex-334; 7 – NKM-40; 8 – 5350; 9 – Risella -17

b) of polyglycol oils

1 – Laprol-202; 2 – Laprol-602; 3 – Laprol-1002;
4 – Laprol-2002; 5 – Laprol-503; 6 – Laprol-3003;
7 – Polyol LG-56; 8 – Laprol-5003;
9 – Laprol-1503;
10 – Laprol-2502; 11 – Syntheso-D 201;
12 – Orites-270 DS (regenerative);
13 – Syntheso-D 201 N; 14 – Laprol- 3503-2-70;
15 – Laprol-3503-2-B5.

and temperature are given [4].

The dependence of diameter of pattern of wear from concentration of components of oil composition based on chemical-modification rape-oil is investigated for pair steel – steel [5, 20].

The dependence of intensity of wear for pair bronze – steel from concentration of components of oil composition based on chemical-modification rape-oil was investigated [6].

The vegetable oils as lubricating materials for metal surfaces have been considerated. Infrared spectrums of vegetable oils in comparison with rape (seed) oil are investigated. The investigation results of infrared spectrums of cedar (tree) oil from the Carpathian mountains in comparison with Siberion stone pine are shown [7, 19].

The dependence of intensity of wear for pair aromatic polyamide – steel from concentration of components of oil composition based on chemical-modification rape-oil was investigated [8].

Loading capacity of lubricating nanofilms of rape oil on metal surfaces has been investigated. It is shown that the character of catalyst influences the loading capacity of lubricating nanofilms of rape oil on metal surfaces [9].

The hypothetical process of plating the roughness surface of base using the complex initial composition of materials has been investigated with «black box» model. Dependence of the layer composition, projection height of microunevenness and its diameter on the average layer surface, quality index, representative area and age of microunevenness on the exposition and steepness of decline, height on the base and type of sets of microunevenness has been shown. The majorant rows optimization parameters have been determined with the graph theory that have let to reduce their quantity for solution of optimization task [10].

The results of investigation of antifriction properties of polyglycols as additions to vegetable oils and polybutene, naphthenic, mineral and synthetic oils under conditions of boundary loading are presented. It is shown

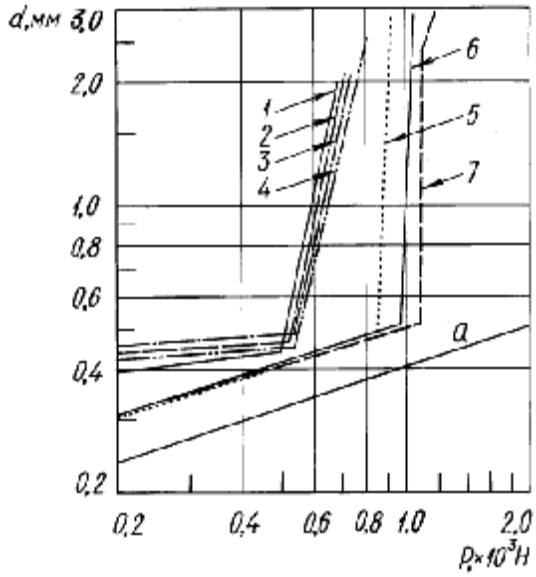

Fig. 2. Dependence of wear spot (d) on the axial loading (P) for linear polypropyleneglycols and statistic copolymers of ethylene and propylene oxides: 1 – Laprol 202; 2 – Laprol 602; 3 – Laprol 1002; 4 – Laprol 2002; 5 – Laprol 1502-2-70; 6 – Laprol 2502-2-70; 7 – Orites 210 DS.

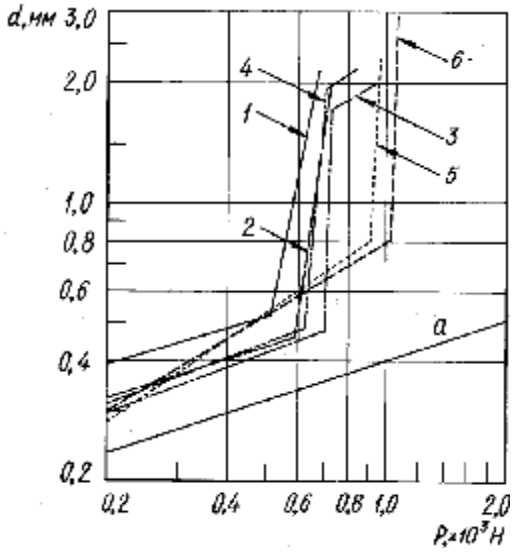

Fig. 3. Dependence of wear spot (d) on the axial loading (P) for ramified polypropylene on the base of glycerine: 1 – Laprol 503; 2 – Laprol 3003; 3 – Laprol 3503-2-70; 4 – Laprol 3503-2-65; 5 – Laprol 5003; 6 – Laprol 10003-2-70.

that loading capacity of polyglycol oils depends on molecular weight (linearly for each class) (fig. 2-4) [11, 18].

The review of sources on vegetable oils as alternative (to carbonic, mineral oils, synthetic liquids) lubricants, such as: row base, physicochemical, ecological, antifriction, viscous-temperature properties, chemical modification and using has been presented.

Advantages of the high thermostable polymers on the regular low thermostable as advanced composition

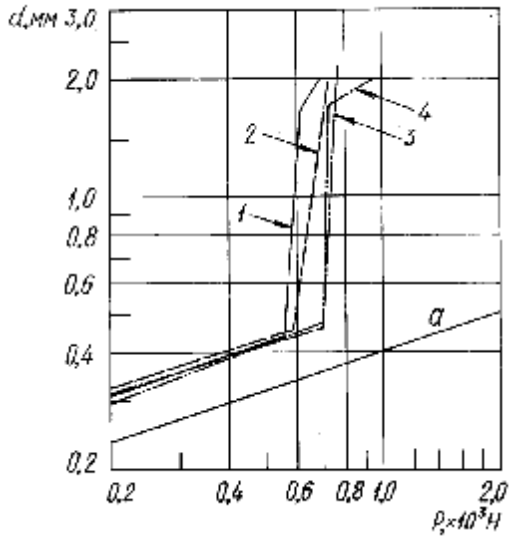

Fig. 4. Dependence of wear spot (d) on the axial loading (P) for ramified polypropyleneglycols: 1 – Polyol LG-56; 2 – Laprol 3003; 3– Syntheso 201 DS; 4 – Laprol 3503-2-70.

materials for metallo-polymer friction blocks in conditions of boundary loading and high temperatures using comparison analysis of physico-mechanical and thermal properties have been shown. Influence of character of polymer matrixes and fillers – carbon fibers on antifriction properties of composites in conditions of overboundary and boundary loading in friction with no and restricted lubrication has been found out. Wear stability increases when mixtures of high thermostable polymers as polymer matrix are used [13].

Antifriction and viscous-temperature properties of low-module potassium silicate solutions, naphthenic and mineral oils, synthetic liquids in point contact of four balls friction machine and on the stand of ball bearing and rolling have been studied. It has been determined that low-module potassium silicate solution imparts steel with high anti-wear and antiscuff properties. The mechanism of lubricating effect of potassium silicate solution have been found [14].

Methods and criterions of estimation of lubricating capacity of lubricants on the four-ball friction machine have been generalized. The three variants of newest methods of investigation on the four-ball friction machine have been studied. Using the newest methods, were found 2 peaks which relate to critical loading of different character – destruction of physical adsorptive layer (first peak) and chemical adsorptive layer (second peak). It has been determined that positive displacement of peaks depends on the modulus of oxyethylation of rape oil. The maximum effect occur under the sulfurization when using 3,5% S. The displacement of first peak in comparison with unmodified rape oil proceeds on 1069 N and of second – 4063-4802 N [15].

The research of the antifriction properties of naphtene and mineral oils has been discussed. Influence of the concentration and molecular mass of the PVBE on the antifriction properties of naphtene and mineral oils has been investigated [17].

Conclusions

1. Review of sources shows that solubility of oils in ethylene and of ethylene in oils at high pressure decreases when molecular mass and viscosity increase, when physic-chemical properties of hydrocarbon oils are not similar with ethylene, more over hydrocarbon oils with normal structure are less soluble in the ethylene than ramified.

2. Use of naphtene and polybutene oils for lubrication of friction pair of the ethylene high-pressure compressors substantially deteriorates using coefficient of compressors equipment, but use of polyglycol oils deteriorates properties of polyethylene – dielectrical and sanitarian-hygienical indexes and resistance to atmospheric and electromagnetic influences.

3. Alloying of compressors lubricants with viscous, antiseizure or others additives substantially decreases temperature of flashing and deteriorates dielectrical properties of polyethylene.

4. The ways of finding effective compressors oils are alloying of oils with high-temperature or viscous additives, which are similar to accordingly naphtene and polyglycol oils.

5. New correlations of viscous-and-thermal and antifriction properties of large class of polyglycol oils let find ways of creating high effective, compatible with polyethylene composition on its base.

6. For the first time dependence of seizure loading during testing on FBFM on the molecular mass of different polyglycols and bounding conditions for high viscous fluids (by extrapolation) are found.

7. Coefficients of logarithmic dependence of kinematic viscosity on temperature at 30º and 90ºC, at 30º and 60ºC, at 60º and 90ºC and their mean arithmetic and quadratic values and assessment of mean-quadratic deviation from mean arithmetic are brought into the procedure for assessment of viscous-and-thermal properties of lubrication oil. For the first time complex assessment of viscous-and-thermal properties of oil by 11 coefficients is used.

8. Into procedure of generalization assessment of antiwear properties of lubrication oils of the base of results of investigations antiseizure indexes dimensionless index of wear-mean-square relative deviation of diameter of spot of wear from the spot by Hertz has been brought in.

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[1] H.A. Sirenko, O. Kuzyshyn, A. Zavoiko. Problemi Tribologiï (Problems of Tribology) 3, 4, 149 (2003).
[2] G.O. Sirenko, O.V. Kuzishin, O.M. Zavojko. Problemi Tribologiï (Problems of Tribology). 1, 102 (2004).
[3] G.O. Sirenko, O.V. Kuzishin. Fizika i himija tverdogo tila 6(3), 508 (2005).
[4] G.O. Sirenko, O.V. Kuzishin. Fizika i himija tverdogo tila 7(3), 593 (2006).
[5] G.O. Sirenko, O.V. Kuzishin, L.Ja. Midak, L.M. Kirichenko, V.I. Kirichenko. Fizika i himija tverdogo tila 8(3), 641 (2007).
[6] G.O. Sirenko, L.Ja. Midak, O.V. Kuzishin, L.M. Kirichenko, V.I. Kirichenko. Voprosy himii i himicheskoj tehnologii 1, 172 (2008).
[7] O.G. Sirenko, N.I. Dzhurenko, O.V. Kuzishin, O.V. Shijchuk, G.O. Sirenko. Fizika i himija tverdogo tila 9(2), 394 (2008).
[8] G.O. Sirenko, L.Ja. Midak, O.V. Kuzishin, L.M. Kirichenko, V.I. Kirichenko. Polimernij zhurnal 30(4), 338 (2008).
[9] G.O. Sirenko, O.V. Kuzishin, B.L. Litvin. Fizika i himija tverdogo tila 10(1), 189 (2009).
[10] G.O. Sirenko, O.V. Kuzishin, O.G. Sirenko, L.Ja. Midak, L.M. Soltis. Fizika i himija tverdogo tila 10(2), 423 (2009).
[11] G.O. Sirenko, O.V. Kuzishin, V.P. Sviders'kij, R.V. Grinevich. Fizika i himija tverdogo tila 10(3), 678 (2009).
[12] O.V. Kuzishin, G.O. Sirenko, O.G. Sirenko, N.I. Dzhurenko, O.P. Palamarchuk, O.L. Sav'jak. Fizika i himija tverdogo tila 10(4), 905 (2009).
[13] G.O. Sirenko,L.V. Bazjuk, O.V. Kuzishin, V.P. Sviders'kij. Fizika i himija tverdogo tila 11(1), 224 (2010).
[14] G.O. Sirenko, O.V. Kuzishin, M.M. Dobrovol's'ka. Fizika i himija tverdogo tila 11(2), 469 (2010).
[15] O.V. Kuzishin, G.O. Sirenko. Fizika i himija tverdogo tila 13(2), 512 (2012).
[16] Gavrishkiv O., Zavojko O. Visnik Prikarp. un-tu im. Vasilja Stefanika. Ser. Himija. Vip. III, 142 (2002).
[17] O.V. Kuzishin, G.O. Sirenko, O.M. Zavojko. Visnik Prikarp. un-tu im. Vasilja Stefanika. Serija. Himija. Vip. IV, 57 (2004).
[18] O.V. Kuzishin, G.O. Sirenko. Visnik Prikarp. nac. un-tu im. Vasilja Stefanika. Serija. Himija. Vipusk V, 65 (2008).
[19] O.G. Sirenko, O.V. Kuzishin, N.I. Dzhurenko, O.P. Palamarchuk. Visnik Prikarp. nac. un-tu im. Vasilja Stefanika. Ser. Biologija. Vipusk IH, 72 (2008).
[20] O.V. Kuzishin, G.O. Sirenko, L.Ja. Midak, L.M. Kirichenko, V.I. Kirichenko, O.V. Shkribljak, G.I. Grinishin. Visnik Prikarp. nac. un-tu im. Vasilja Stefanika. Ser. Himija. Vip.VI, 46 (2008).

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Рослинні оливи і поліґліколі як основа для рідинних дисперсійних систем при граничних умовах динамічного контакту

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У роботі досліджені рослинні олії, мінеральні, нафтенові та поліґліколеві оливи, синтетичні рідини як мастильні матеріали для металевих поверхонь.

Ключові слова: рослинні олії, поліґліколі, тертя, зношування, мастило, нафтени, гідродинамічний ефект, навантажувальна здатність.