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CREATION OF NEW PERSPECTIVE OIL COMPOSITIONS BASED ON THE ESTERS OF CYCLIC POLYATOMIC ALCOHOLS AND PETROLEUM BASE OILS

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New oil compositions were prepared and investigated with additions of 10-20% symmetric and asymmetric esters of 2,2,5,5-tetramethylcyclopentanol and 2,2,6,6-tetramethylcyclohexanol into T-30 and T-46 base oils. It was found that with the addition of esters, the operational characteristics of the compositions are significantly improved: a viscosity index rises to 20-70 units, a flash point increases 30-80°C, a freezing point of 5-15°C decreases, and a thermal oxidative stability also increases.

Keywords: esters of polyatomic alcohols, petroleum base oils, operational properties of oil compositions, synergistic effect syndrome

The rapid development of technology in the modern era dictates the need to improve the quality of lubricants and fuels. The required lubricants should have high technical and thermo-oxidation stability, viscosity and temperature, low temperature-rheological properties. One of the most effective ways to create new, effective oil types (from an economic point of view) is to create new oil compositions and extensive and purposeful research works are currently underway in this direction [1-2].

At present, the components used in making synthetic and oil-based compositions are added in the amount of 5-20%, which is selected and manufactured according to the operation of machines and mechanisms. In the development of oil compositions, synergistic effects are also often found, which has a strong influence on oil quality indicators.

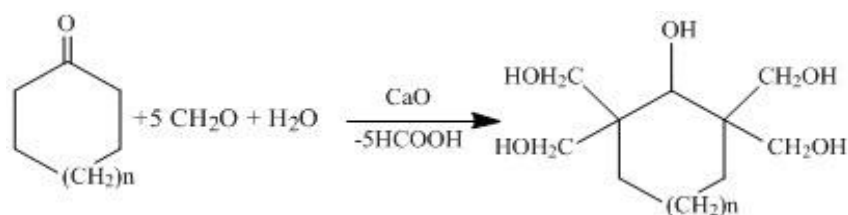
For this purpose, some symmetric and asymmetric esters of cyclic polyatomic alcohols

- 2,2,5,5-tetramethylcyclopentanol (TMCP) and 2,2,6,6-tetramethylcyclohexanol (TMCH) were synthesized and compositions were prepared with addition of 10-20% of their to petroleum oils and investigated.

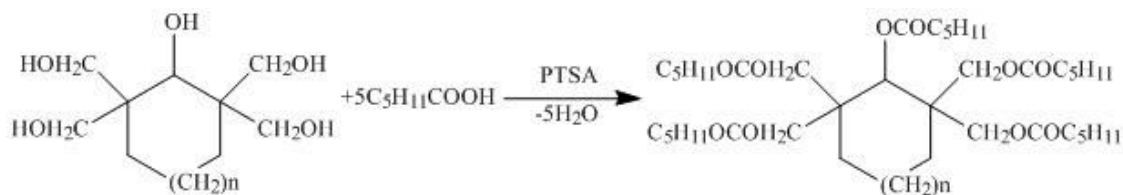
Experimental part

The primary alcohol used for the obtaining of some symmetric and asymmetric esters of cyclic polyatomic alcohols- 2,2,5,5-tetramethylcyclopentanol (TMCP) and 2,2,6,6-tetramethylcyclohexanol (TMCH) was synthesized by the way of condensation of cyclopentanone and cyclohexanone with formaldehyde in alkaline medium in the presence of CaO catalyst according to known method [3].

In order to obtain symmetric esters, the esterification reaction was carried out with the addition of capron acid to them by taking paratoluolsulfoacid (PTSA) as a catalyst.

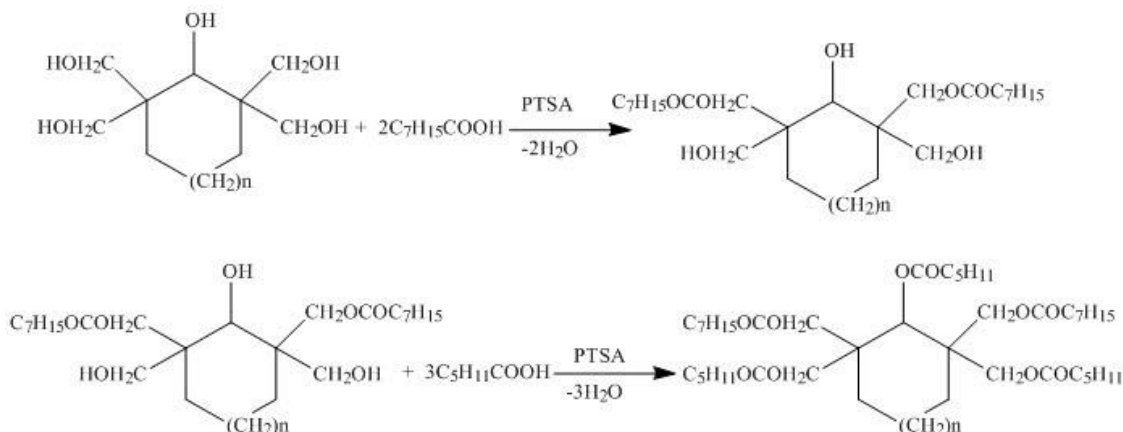


where, $n = 0, 1$



where, if $n = 0$, ester 1
if $n = 1$, ester 2

The synthesis of asymmetric esters of TMCP and TMCH is carried out in two stages: at the first stage diester of polyatomic alcohols is obtained by enanthic acid, at the second stage free hydroxyl groups are esterified with capron acid:



where, if $n = 0$, ester 3
if $n = 1$, ester 4

The synthesis of symmetric and asymmetric esters is carried out with PTSA as a catalyst at a temperature of $140-160^\circ C$ according to the known method. Finally, the esters were evacuated at a residual pressure of 2 mm Hg and temperatures up to $210-250^\circ C$ and separated individually and used [4-5].

The yield of esters was 85-90% of theoretical.

The structure of the esters was confirmed by IR and NMR spectroscopy, as well as by determining the molecular weight, ester and acid numbers. The viscosity-temperature and thermochemical stability of esters are also studied.

Discussion of the results

The viscosity-temperature parameters of the symmetric and asymmetric esters of polyatomic alcohols are given in table 1.

As seen from the table, the asymmetric esters (3, 4) have relatively high viscosity index

(135-137 units), flash point ($290-309^\circ C$) and low freezing point ($-50 \div -53^\circ C$) compared to symmetric esters.

Different oil compositions have been prepared and studied with the addition of 10-20% of symmetric and asymmetric esters in order to improve the properties of petroleum oils [6].

It comes to comparison of respective esters of TMCP and TMCH, the properties of the esters of TMCP are higher than the esters of TMCH.

The properties of oil compositions based on T-30 petroleum oil are given in table 2.

As seen from table 2, with the addition of different esters to the T-30 petroleum oil the viscosity is increased from $6.20 \text{ mm}^2/\text{s}$ to $8.12 \text{ mm}^2/\text{s}$ at $100^\circ C$, from $47.9 \text{ mm}^2/\text{s}$ to $49.56 \text{ mm}^2/\text{s}$ at $40^\circ C$, the viscosity index increases from 64 units to 89 units, the flash point increases from $214^\circ C$ to $276^\circ C$, freezing point drops from minus $34^\circ C$ to minus $48^\circ C$. In general, with the addition of the esters of TMCP and TMCH to T-30 petro-

leum oil, there is a sharp improvement in the its viscosity-temperature properties: the viscosity index, the flash point rise significantly, and the freezing point drops. A comparison of the esters shows that improvements with the addition of the esters of TMCP are higher which is explained by

the effect of the specific spatial conformations of the cyclopentane ring in the composition of the esters. A comparison of the esters among themselves shows that asymmetric esters of TMCP have better performance than symmetric ethers [8].

Table 1

Viscosity-temperature properties of the esters

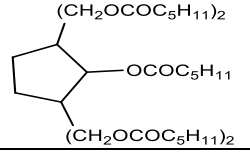
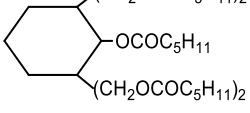
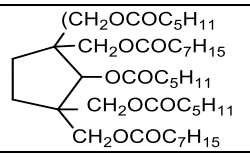
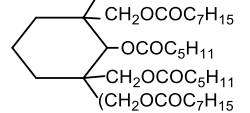
№	Esters	Viscosity, mm ² /s			Viscosity index	Temperature, °C	
		100	40	-30		freezing point	flash point
1		7.90	34.20	26346	125	-50	290
2		10.28	42.25	26500	125	-47	281
3		8.12	36.28	26760	137	-53	309
4		10.47	44.51	24300	135	-45	291

Table 2

Viscosity-temperature properties of the compositions

Content of compositions	Viscosity, mm ² /s		Viscosity index	Temperature, °C	
	100	40		freezing point	flash point
T-30 + 10% ester 1	6.50	30.65	69	-40	250
T-30 + 20% ester 1	6.90	34.21	78	-44	260
T-30 + 10% ester 2	6.75	32.56	67	-38	242
T-30 + 20% ester 2	7.18	36.23	74	-36	253
T-30 + 10% ester 3	6.78	33.61	79	-46	271
T-30 + 20% ester 3	7.56	42.11	86	-48	276
T-30 + 10% ester 4	7.95	46.16	75	-43	273
T-30 + 20% ester 4	8.12	49.56	78	-41	270
T-30 petroleum oil	6.20	47.9	64	-34	214

The oil compositions were prepared by the addition of the esters of TMCP and TMCH to T-46 base oil, and the results are presented in table 3.

As seen from the table, with the addition of the esters (10-20%) to T-46 petroleum base oil, the viscosity of esters increase from 8.61 mm²/s to 9.25 mm²/s at 100°C, the viscosity index increases from 69 units to 146 units, the flash point increases from 199°C to 285°C, and the freezing point drops from minus 30°C to minus 45°C. Generally, all data of compositions show significant improvement compared with T-46 base oil. It comes to the type of esters, it has been noted that there are better indications for the presence of the TMCP. In both cases,

the data of asymmetric esters is higher than that of symmetric esters. The highest data was recorded in the symmetric esters of the TMCP: the viscosity index increases from 69 units to 140 units, the flash point increases from 199°C to 280°C, and the freezing point drops from minus 30°C to minus 48°C.

In this case, the synergistic effect syndrome in oils is self-evident that this should also be noted as the best results achieved in the prepared compositions [9-10].

The thermo-oxidation stability of the prepared oil compositions (20% of ester) was also studied (GOST 11063-77, 10 hours) and the results are given in table 4.

Table 3

Viscosity-temperature properties of compositions

Content of compositions	Viscosity, mm ² /s		Viscosity index	Temperature, °C	
	100	40		freezing point	flash point
T-46 + 10% ester 1	8.30	40.8	74	-35	220
T-46 + 20% ester 1	8.15	38.6	80	-42	215
T-46 + 10% ester 2	8.80	44.5	73	-32	220
T-46 + 20% ester 2	9.23	48.12	78	-34	236
T-46 + 10% ester 3	8.60	41.23	135	-45	260
T-46 + 20% ester 3	8.70	43.01	140	-48	280
T-46 + 10% ester 4	8.90	45.20	78	-36	232
T-46 + 20% ester 4	9.25	47.38	81	-38	240
T-46 petroleum oil	8.61	81.33	69	-30	199

Table 4

Thermal-oxidative properties of compositions

Content of compositions	The precipitate,% wt.	Viscosity, mm ² /s			Evaporation % wt.			loss, %
					weight of substances, gr			
		before	after	increase, %	before	after	loss	
T-30	0.36	6.20	7.50	0,0020	35.75	35.27	0.86	0.24
T-30 + ester 1	0.22	6.50	7.80	0.0030	34.90	34.70	0.20	0.17
T-30 + ester 2	0.30	6.75	8.12	0.038	33.70	33.52	0.15	0.16
T-30 + ester 3	0.20	6.80	8.41	0.025	33.52	33.40	0.13	0.12
T-30 + ester 4	0.40	7.95	9.14	0.040	38.60	35.20	0.26	0.16
T-46	0.51	8.61	9.61	0.012	32.27	32.27	0.27	0.25
T-46 + ester 1	0.38	8.15	9.26	0.032	36.40	36.38	N/A	0.00
T-46 + ester 2	0.28	8.80	10.20	0.036	39.23	39.20	N/A	0.00
T-46 + ester 3	0.32	8.50	9.70	0.030	35.42	35.30	N/A	0.00
T-46 + ester 4	0.43	9.00	10.60	0.038	36.30	36.40	N/A	0.00

As seen from table 4, in the compositions which made by T-30 petroleum oil, the sediment content decreased from 0.36% to 0.20%, and in the compositions with T-46 from 0.51% to 0.28%. After the evaporation of the compositions by T-30 oil, the amount of the loss fell from 0.24% to 0.12%, and in the compositions with T-46 oil declined from 0.27% to zero.

As it is seen, it is observed a sharp improvement of TOS in the compositions made on the basis of T-30 and T-46 petroleum base oils. Since the created oil compositions meet all the requirements for the base oils currently applied in the industry and in the future, their use in various industries may be advisable [11].

Thus, symmetric and asymmetric esters of cyclic polyatomic alcohols - TMCP and TMCH with capron and enant acids were synthesized and their oil compositions were prepared and investigated with additions of 10-20% of esters into T-30 and T-46 petroleum base oils. It has been found that there is a significant improvement in oil composition with the addition of the esters: the viscosity index and flash temperature rise and the freezing temperature drops. As for the TOS, the amount of sediment and the amount of loss after evaporation are significantly reduced. In some compositions, there is a sharp improve-

ment that is also explained by the synergistic effect syndrome that is characteristic of oils.

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TSİKLİK ÇOXATOMLU SPİRTLƏRİN MÜRƏKKƏB EFİRLƏRİ VƏ NEFT BAZA YAĞLARI ƏSASINDA YENİ PERSPEKTİV YAĞ KOMPOZİSİYALARININ YARADILMASI

M.Ə.Məmmədیارov, H.N.Qurbanov, L.M.Yusifova

2,2,5,5-tetrametiloltsiklopentanol (TMTP) və 2,2,6,6-tetrametiloltsikloheksanolun (TMTH) simmetrik və qeyri-simmetrik efirlərinin T-30 və T-46 neft baza yağlarına 10-20% əlavəsilə yeni yağ kompozisiyaları hazırlanmış və tədqiq edilmişdir. Müəyyən edilmişdir ki, efirlərin əlavəsilə baza yağlarının istismar keyfiyyət göstəriciləri xeyli yüksəlir: özlülük indeksi 20-70 vahid yüksəlir, alışma temperaturu 30-80°C artır, donma temperaturu isə 5-15°C aşağı düşür, termooksidləşmə stabilliyi yüksəlir.

Açar sözlər: çoxatomlu spirtlərin efirləri, neft baza yağları, yağ kompozisiyalarının istismar xassələri, sinergetik effekt sindromu

СОЗДАНИЕ НОВЫХ ПЕРСПЕКТИВНЫХ МАСЛЯНЫХ КОМПОЗИЦИЙ НА ОСНОВЕ СЛОЖНЫХ ЭФИРОВ ЦИКЛИЧЕСКИХ МНОГОАТОМНЫХ СПИРТОВ И НЕФТЯНЫХ БАЗОВЫХ МАСЕЛ**М.А.Мамедьяров, Г.Н.Гурбанов, Л.М.Юсифова**

Созданы и исследованы новые смазочные композиции на базе симметричных и несимметричных эфиров 2,2,5,5-тетраметилолциклопентанола и 2,2,6,6-тетраметилолциклогексанола (10-20%) и базовых нефтяных масел Т-30 и Т-46. Найдено, что с добавлением эфиров значительно улучшаются эксплуатационные характеристики композиций: повышаются индекс вязкости 20-70 ед., температура вспышки 30-80⁰С, понижается температура застывания 5-15⁰С, а также повышается термоокислительная стабильность.

Ключевые слова: *эфиры многоатомных спиртов, нефтяные базовые масла, эксплуатационные свойства масляных композиций, синдром синергетического эффекта*