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ENGINE OILS WITH A NEW COMPOSITION OF ADDITIVES

by

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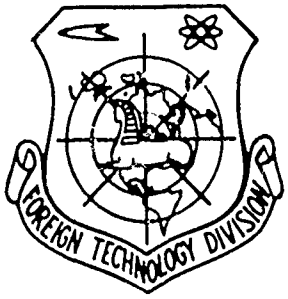

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An alk. additive compn. IKhP (2.6% BFK, a Ba salt of a CH2O-alkylphenol condensation product; 1.4% SB-3, a Ba sulfonate; 1.2% IN-KhP-21, a Ba salt of a CH2O-NH3-alkylphenol condensation product, 0.005% PMS-200A, and 0.5% AzNII) imparted to bakin oils AS-6 and AS-10 the required detergency and resistance to oxidn., corrosion, wear, and lacquer and sludge formation for use in carburetor engines. [AT1202024]

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Lubricant Additive						
Detergent Additive						
Anticorrosion Additive						
Antioxidant Additive						
Lubricating Oil/(U)IKhP Lubricant Additive						
(U)BFK Lubricant Additive						
(U)SB3 Lubricant Additive						
(U)AS-6 Crude Oil						
(U)AS-10 Crude Oil						

EDITED TRANSLATION

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At present oils for carburetor automobile engines are being turned out from the Baku crudes following ГОСТ 1862-63 [ГОСТ = GOST = All Union State Standard] and from Vostochnyy according to GOST 10541-63. The issue of oils according to GOST 1862-63 is specified from Baku crudes with additive SB-3, SK-3 and AzNII-8u. Because of the deficiency of high-efficiency additives, the oils according to GOST 1862-63 are being produced with the less effective additive AzNII-8u, and according to GOST 10541-63 with additive VNII NP-360.

The oils turned out according to GOST 1862-63 are not intended for modern automobile engines. Moreover, the production of oils according to GOST 10541-63 is concentrated in the Vostochnyy raions of the country, which means that the south and west raions of the country are experiencing difficulties in supplying their fleet of automobile vehicles with these oils.

The Institute of Chemistry of Additives (IKhP) of the Academy of Sciences Az. SSR has synthesized a series of new effective additives. These include the alkylphenol additive BSK, which is

a barium salt of the condensation products of alkylphenol with formaldehyde, and the antioxidant additive INKhP-21, which is a barium salt of the condensation products of alkylphenol with ammonia and formaldehyde treated with phosphorous pentasulfide. On the basis of these additives in combination with the earlier-developed detergent additives SB-3 (barium sulfonate), which is a barium salt of sulfo acids, and the antifoaming additives PMS-200A IKhP AN AzSSR a new additive composition was developed, containing 2.6% VFK, 1.4% SB-3, 1.2% INKhP-21, 0.005% PMS-200A and 0.5% depressor AzNII (later called composition of IKhP additives).

Table 1 gives the main physicochemical quality indices of the Baku oils AS-6 and AS-10 with this additive composition and oils AS-8 and AS-10 GOST 10541-63, which were used as the standards for comparison. The same table gives the indices for the Baku commercial oils ASp-6 and ASp-10 with 5% additive AzNII-8u, previously tested at NIIAT.

The data of Table 1 showed that oils with additive composition 2.6% BFK + 1.4% SB-3 + 1.2% INKhP-21 + 005% PMS-200A + 0.5% depressor AzNII possess a great reserve of alkalinity and have significantly higher oxidation stability in comparison with commercial oils GOST 1862-63 and 10541-63.

In addition to physicochemical analysis of the properties of experimental oils, their antioxidant stability in the finely-dispersed state was checked in a NIIAT instrument.

The results of oil oxidation in the NIIAT instrument, given in Table 2, show that the experimental additive composition possesses better antioxidant properties in comparison with oils having additive AzNII-8u (excluding the viscosity increase in oil ASp-10) and is near oils with additive VNII NP-360.

Table 1. Basic indices of physicochemical properties of oils with additives.

Quality indices	Oil AS-10			Oil AS-6		
	with 5% AzNII-8u	with 2.6% BFK, 1.4% SB-3, 1.2% INKhP-21, 0.5% depressor AzNII	oil AS-10 with 3.5% VNII NP-360	with 5% AzNII-8u	with 2.6% BFK, 1.4% SB-3, 1.2% INKhP-21, 0.5% depressor AzNII	oil AS-10 with 3.5% VNII NP-360
Kinematic viscosity, cSt, at a temperature of:						
100°C	10.38	11.24	10.26	7.0	7.93	7 99
50 °C	66.98	71.82	55.9	35.2	42.09	40.57
0°C	3 379	3 447	1 118	1 274	785	700
-10°C	13 049	21 213	–	4 901	2 752	1 841
-15°C	26 990	–	–	–	–	4 053
-20°C	–	–	–	26 564	11 936	–
Ratio of kinematic viscosities:						
at 50° and 100°C	6.44	6.38	5.46	5.03	5.30	5.08
at 0° and 100°C	326	306	109	182	98.7	87.7
Index of viscosity	60	70	92	74	76	86
Freezing point, °C	-27	-25	-12	-38	-32	-28
Flash point, determined in an open crucible, 0°C	204	227	218	180	190	210
pH value, pH	9.15	10.0	12.7	9.1	10.6	10.1
Content of water-soluble acids and alkalis	Alkaline reaction					
General alkalinity, titration to pH-4; mg KOH per 1 g of oil	0.8	0.93	0.99	0.9	1.8	1.63
Ash content, %	0.398	0.58	0.55	0.370	0.543	0.504
Amount of additive base, %						
barium	0.217	0.348	0.306	0.235	0.344	0.263
phosphorous	–	0.04	0.025	–	0.02	0.015
Amount of sulfur, %	0 23	0.26	0.31	0.26	0.17	0.80
Amount of impurity, %	0.07	0.028	0.044	0.155	0.008	0.025
Amount of water, %	0.05	none	0.035	none	none	none
Oxidation stability according to the Papok method at 250 °C, min	19	67	35	20	74	31
Detergent properties by PZB, marks	2.0	–	2.0	1.5	1.0	1.0

Table 2. Results of oil oxidation in NIIAT instrument for 20 hours.

Oil	Accumulation of oxidation products, insoluble in petroleum ether, %	Drop in pH values	Increase in acid number, titration to pH-10; mg KOH per 1 g oil	Increase in kinematic viscosity at 100°C, cSt
Oil AS-10 with 2.6% VFK, 1.4% SB-3, 1.2% INKhP-21 and 0.5% depressor AzNII....	0.96	2.85	0.268	0.73
Oil AS-10 with 5% AzNII-8u.....	0.132	5.16	0.415 (to pH-8.5)	1.54
Oil AS-10 with 3.5% VNII NP-360.....	none	5.50	0.253	0.59
Oil AS-6 with 2.6% VFK, 1.4% SB-3, 1.2% INKhP-21 and 0.5% depressor AzNII.....	0.190	4.25	0.538	1.60
Oil AS-6 with 5% AzNII-8u.....	0.34	5.3	0.560	1.13
Oil AS-8 with 3.5% VNII NP-360.....	none	4.05	0.403	1.0

The operational tests of the oils were made with automobiles GAZ-51, ZIL-164 and ZIL-130 in Egor'evska ATK No. 1416 in conditions of ordinary transportation operations of conveying industrial and agricultural loads.

Before beginning the automobile engine tests, they were partially dismantled in order to examine and count the parts and subassemblies.

In order to determine the cylinder wear in three areas and in two mutually perpendicular planes, craters were inflicted and measured with a UPOI-6. In these same areas and planes micro-measurements were made of the cylinders. The wear of the piston rings and connecting rod bearings was determined by weighing them before and after testing.

During the period of operational testing the oil was changed every 9000 km of running (oil AS-6 and AS-10 with additive AzNII-8u every 6000 km), and the filters were changed and cleaned by centrifuging every 3000 km. Oil is added to compensate for waste and losses to meet the actual requirement.

Automobiles GAZ-51 and ZIL-164 were operated on commercial nonethyl automobile gasoline A-66 and automobiles ZIL-130 were operated on nonethyl gasoline A-76.

The main indices for evaluating the quality of the experimental and commercial oils during tests were the state of the engine parts, wear, deposits of sludge and varnish, and also the change in the physicochemical indices of the oil during the engine operation.

Table 3 gives the average wear data of the main engine parts, grouped according to the brands of oils and additives and the engine models. From the data of Table 3 we see that the wear of the main engine parts was approximately the same for all the tested oils. The differences in the amount of wear between the groups of oils were less than the differences between the individual automobiles in each group. Oil with additive AzNII-8u was changed after 6000 km of running, and for all other oils after 9000 km of running. Thus, in terms of antiwear properties the experimental oils with additive composition IKhP An Az. SSR were not inferior to commercial oils with additives VNII NP-360 and AzNII-8u.

The results of examining the engines after testing also testified to the good operational properties of oils with the new additive composition. No cases of piston ring scorching were observed after the operational tests. In the piston grooves during operation using oil with additive composition IKhP AN Az. SSR dark varnish and particularly carbon deposits were observed; during operation using commercial oils following GOST 1862-63 and

Table 3. Average engine wear during testing.

Oils	Average run of one automobile during testing, thous. km	Cylinder wear, μm per 10^3 km automobile run			Weight loss, g per 10^3 km	
		in terms of crater measurement	According to data of micro-measurement	Average	Piston Rings	Connecting rod deposits
Baku AS-10 with 2.6% BFK, 1.4% SB-3, 1.2% INKhP-21, 0.5% depressor AzNII.....	18/22	19/16	21/19	20/18	0.522/0.52	0.233/0.153
Baku AS-10 with 5% AzNII-8u.....	22/51	16/12	22/16	19/14	0.65/0.36	0.24/0.18
Vostochnyy AS-10 with 3.5% VNII N -360.....	16/18	15/18	19/20	17/19	0.513/0.571	0.201/0.212
Baku AS-6 with 2.6% BFK, 1.4% SB-3, 1.2% INKhP-21, and 0.5% depressor AzNII.....	40*	8*	8*	8*	0.111*	0.100*
Baku AS-6 with 5% AzNII-8u.....	24/39	15/21	18/23	17/22	0.36/0.26	0.17/0.14
Vostochnyy AS-8 with 3.5% VNII NP-360.....	18/33 33*	15/16 8*	21/21 7*	17.5/19.5 7.5*	0.295/0.339 0.108*	0.203/0.112 0.066*

Note: The numerator gives data for the engine GAZ-51, and the denominator gives data for the engine ZIL-164. The asterisk indicates data for the engine ZIL-130.

GOST 10541-63 a considerably greater amount of carbon deposit was observed. Individual cases of carbon deposit contact with piston rings were observed.

Table 4 gives the results of a conditional six-mark estimate of deposits on engine parts after testing. An absence of deposit was evaluated as a mark of 0, and the greatest amount of deposit was evaluated at a mark of 6.

From the data of Table 4 it follows that oils with additive composition IKhP AN Az. SSR assures the least contamination of NP-360 or AzNII-8u.

Table 4. Evaluation of oils in terms of engine contamination by varnish and sludge deposits.

Form of deposit and model of engine	Oil AS-10			Oil AS-6		
	with 5% AzNII-8u	2.6% BFK, 1.4% SB-3, 1.2% INKhP-22	Oil AS-10 with 3.5% VNII NP-360	with 5% AzNII-8u	2.6% BFK, 1.4% SB-3, 1.2% INKhP-21	Oil AS-8 with 3.5% VNII NP-360
Varnish formation, marks:						
GAZ-51	3.3	3.3	4.0	4.0	2.75	3.0
ZIL-164	1.0	1.5	2.3	3.0	1.0	1.5
ZIL-130	—	—	—	—	4.5	4.75
Sludge formation, marks:						
GAZ-51	1.1	1.0	0.7	1.1	0.4	1.6
ZIL-164	0.7	0.8	1.2	0.85	0.4	0.6
ZIL-130	—	—	—	—	0.8	0.7

Comparison of the intake and exhaust valves, cylinder faces and other parts was approximately the same.

The antioxidant, anticorrosive and detergent properties of the considered oils, and the stability of the additives were also evaluated from the results of analyzing the oil samples taken

from the oil lines of the engines.

Table 5 gives the average values of the main quality indices for the oils. From the data it follows that in summer oils (AS-10, ASp-10) oil with additive composition IKhP AN Az SSR on the average caused a somewhat greater accumulation of oxidation and polymerization products than oils with additive AzNII-8u and with additive VNII NP-360. In the winter oils (AS-6 and AS-8) the oil with additive composition IKhP AN Az SSR caused significantly less formation of the organic impurities than oil with additives AzNII-8u and somewhat more than oil with additives VNII NP-360. Approximately the same position was observed with the accumulation of noncombustible impurity components.

Analysis of data on the amount of organic impurity components, deposits on the filter units shows that the antioxidant properties of oil with additive component IKhP An Az. SSR is higher then oils with additives AzNII-8u.

We also note the best dispersive properties of oils with additive composition IKhP AN Az. SSR, which caused less deposit on the filter units than oils with additives AzNII-8u and VNII NP-360.

The anticorrosive properties of the oils and the accumulation of acid compounds in them are characterized by the pH index.

The significantly greater reserve of alkalinity in fresh oils with additive composition IKnP AN Az SSR and with additive VNII NP-360 as compared to oils with additive AzNII-8u created high pH values (pH 4-5) in the final tests of the oil.

In summer use conditions the oil with new additive composition IKhP AN Az. SSR showed better results than commercial oil ASp-6 with additive AzNII-8u. During engine operation the pH for oil

Table 5. Average values of quality indices for working oils after automobile test run of 9000 km.

Quality indices	Working oil AS-10 with 5% additive AzNII-8u		Working oil AS-10 with 2.6% BFK 1.4% SB-3 1.2% INKhP-21		Working oil AS-10 with 3.5% VNII NP-360		Working oil AS-6 with 5% additive AzNII-8u		Working oil AS-6 with 2.6% BFK 1.4% SB-3, 1.2% INKhP-21		Working oil AS-8 with 3.5% VNII NP-360	
	GAZ-51	ZIL-164	GAZ-51	ZIL-164	GAZ-51	ZIL-164	GAZ-51	ZIL-164	ZIL-130	ZIL-164	ZIL-130	ZIL-164
Kinematic viscosity at 100 C, cSt	10.12	10.3	11.5	11.6	10.2	9.64	8.4	7.5	7.63	7.60	8.36	8.40
Total impurity content, %:	1.150	0.992	1.464	1.369	1.244	1.265	2.100	2.040	1.179	1.030	0.859	1.201
Including:												
organic component	0.878	0.708	1.086	0.965	0.903	0.765	1.762	1.690	0.945	0.696	0.772	0.400
noncombustible components	0.222	0.284	0.378	0.404	0.341	0.500	0.338	0.350	0.234	0.336	0.117	0.400
Oil index	4.0	4.84	3.92	5.35	4.07	4.96	3.8	3.8	4.23	4.40	3.82	3.86
Amount of base addition, %	0.174	0.169	0.268	0.[illegible]	0.168	0.141	0.13	0.26	0.120	0.225	0.070	0.136
Total amount of oil, l/1000 km	6.3	8.0	3.3	8.1	3.7	7.2	4.6	5.3	2.3	—	2.5	—
Gain in weight of filter units, g/1000 km	33	29	23.6	88	18	25	48	87	20.5	—	24.3	—

with additive AzNII-8u dropped to pH 3.8.

In all the engines the oil with additive composition IKhP AN Az. SSR had a greater amount of the barium additive base when it was changed than oils with additives AzNII-8u and VNII NP-360.

On the basis of the test results oils AS-6 and AS-10 with additive composition 2.6% BFK + 1.4% SB-3 + 1.2% INKhP-21 + 0.005% PMC-200A and 0.5% depressor AzNII, which possess good detergent and antioxidant properties, were recommended for production and use in both old model automobiles and in current automobiles with carburetor engines ZIL-130 and GAZ-53.

The production of oils with the new additive composition makes it possible to use higher quality oils, increases the motor potential of the engines and reduces the costs of automobile servicing and repair.

In addition, this assures high-quality oils for the southern raions of the country, where there has been no production of oils for modern carburetor engines.

The use of the new oil with effective additive composition for both the older and the current engines will unify motor oils, which considerably simplifies the conditions of using automobile transportation.

In order to obtain a more complete evaluation of the effectiveness of using the new additive composition for all types of automobile carburetor engines, it is necessary to test this composition with the Vostochnyy base oil, and also to compare it with other oils following GOST 10541-63 and the possibility of their joint use and interchange.