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USE OF DV-ASZp-10V (M-6z/10V) OIL IN ENGINES OPERATING AT DIFFERENT LEVELS OF STRESS

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The effective and rational utilization of lubricants is one of the most important tasks of chemmotology. This task can be accomplished by selecting motor oils for particular engines so that the oil quality will correspond to the level of thermal stress and the operating conditions of the engine and will thus give reliable operation of the engine. Engine manufacturers often tend to overstate the requirements on oil quality. In the selection of oils for an engine, account should be taken of the need for unification of grades, which in recent years has become more and more important as a measure to reduce the number of different fuels and lubricants that are manufactured and supplied commercially [1].

A case in point in the unification of motor oils is the need for studying the possibility of using the motor oil DV-ASZp-10V (M-6z/10V) in future models of automotive vehicles with the KamAZ-740 engine, in place of the oils M-8GFz (winter) and M-10GF*l* (summer), which have been specified in the corresponding lubrication charts [2]. This replacement will make it possible to expand the field of application of the DV-ASZp-10V oil and to eliminate the seasonal change of oil in the KamAZ-740 engine. The universal all-season oil DV-ASZp-10V (TU 38101155–76) is intended for use in diesel and carburetor engines with an oil drain period of 15,000-18,000 km of vehicle travel. Two versions of this oil are to be produced, one with a solid point of −40°C with ASV-5 oil base stock, and the other with a solid point of −30°C with ASV-6 oil base stock. The M-8GFz and M-10GF*l* oils (conforming to TU 38101651–76) are obtained by compounding distillate and residual components produced from medium-sulfur crudes. They are recommended for the lubrication of high-speed, high-performance diesels (YaMZ-238N and YaMZ-240N models, and others) under winter and summer operating conditions. The physicochemical properties of these oils are listed in Table 1, along with certain service properties.

Recommendations for the rational utilization of oils can be based on correlation of operating experience and on laboratory tests in model single-cylinder test units and in multicylinder engines on the test stand. In resolving the problem as it has been presented, it has been found advisable to carry out a more detailed evaluation and comparison of quality for the oils DV-ASZp-10V, M-10GF*l*, and M-8GFz, and also to analyze the level of thermal stress and the oil operating conditions in the KamAZ-740 engine. For this purpose, tests were performed in accordance with the methods specified in the GOST 17479–72 standard as classification tests. In characterizing the detergency, the DV-ASZp-10V oil was tested in a UIM-6-NATI unit in accordance with GOST 21490–76. These results were compared with data from tests on the reference oil M-10V_2 (TU-3840159–73). The results on the two oils (Table 2) were equivalent. This means that the DV-ASZp-10V oil can be classed in group V_2 with respect to detergency.

The M-8GFz and M-10GF*l* oils were tested in the UIM-6-NATI unit in accordance with GOST 21490–76. The quality of these oils was rated by comparing the test results with those obtained on the reference oil M-10G_2 (TU-3840159–73). These results (Table 3) indicate that the M-10GF*l* oil and the M-10G_2 reference oil are essentially equivalent. In the test on the M-8GFz oil, the oil consumption was higher and the oil system

* As in Russian original – Translator.

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TABLE 1. Physicochemical and Service Properties of DV-ASZp-10V, M-10GFl, and M-8GF$_Z$ Oils

Indices	Oil		
	DV-ASZp-10V	M-10GFl	M-8GF$_Z$
Viscosity, mm^2/sec			
at 100°C	10.1	11.1	8.0
at −50°C	46.2	63.4	36.9
at −18°C	6648.0	–	–
Solid point, °C	−30	−15	−30
Flash point (open cup), °C	210	233	201
Content			
solid contaminants, %	0.012	0.01	0.01
water	None	Trace	
Sulfated ash, %	1.12	0.92	1.0
Base number, mg KOH/g	6.5	6.6	6.5
Detergent potential, %			
at 250°C	80	70	70
at 300°C	30	50	50
Detergency (PZV apparatus, severe method), demerit rating	1.0	0.5	0.5-1
Varnish formation tendency (in "sliding ring" apparatus at 330°C), varnish equiv.	10	6.5	14.0
Corrosivity (in PZV unit, g/m^2)			
lead	7	1	0
copper	3	1	1

TABLE 2. Test Results on DV-ASZp-10V and Group V$_2$ Reference Oil in UIM-6-NATI Unit

Indices	Oil	
	DV-ASZp-10 V	M-10V$_2$ Reference oil
Ring mobility demerit rating	0.0	0.0
Piston deposit demerit rating		
first groove	2.2	3.9
all grooves	4.1	5.9
lands	1.4	1.8
skirt	0.0	0.0
drain holes	0.0	0.0
inside surface of head	0.6	0.9
overall rating	6.1	7.7
Ring wear, mg		
first	235	470
set	540	835
Wear on rod bearing inserts, mg	17	40

pressure lower than the limits required by GOST 21490−76. With the exception of these deviations, the test results obtained on the M-8GFz oil may be considered as satisfactory.

An attempt had been made previously to correlate laboratory and engine test results, in line with modern views of the mechanism of detergency for additive oils [3]. On the basis of the model that has been proposed for detergency, it was found possible to express the tendency of the oils to form carbonaceous deposits (S) by a ratio between an index characterizing the antioxidant properties of the oil (a) and an index character-

TABLE 3. Test Results on M-10GFl, M-8GFz, and G_2 Reference Oil in UIM-6N-NATI Unit

Indices	Oil		
	M-10GFl	M-8GFz	M-10G_2 Reference oil
Ring mobility demerit rating	0.0	0.0	0.0
Piston deposit demerit rating			
first groove	2.63	3.71	4.5
all grooves	5.17	7.75	5.85
lands	1.22	1.98	0.2
skirt	0.0	0.0	0.0
drain holes	0.0	0.0	0.0
inside surface of head	0.8	0.9	0.54
overall rating	7.3	10.6	6.6
Ring wear, mg			
first	505	540	440
set	875	870	805
Wear on rod bearing inserts, mg	25	45	31
Oil consumption by burning, g/h	82	205	55

Note. During the tests on the M-8GFz oil, the oil system pressure was 0.19 MPa, instead of the 0.25 MPa as specified in GOST 21490−76.

izing the detergency of the oil (M). The effectiveness of motor oil detergency is determined by several factors, in particular the surface and bulk properties of the additives. The surface properties of the additives characterize the true detergency of the oil (S_S), and the bulk properties characterize the solubilizing, dispersing, and ultimately the stabilizing properties of the system (S_b). The overall level of detergency for additive oils can be approximated by the expression

$$S \approx \frac{a}{M} \approx \frac{a}{S_s + S_v}$$

It was also noted that, in determining the indices appearing in this formula, various laboratory test methods can be used [3]. In the present case, it has been of interest to determine just how objective are the quantitative ratings of additive oil detergency and how well they agree with test results on oils in single-cylinder units.

The susceptibility of oils to oxidation(OS) was rated on the basis of the quantity of oxygen absorbed in an RSL unit [4] in a 7-h test at 200°C; the dispersancy was rated on the basis of the detergent potential (DP) at 250°C (in accordance with GOST 10734−64); the true detergency (DT) was rated according to the reciprocal of the level of oil detergency as determined in a PZV unit, using the severe test conditions [5]. In calculating the correlation index S of detergency for additive oils, the following relationship can be proposed:

$$S \approx OS/(DPM - DT \cdot 100)$$

The results from determination of these indices, along with calculated values of the correlation index characterizing the oil detergency (Table 4), support the results obtained in the classification tests in the UIM-6-NATI and UIM-6N-NATI units. A more detailed analysis of this relationship shows that at higher temperatures (higher heat load and thermal stress), the value of S is considerably higher, particularly for the DV-ASZp-10V oil. Thus, the detergency at 300°C is about twice that for the M-10GFl and M-8GFz oils (see Table 1). At lower temperatures, in contrast, the index characterizing the detergency of these oils tends to approach a common level. Such an analysis makes it possible to arrive at a more rational and effective selection of the optimal oils, with due regard for the operating conditions and thermal stress in the engine.

An analysis of the operating conditions for the KamAZ-740 engine, using the indices proposed in [6], shows that this engine is not classed as a high-performance engine. In terms of operating stress, it is practically equivalent to the YaMZ-236/238 and YaMZ-238NB engines (the criterion of thermal stress, as calculated in the cited work for the engines YaMZ-236/238, KamAZ-740, and YaMZ-238NB, was 0.530, 0.535, and 0.545, respectively). On this basis, with due consideration of the changes in oil detergency with temperature,

TABLE 4. Detergency and Oxidation Resistance of DV-ASZp-10V, M-10GFl, and M-8GFz Oils

Indices	Oil		
	DV-ASZp-10V	M-10GFl	M-8GFz
Detergent potential (DP) at 250°C,%	80	70	70
DT·100, %	100	200	150
OS, ml/100 g	811	828	840
S_{calc}	4,5	3,1	3,8

the DV-ASZp-10V oil has been recommended for use in the KamAZ-740 engine. Tests under service conditions have confirmed the correctness of this recommendation. Finally, the DV-ASZp-10V oil has been included in the lubrication chart for the KamAZ-740 engine with the same oil change periods as for group G_2 oils.

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INDUSTRY-BRANCH UNIFICATION OF DIESEL OILS

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The basic principles of industry-branch unification of lubricating oils for general-purpose industrial diesels, the advantages of unification of diesel oils for the given consumer branch of industry, and the minimal assortment of unified grades have been discussed previously [1]. Experiments in the application of the principles originally formulated for industry-branch unification have demonstrated the correctness of these principles, but have also shown the advisability of improvements in the unification procedures. This article is devoted to certain urgent problems in the industry-branch unification of diesel oils. The main principle of this unification consists of the establishment of a strictly limited and rather stable assortment of products, along with the use of a minimal number of unified grades of oil by each consumer or group of related consumers.

Thanks to the high level of service properties of the oils included in the unified product list in 1975 [1], it has been possible to satisfy the increasingly severe requirements on oils for marine diesels without introducing any new grades. For the reliable lubrication of marine diesels at the higher performance levels, in which the rubbing parts operate at higher loads and temperatures, it has been adequate to simply increase the oil viscosity, without changing the additives package. For example, the new oils M-14G_2TsS, M-16G_2TsS, M-14DTsL20, and M-14DTsL30 are analogues of the unified oils M-10G_2TsS, M-10DTsL20, and M-10DTsL30; and the new oil M-20E60 is an analogue of the unified oil M-16E60 [2]. The new oils differ only in having a higher viscosity for the oil base stock. This means that it is possible to set up viscosity series of oils in the unified grades.

In connection with changes in the diesel locomotive fleet, it has become necessary to add one more grade of oil to the unified product list. For new locomotive diesels of the ChN 26-26 type with a power of 2945 kW,

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