life and equipment operating life will amount to several million rubles. The use of this oil will eliminate the need for production and supply (to airports) of the synthetic oils 36/1, VNII NP-75A, VNII NP-5, VNII NP-50-1-4f, and others.

Oils for Turboprop Engines. Currently used in turboprop engines are several oil blends and the mineral oil MN-7.5. Also, the technical documentation on the engines calls for the synthetic oil VNII NP-7. The oil blends are relatively poor in service properties, but the VNII NP-7 oil is not available in adequate quantities because of the limited raw material supply. The best of the mineral oils is the MN-7.5. But even this oil does not fully satisfy the engine requirements, since it tends to form deposits on the parts. These deposits that are readily removed from the metal and transported by the oil flow to the filters, so that there is certain danger of filter plugging and all of the undesirable consequences. Another shortcoming of the MN-7 oil is its high volatility.

An improved oil designated MN-7.5u has been developed and is being tested. On the basis of preliminary studies, it is free of the shortcomings noted above. After the tests have been completed, this oil may serve as the unified grade, suitable for year-round operation of turboprop engines of all types in all locations in the USSR. The next step must be the development of an operational/preservative oil on the basis of the MN-7u, so as to eliminate the use of MK-8 oil in these engines for the corrosion protection of fuel-system components.

Thus, we see that the following unification of the assortment of lubricating oils for aviation gas-turbine engines is possible: for use in turbojet engines up to 150°C, the oils MS-8p and MS-8RK (in place of MK-8, MS-8, TK transformer oil, medium-sulfur transformer oil, MK-8p, MS-8p, MS-8RK, and MR-10u); for use in turbojet engines up to 200°C, the oil IPM-10 (in place of VNII NP-50-1-4f, 36/1, VNII NP-5, NVII NP-75A, 36/1ku-A, IPM-10, and B-3-V); for turboprop engines, the oil MN-7.5u (in place of 75/25 or 25/75 blends of MK-8 and MS-20 oils, VNII NP-7, MN-7.5, and MN-7.5u). This means that 20 different grades of oils and oil blends will be replaced by 4 grades of oil.

UNIFICATION OF GRADES OF MOTOR OILS FOR LAND VEHICLES

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The rapid growth of the engine manufacturing industry is being expressed in the development of more efficient and economical engines, as well as in the improvement of existing designs. Successful development and growth in this branch of machinery construction, as well as reliable operation of engines, are highly contingent on the selection of motor oils and the feasibility of producing these oils. During the past 10-15 years, the assortment of motor oils has been expanded quite considerably. In a number of cases, the different grades of oils that are being used are only very slightly different from each other in quality. For example, in the 1975-1976 period, the available grades of motor oils included 12 oils in group B and 14 oils in Group V. In this connection, it has become necessary to unify the grades of motor oils.

Experience accumulated over the past few years has indicated that the unification of oils for land vehicles is best carried out on the basis of all-season (multigrade) universal oils. This opens up the possibility of departing from the concept of seasonal oils (summer and winter) and from the distinction of oils that are to be used only in gasoline engines or only in diesel engines. As an example, we may cite the development of commercial use of the all-season long-life motor oil M-6z/10V (DV-ASZp-10V) as the single oil to be used in carburetor and diesel (nonsupercharged) engines in tractors.

The DV-ASZp-10V oil is the first of the USSR-produced long-life motor oils. Its service life in the engine is two or three times that of motor oils previously used in tractors. In connection with the universality of this oil and its suitability for year-round use, it is being used to replace more than 10 grades of motor oils (AS-8, M-8B_1U, AS-10, M-8V, Dp-11, M-10V, and others). Even though the cost is somewhat higher than that of the other oils listed, the use of the long-life oil will give savings of more than 40 rubles per metric ton of oil. The commercial production of this oil started in the 1970s; in 1977, the oil was awarded the State Seal of Quality.

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Classification tests performed within the framework of GOST 17479−72 have shown that the oil DV-ASZp-10V should be assigned to Group V with respect to its service properties. Along with this, a service test has demonstrated the feasibility of using this oil, with an adjusted oil change period, for the lubrication of high-performance diesel engines (YaMZ-238NB and SMD-62), in which oils with a higher level of service properties are normally used (groups G and D according to GOST 17479−72). Thus, we see that an objective approach to the selection of oils for engines does create a favorable situation for subsequent unification, and this is important from the economic standpoint. Currently, optimization of the selection of motor oils is also the subject of major attention in various capitalistic countries, in particular in the United States, where this problem is being solved by the joint efforts of engine manufacturers and oil producers.

The unification of motor oils, in particular the use of DV-ASZp-10V oil as a universal motor oil, can be justified on the basis of its successful use in lubricating not only the engine, but also the transmission. From domestic and foreign experience in the use of motor oils, with further consideration of the developmental trends in USSR engine construction, we may assume that the unification of motor oils is best carried out on the basis of products with rationally selected service properties.

Here, along with meeting the specification requirements related to the operational features of specific equipment, the new, unified grades of motor oil must provide the following: cold-starting of the engine at temperatures from −35 to −45°C, combined with operability in thermally stressed components in which the oil temperature in a thin film may be as high as 250-275°C; a high level of service properties (corresponding to oils in Groups G and D) with a low sulfated ash content; extended oil drain periods in the engine (15,000 km of vehicle travel or more); and a sufficiently high level of protective (preservative) properties.*

Foreign experience in the development and application of motor oils indicates that, as a rule, only motor oils with a synthetic or semisynthetic base can satisfy these requirements. Synthetic motor oils are particularly good in low-temperature properties, giving cold startup of engines at −50°C. The low volatility of synthetic motor oils can give reductions of oil consumption in the engine amounting to 25-30% or more in comparison with a mineral oil used in the same service; also, the oil drain period for the engine can be increased to 25,000-50,000 km, and the fuel consumption can be reduced by an average of 5% [1].

As shown by experience in other countries, the higher cost of synthetic oils has not been a barrier to their application. In particular, the use of a synthetic oil costing three times as much as a mineral oil can give a considerable saving, owing to the operational advantages of the synthetic oil (an increase in oil service life by a factor of 3.5, a reduction of fuel consumption, etc.); as a result, the unit costs for production and application of synthetic motor oil become much lower [2]. A characteristic feature of synthetic motor oils is their universality; in combination with specially selected additives, they can be used not only in carburetor and diesel engines for land vehicles, but also in the hydraulic systems of mechanical and hydromechanical transmissions [2].

Synthetic motor oils are being used successfully for land vehicles in other countries, these oils being classed in Groups SE/CC and SE/CD (API classification): Mobil 1 (SAE 5W/20, SE/CC); Mobil Delvac 1 (SAE 5W/30, SE/CD), and others. In the next 5-10 years, we should see a considerable growth in production of synthetic motor oils for land vehicles [4]. For example, in 1976, in the United States, the Western European countries, and Japan, 85% of the synthetic base stock production went into the manufacture of aviation oils, and only 7% into the manufacture of motor oils; in 1986, according to preliminary calculations, this ratio will change very sharply with 68% going into aviation oils and 23% into motor oils.

In the development of domestic (USSR) unified synthetic motor oils for land vehicles, it will be necessary to select synthetic base stocks that have an adequate raw material base and that are suitable for the formulation of motor oils of the required quality; here we may mention isoparaffinic hydrocarbons, alkylbenzenes, and esters with various types of structures. It will also be necessary to develop highly effective, thermally stable additives of various types, primarily antioxidants, antiwear or lubricity additives, V. I. improvers, and ashless detergents. The use of synthetic oils will make it possible, on the one hand, to improve the operational reliability of equipment and vehicles, particularly under severe service conditions, and on the other hand, to carry out a further unification of oils for land vehicles.

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* The greater demands on the oil's protective properties reflect the fact that the equipment does not operate continuously.

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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-10GFl (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-10GFl 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-10GFl, 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-10GFl 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-10GFl 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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