

MOTOR OILS: TREND OF DEVELOPMENT, CHARACTERISTICS OF DOMESTIC LUBRICANTS

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We consider trends of improving the performance characteristics of motor oils, the most popular brands and the characteristics of domestic lubricants in this article.

Introduction. The development of engine building, the improvement of their design and the tightening of the environmental requirements are impossible without the use of progressive and modern lubricants.

Special attention is paid to the growing environmental problems associated with cars which can lead to the change in the requirements for the car engines design and a significant improvement in the performance of exhaust gas cleaning systems. This is reflected in the requirements for engine oil. According to the European legislation, all motor oils must comply with environmental standards. In order to meet the standards the engine oil should be compatible with the units of the gas cleaning system, and its chemical composition should be limited for this. In particular, sulfur and phosphorus which are active elements of anti-wear and antioxidant additives "poison" the catalysts. That is why their content in the oil should be low.

Main body. The production of new gasoline engines with direct injection or turbocharging is the main stimulating factor for the development of the new ACEA 2016. The new specification introduces a new category ACEA C5. A key feature of this specification is particulate filters. In the near future not only diesel, but also gasoline engines with direct injection will be equipped with soot filters [1].

The requirements for the category C5 are presented in Table 1.

Table 1. – The requirements for the category C5 according to ACEA

HTHS @ 150°C	$\geq 2,6 < 2,9$ mPa·s
HTHS @ 100°C	Report
Shear stability	Stay in grade
NOACK	$\leq 13\%$
TBN	≥ 6.0 mgKOH/g
Sulphur	$\leq 0,3$ %m/m
Phosphorus	$\geq 0,07 \leq 0,09$ %m/m
Sulphated ash	$\leq 0,08$ %m/m
Chlorine	Report
Fuel economy	$\geq 3.0\%$ (M111FE)

There is definitely a clear tendency to limit the content of phosphorus and sulfur for compatibility with modern systems of neutralization of exhaust gases and compliance with the Euro-6 standards. According to the API classification, the most modern oils are oils SP and CK-4 in 2018. Having analyzed the requirements for new standards and the trend of changing requirements for oils we can assume the following changes in the characteristics of oils of classes SP and CK-4 according to the API and C5 specifications for ACEA in comparison with the previous classifications:

- 1) Lessened sulfate ash (requires to use magnesium sulfonates);
 - 2) Lower sulfur and phosphorus content;
 - 3) Greater resource economy;
 - 4) Better compatibility with seals;
 - 5) Increased protection against oxidation of oil;
 - 6) Better anti-wear properties;
 - 7) The best detergent properties;
 - 8) Better dispersing properties;
 - 9) Better anti-foam properties;
 - 10) Better resistance to evaporation.
- These properties are achieved by using additives with improved properties.

To obtain high-quality oil it is necessary to pack the additives and then introduce the resulting additive package as a concentrate into the base oil.

To obtain oils according to the ACEA API and C5 API and CK-4 specifications it is necessary to use low-ash magnesium sulphonates (multifunctional additives), antiwear additives, antioxidant additives, anticorrosive additives, antifoam additives, antifriction additives, detergent and dispersant additives, thickening agents additives and depressant additives some properties of which can be combined in multifunctional additives.

For synthetic oils antioxidant additives play the most important role.

All components included in the engine oil are supplied as a balanced additive package in which the component ratio is clearly fixed, tested for compatibility and provides the best performance for each type of engine oil with specified requirements. It is for this reason that the majority of manufacturers of machinery and lubricants are strictly prohibited to use additional additives in oils. Additive packages are mixed according to a clearly defined formula with base oils for the production of motor oils [2].

In the market of motor oils there is a huge number of brands and each in its own way surpasses the rest and is more popular in certain circles of automakers and consumers. The most popular companies producing motor oils among the CIS countries are Zic, Xado, G-Energy, Liqui Moly, Shell, Castrol, British Petroleum, Mobil and others.

The Republic of Belarus has its own progressive enterprises which produce high quality lubricants that meet all modern requirements. Leading companies in this area are JLLC "LLK-Naftan" and JSC "Naftan".

"LLK-Naftan" investigates and develops additives as well as produces additive packages for motor, transmission and marine oils that are capable of ensuring those oils comply with current API and ACEA requirements. This is the largest producer on the post-Soviet territory. Today more than 95% of LLK-Naftan products are exported.

The Belarusian Chamber of Commerce and Industry recognized LLK-Naftan as the best exporter in the nomination "Oil refining in 2014, chemical and petrochemical industry". The Association of Oil Refiners and Petrochemicals (Russia) recognized the products of JLLC "LLK-Naftan" as the best in the CIS in the field of import substitution of additives for lubricating oils [3].

JSC "Naftan" produces modern hydrocracked motor oils HC4 and HC7 corresponding to the Group III of API oils. This trend is promising in the context of the growing tendency of the Group II and III API oils throughout the world and also because of the approach in composition and properties of hydrocracked oils to the Group IV synthetic oils. All-season motor oil "Naftan Guarantor" produced by JSC "Naftan" corresponds to SJ / CD classification, and "Naftan Prime" to SL / CF [4].

Hence, the development and improvement of the performance characteristics of motor oils are an integral part of improving the design of ICE and improving the environmental situation in the world and the production of lubricants produced in the territory of the Republic of Belarus is modern and competitive.

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