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**ON THE QUESTION OF IMPROVING THE QUALITY OF LOW SAPS MOTOR OILS**

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*The article describes a promising direction for improving the quality of motor oil aiming to reduce the ash content, while maintaining the performance and environmental characteristics. It is proposed to expand the range of action of functional ashless dispersant additives that will reduce the involvement of the metal detergents.*

**Introduction.** Motor oils are obtained by compounding the basic oil and package of additives which improves the properties of the original base or adds some new properties, which the original oil does not have [1]. As regards purpose, additives are combined into several groups:

1. Viscosity additives which improve the viscosity index and other properties (viscosity index modifiers).
2. Additives which improve lubricity (antiwear, extreme pressure, etc.).
3. Anti-corrosion additives (corrosion inhibitors).
4. The antioxidant additives which reduce oil consumption and increase the life oil operation (anti-oxidants).
5. Detergents, dispersing additives.
6. Additional (defoamers, etc.).

In recent times more and more attention is paid to maintenance of road vehicles from an environmental point of view. Over the past thirty years seven environmental standards have been developed (Euro 0 – Euro-6), controlling the content of harmful substances in exhaust gases of vehicles with diesel and gasoline engines.

Promising directions for improving the quality of motor oils are developing Low Saps motor oils with improved properties. One way to solve this problem is to expand the functional action ashless dispersants, which reduce the involvement of metal additives in the component structure of commercial oil [2].

**Formulation of research tasks:**

The major source of ash in engine oil is the metal-containing additives: sulfonates (Ca, Mg, Ba) and dithiophosphates (Zn). Under high temperatures in the process of oil operation metal-containing additives can be oxidized, and by reacting with the sulfur contained in the fuel or additives form metal phosphates and sulfates, also known as sulphated and phosphated ash [3]. These compounds are first-class abrasives, i.e. they are hard, which leads to accelerated wear of engine parts in friction zones. If any oil hit in the running engine due to incomplete sealing it burns away and combustion gases are removed through the exhaust system. However, diesel cars that were released after the introduction of Euro 5 standard in 2011 and some modern models with petrol engines are equipped with a particulate filter. When injected into the filter, ash settles and accumulates in it, which significantly reduces the service life of the diesel particulate filter [4].

Nowadays the engine oil classification ACEA (Association of European car manufacturers) at the same time with the classic division into oil for gasoline (A) and diesel (B) engines added a separate category of oil that is compatible with diesel particulate filters and catalytic converters (C).

Thus, due to the stiffening of operational and environmental requirements for motor oil, the maximum improvement of its properties is required, which is mainly achieved by the addition of additives, and at the same time it is necessary to decrease the ash content that requires a reduction of ash additives quantity.

The solution is made possible by the use of ashless additives. Ashless dispersants are: succinimides, high molecular Mannichbases, polyethers. These additives are multifunctional, that means, they don't have only a function of dispersing but also neutralizing.

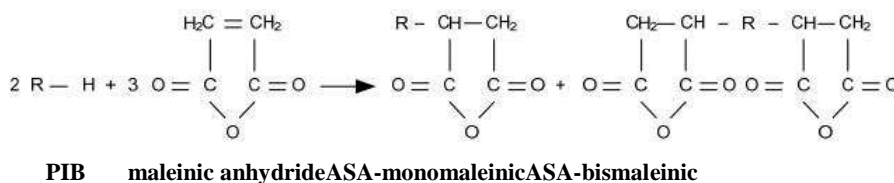
In Full SAPS engine oil neutralizing function is assigned to the cleaning additives (detergents) and is defined by total base number. Total Base Number - ability index to neutralize corrosive acidic products formed in the oxidation of oil, expressed in mg KOH/g. The ashless dispersants have high alkalinity, therefore they partially offset the neutralizing function, thereby reducing the involvement of detergents and reducing ash content in the engine oil [5].

It is known that succinimids neutralizing ability is conferred by imide structures =NR. The more nitrogen atoms contains an aminating agent, the higher will be total base number of the received additive. For this purpose, there was suggested in this study to substituted diethylenetriamine ( $C_4N_3H_{13}$ ) to pentaethylenehexamine ( $C_{10}N_6H_{29}$ ).

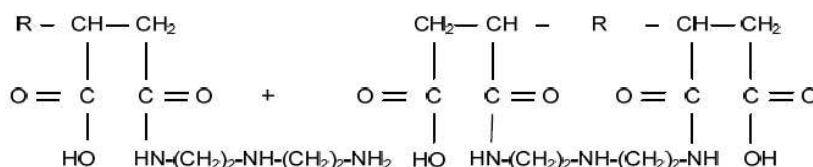
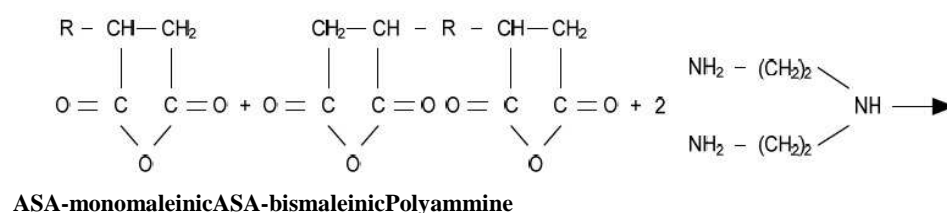
Technology, Machine-building, Geodesy

The technology of producing such ashless dispersants as succinimide includes 3 stages:

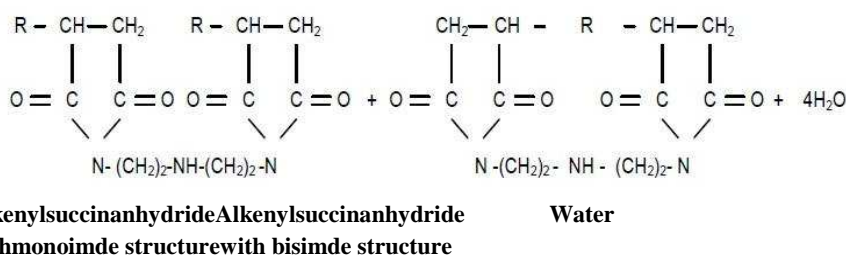
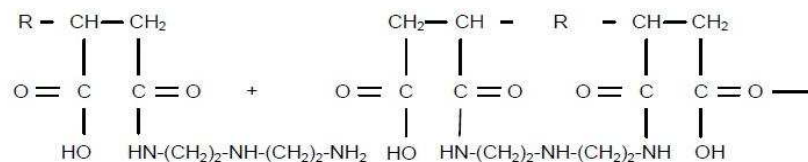
1) The reaction of polyisobutylene with maleic anhydride to obtain polyisobutenylsuccinimid:



2) Neutralization of the resulting polyethylene polyamine product in a hydrocarbon solvent to give the corresponding amide:



3) Thermal treatment with resulting a polyisobutenylsuccinimide amide



By comparison the total base number of synthesized high-alkaline additive with industrial C5 additive A (EI 38.101146-77), neutralizing capacity increased almost in 2.5 times (from 35 mg KOH / g to 82). Such a high neutralizing capacity of dispersant additive allow reducing the involvement of highly alkaline detergent, which has a positive effect on the ash content of the commercial oil (Table 1).

Table 1 – Ash comparison of Full SAPS and received Low SAPS engine oils

	Units	Full SAPS oil	Low SAPS oil
Sulphated ash	% m/m.	1,4	0,75

Thus, the received engine oil corresponds categories C2<sub>.12</sub> and C3<sub>.12</sub> by ACEA engine oil classification by content of sulphate ash for the Low SAPS motor oils.

**Results and perspectives**

Reduced ash in engine oil allows improvinfg the following characteristics:

- 1) reduce engine wear by reducing the quantity of abrasive ash;
- 2) extend the operation of the engine oil;
- 3) reduce the fuel consumption by reducing friction of moving parts;
- 4) extend the service life of the vehicle exhaust system.

At present, ina CIS territory the production of Low SAPS oils is still developing. Motor oil, corresponding to category C on the ACEA classification is obtained by adding additives, which are produced by foreign firms. Using the above method of producing Low SAPS oil could be implemented the import substitution in the business.

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