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MULTIFUNCTIONAL ADDITIVES TO LUBRICATING OILS

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In order to expand the range and efficiency of sulfonate additives the possibility of obtaining on the basis sulfomethylated dialkylphenols, synthesized by repeated alkylation of technical nonyl phenol and alkyl (C_8-C_{12}) phenol by the ethylene oligomer of fraction (C_{10}-C_{14}) was investigated.

Developed basic and medium alkaline calcium hydroxydialkylbenzylsulfonates are completely soluble in vase oils, are characterized by good physicochemical and functional properties and by quality indicators slightly differ among themselves. Being the additives of multifunctional action they vastly improve the detergent, dispersant, anti-corrosive properties and stability against oxidation of lubricating oils and by efficiency exceed foreign analogue- Hightech 6060M additive.

Keywords: *alkylphenol, sulfomethylation, multifunctional additives, lubricating oils, functional properties*

One of the main types of detergent – dispersing additives to lubricating oils is strongly alkaline sulfonate additive, produced from petroleum oil and synthetic alkylaromatic hydrocarbons [1]. Therefore, extensive studies are currently carried out on advancement of sulfonate production technology, improvement of its quality, expansion of variety and improvement of environmental performance [2,3].

In order to obtain sulfonate type effective multifunctional additives, we studied the possibility of their synthesis, using available raw material-technical alkylphenols. Origin nonylphenol and alkyl (C_8-C_{12}) phenol are produced using trimer propylene and polymer distillate, and generally are presented as monoalkyl derivatives.

Previously it is recognised that the specified alkyl phenols are not suitable for synthesis of sulfonate additives, because their salts are not oil-soluble and they are ineffective.

The increase of oil solubility and additive efficiency was achieved as a result of repeated alkylation of origin alkylphenols by ethylene oligomers of C_{10}-C_{14} fraction in the presence of acid catalyst at 100-105^{o}C temperature for 5 hours.

Sulfomethylation of synthesized dialkylphenols was carried out with hydroxymethanesulfonate natrium at the mole ratio 1:1 over a catalyst-sodium hydroxide at a temperature of 70-80°C for 10 hours in a solution of nonane (nonyl hydride). Base dialkylphenolsulfonates OCK_{DP1}, and OCK_{DP2} were synthesized by interaction of generated sodium sulfonate with calcium hydrate at a temperature of 70-80°C for 5 hours.

Carbonation of base sulphonates with carbon dioxide in the presence of excess calcium hydroxide, promoter - acetic acid, diluent oil, solvent - toluene at a temperature of 85 - 90ºC produced mid-alkali additives $CC\text{-}150_{DP1}$, $CC\text{-}150_{DP2}$.

Formulated additives are darkly brown viscous fluid, and the characteristics were presented in the table. According to presented data, calcium sulfonate synthesized on the basis of dialkylphenols is completely oil-soluble, and have good physicochemical and functional properties. While being additives of multifunctional action, they significantly improve detergent, dispergate, anticorrosive properties and stability against M-11 oil ageing.

Table

Physicochemical and functional properties of the calcium sulfonate on the basis of sulfomethylated dialkylphenols

Indices	Base dialkyl-phenol-sulphonates		Mid-alkali additives		
	$ОСК_{DP1}$	$ОСК_{DP2}$	$СС\text{-}150_{DP1}$	$СС\text{-}150_{DP2}$	Hightech 6060M
Alkaline number, mg KOH/g	38	42	151	153	142
Mass fraction, % calcium sulfonate	58	60	30,5	31,7	30
mechanical impurities	0,07	0,06	0,04	0,04	0,05
Sulfated ash, % mass	11,9	12,1	23,1	23,4	23,1
Detergent properties PZV method, points *	0,5	0,5	0	0	0
Dispersing ability at 250°C, %*	55	55	70	70	60
Corrosion in lead g/m^{2} *	37	34	20	22	85
Stability against oxidation: * deposit, %	0,7	0,6	0,4	0,3	0,8
Colloidal dispersion stability, %	–	–	75	76	76
Calcium mass fraction, %	3,1	3,2	5,7	5,9	–
Open-cup flash-point, °C	180	180	180	180	180
Oil solubility	Complete				

*Oil M-11 with 5% additive

Upon quality index, obtained additives slightly differ from each other. Thus, yield and content of the active agent in base sulfonates is 90 – 92% and 58 – 60% respectively.

According to physicochemical and detergent properties, the formulated mid-alkali additives are on a level of foreign analogue - mid-alkali sulfonate additive Hightech 6060M, but according to dispergate, anticorrosive properties and stability against oil ageing exceeds it. Thus, when the additives $СС\text{-}150_{DP1}$ and $СС\text{-}150_{DP2}$ are added to oil M-11 in a concentration of 5%, corrosion in lead is respectively 20 and 22 g/m^2, while for the Hightech 6060M additive this value is 85 g/m^2.

Colloidal dispersion stability to water action is 75 – 76% in mid-alkali additives and is at the level of foreign analogue (74%).

Identified multifunctionality and high efficiency of the obtained additives is probably due to the presence of double alkylene radicals, phenolic hydroxyl, sulfonate fragment in their composition and their intramolecular synergism.

It should also be noted that, the process of obtaining oil soluble hydroxide alkyl benzene

calcium sulfonate is low-waste, excluding sludging, and the yield of denoted waste is significant during production of sulfonate additives.

Therefore, the effective sulfonate additives to lubricating oils with improved environmental specifications were synthesized on the basis of re-alkylation products of technical nonylphenol and alkyl (C_8-C_{12}) phenol with α-olefins of C_{10}-C_{14} fractions. High efficiency of the formulated additives allows using them for modern engine oil during creation of multifunctional additive packages.

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SÜRTGÜ YAĞLARINA ÇOXFUNKSİYALI AŞQARLAR

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Sulfonat aşqarlarının çeşidlərini genişləndirmək və təsir effektini yüksəltmək məqsədilə onların texniki nonilfenol və alkil (C_8-C_{12}) fenolun C_{10}-C_{14} fraksiyalı etilen oliqomerləri ilə alkilləşməsindən alınan dialkilfenolların sulfometilləşməsi məhsulları əsasında sintezinin mümkünlüyü tədqiq edilmişdir. Sintez edilmiş əsas və ortaqələvili sulfonatlar yağda tam həll olur və yaxşı fiziki-kimyəvi və funksional xassələrə malikdir və müqayisə olunan keyfiyyət göstəricilərinə görə bir-birindən az fərqlənir.

Alınmış sulfonatlar çoxfunksiyalı aşqar olaraq sürtgü yağlarının yuyucu, dispersiyaedici, korroziyaya və oksidləşməyə qarşı xassələrini əhəmiyyətli dərəcədə yaxşılaşdırır.

Açar sözlər: *alkilfenol, sulfometilləşmə, çoxfunksiyalı aşqarlar, sürtgü yağları, funksional xassələr*

МНОГОФУНКЦИОНАЛЬНЫЕ ПРИСАДКИ К СМАЗОЧНЫМ МАСЛАМ

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Для расширения ассортимента и эффективности действия сульфонатных присадок исследована возможность их получения на основе сульфометилированных диалкилфенолов, синтезированных повторным алкилированием технических нонилфенола и алкил (C_8 – C_{12}) фенола олигомерами этилена фракции C_{10} – C_{14} . Разработанные основные и среднещелочные гидроксидиалкилбензилсульфонаты кальция полностью растворимы в базовых маслах, характеризуются хорошими физико-химическими и функциональными свойствами и по показателям качества незначительно различаются между собой. Являясь присадками многофункционального действия, они значительно улучшают моющие, диспергирующие, противокоррозионные свойства и стабильность против окисления смазочных масел и по эффективности превосходят зарубежный аналог – присадку Хайтек 6060М.

Ключевые слова: *алкилфенол, сульфометилирование, многофункциональные присадки, смазочные масла, функциональные свойства*