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Evaluation of Physicochemical and Commercial Properties of Additives for Motor Oils

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ABSTRACT: The article studies chemical additives to oils and presents the results of analyzes of the physicochemical characteristics of the additive with I stage of carbonation (PDzh-2), Physicochemical characteristics of the additive with II stages of carbonation (PDzh-3), in addition, the change in optical density on blue (Ds) and red (DK) light filters of M-10DM oil samples during their oxidation by the VKO method.

KEY WORDS: motor oils, additives, phenates, oil color, optical density, M-10DM oils.

I.INTRODUCTION

Onboard reforming of petroleum-based fuels, such as gasoline, may help ease the introduction of fuel cell vehicles to the marketplace. Although gasoline can be reformed, it is optimized to meet the demands of ICEs. This optimization includes blending to increase the octane number and addition of oxygenates and detergents to control emissions. The requirements for a fuel for onboard reforming to hydrogen are quite different than those for combustion. Factors such as octane number and flame speed are not important; however, factors such as hydrogen density, catalyst-fuel interactions, and possible catalyst poisoning become paramount. In order to identify what factors are important in a hydrocarbon fuel for reforming to hydrogen and what factors are detrimental, we have begun a program to test various components of gasoline and blends of components under autothermal reforming conditions. The results indicate that fuel composition can have a large effect on reforming behavior. Components which may be beneficial for ICEs for their octane enhancing value were detrimental to reforming. Fuels with high aromatic and naphthenic content were more difficult to reform. Aromatics were also found to have an impact on the kinetics for reforming of paraffins. The effects of sulfur impurities were dependent on the catalyst. Sulfur was detrimental for Ni, Co, and Ru catalysts. Sulfur was beneficial for reforming with Pt catalysts, however, the effect was dependent on the sulfur concentration. [1]

II. SIGNIFICANCE OF THE SYSTEM

The paper mainly focuses on how to get effective additives for motor oilsand their application. The study of literature survey is presented in section III, Methodology is explained in section IV, section V covers the experimental results of the study, and section VI discusses the future study and Conclusion.

III. LITERATURE SURVEY

This work compared the piston deposit ratings in an engine when it was run on gasoline with a high concentration of deposit control additive (DCA) versus gasoline with a low concentration of additive. The additives came from different sources and contained detergents with different functional groups. The engine was a Ford V-8 PFI engine, which is used in ASTM D6593, the Sequence VG test. The experimental procedure followed the ASTM protocol, except for the

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fuel, which was treated with additives. Deposit ratings were better, at 95% confidence, in the tests using a high concentration of additive versus the tests using a low concentration.[2]

Different blends of gasoline range hydrocarbons were investigated to determine the effect of aromatic, naphthenic, and paraffinic content on performance in an autothermal reformer. In addition, we investigated the effects of detergent, antioxidant, and oxygenate additives. These tests indicate that composition effects are minimal at temperatures of 800°C and above, but at lower temperatures or at high gas hourly space velocities (GHSV approaching 100,000h-1) composition can have a large effect on catalyst performance. Fuels high in aromatic and naphthenic components were more difficult to reform. In addition, additives, such as detergents and oxygenates were shown to decrease reformer performance at lower temperatures.[3]

The tendency of spark ignition direct injection (SIDI) engines to form injector deposits was investigated using engine dynamometer tests on a SIDI engine equipped with fan spray type injectors. Fifteen test fuels with varying 90% distillation temperature (T90), aromatics, olefins, oxygenates and sulfur levels were prepared to identify the effects of fuel properties on injector deposits. The results suggested that not only the T90 but also the number of alkyl substituent of aromatics had effects on injector deposit formation. Effects of detergents on the injector deposit cleanliness were also evaluated in this study.[4]

IV. METHODOLOGY

In determining the purification efficiency and colloidal stability of phenolic additives, the experience of evaluating the same properties of sulfonate additives was taken into account. The results of the study of sulfonate additives by well-known methods (ASTMD 91, colloidal stability according to Whipper, etc.) did not give a clear assessment of the properties. Therefore, a method developed by the specialists of the Scientific and Production Enterprise (SPE) “Qualitet” Ltd and presented in the article [3,4] was used to assess the phenolate additives.

V. EXPERIMENTAL RESULTS

After obtaining satisfactory results from the synthesis of naphthalene additives, their main physicochemical characteristics were determined. The test results are shown in Tables 1 and 2.

Table 1. Physicochemical characteristics of the additive with I stage carbonation (PDj-2)

№	Index	Technical requirements	Factual importance	Testmethods
1	Base number, mg KOH / g, not less	180	189	GOST 11362
2	Mass fraction of sulphated ash,%, not less	20	22	GOST 12417-73
3	Flash-point, determined in an open crucible, ^0C	Notless170	205	GOST 4333-85
4	Kinematic viscosity at 100 ^0C, mm^2/s	Notmore500	50	GOST 33-2000
5	Mass fraction of mechanical impurities, %	Notmore0,1	0,023	GOST 6370-83
6	Mass fraction of water, %	Notmore0,1	N/A	GOST 2477-65
7	Stability in the induction period of sedimentation of oil M-11 with 3% additive PDj-2, not less than 40 hours	Satisfies	Satisfies	According to GOST 11063

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The data shown in Table 1 indicate that all physicochemical parameters of the studied additives correspond to the required result.

Table 2. Physicochemical characteristics of the additive with II stage carbonation (PDj-2)

№	Index	Technical requirements	Factual importance	Test methods
1	Base number, mg KOH / g, not less	279	306	GOST 11362
2	Mass fraction of sulphated ash,%, not less	28	37	GOST 12417-73
3	Flash-point, determined in an open crucible, ^0C	Not less 170	198	GOST 4333-85
4	Kinematic viscosity at 100 ^0C, mm^2/s	Not more 500	103,2	GOST 33-2000
5	Mass fraction of mechanical impurities, %	Not more 0,1	0,022	GOST 6370-83
6	Mass fraction of water, %	Not more 0,1	N/A	GOST 2477-65
7	Stability in the induction period of sedimentation of oil M-11 with 3% additive PDj-2, not less than 40 hours	Satisfies	Satisfies	According toGOST

The data given in Table 2 show that all physicochemical parameters of the investigated additive meet the requirements of the technical requirements for additives.

The results of determining the cleaning efficiency and colloidal stability as well as the color of the solutions of additive are presented in Table 3.

Table 3. Comparative assessment of the quality of naphthalene additives [4]

Additive's name	Color, pts. (compared to standard)		Transmission coefficient T750, %		Purification efficiency,%	Residual solid sediment, %
	10% solution in C2 80/120	10% solution in Vaseline oil	Before refilling	After refilling		
PDj-2	4,1-4,5	4,4	93	95	98,9	0,1
PDj-3	4,4-5	4,4-5	87	88	99	0,3
Oloa-219	3,5-4,0	5,0 -6,0	90	91	98,9	0,25
K-36	4,0	6,0	61	71	85,9	0,5
WFY 007-1	5,0	>8,0	55	70	78,5	0,7

The data given in Table 3 show that the characteristic "color according to GOST 20284-74",of the additives PDj-2 and PDj-3 is not inferior to imported analogues.

The colloidal stability of PDj-2 and PDj-3 was also compared with foreign analogues. The data given in Table 3 indicate a high level of stability of all studied additives, however, the Eo value for K-36 is somewhat lower but exceeds the Eo value of the WFY007-1 additive [4].

There is a correlation of the obtained values by color, determination of the coefficients Eo, and VFRost: with an increase in color values (units), Eo decreases, while the amount of sediment VFRost grows [4].

VI. CONCLUSION AND FUTURE WORK

The methodology for assessing colloidal stability and purification efficiency developed in the SPE“Qualitet” is universal as it can be used to evaluate both sulfonate and phenolate additives and can be elaborated in further studies. Assessment of colloidal stability and color of additives showed that additives PDj-2 and PDj-3 are not only similar in quality, but even surpass some foreign and domestic analogues.

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