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FORMULATION OF NEW LUBRICATING COMPOSITIONS OF M-20 Бп ENGINE OIL FOR MARINE DIESEL ENGINES

Abstract: *New lubricating compositions of the well-known industrial engine oil M-20 Бп were formulated for ship diesel engines of the 42-56 ЧНСН 16/17 brand engines M-503, M-504 and M-507, which meet the requirements of standards of M-20Бп oil with the use and comparative study of detergent-dispersant additives ИХП-101, AKI-114 and AKI -218 high functional properties, which are barium and calcium salts of condensation products of alkyl phenol with formaldehyde and ammonia and other amines.*

Key words: *ships, diesel, base oil, additive, engine, lubricating composition.*

Language: *English*

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Introduction

New lubricating compositions of the well-known industrial engine oil М-20 Бп were formulated for ship diesel engines of the 42-56 ЧНСП 16/17 brand engines М-503, М-504 and М-507, which meet the requirements of standards of М-20Бп oil with the use and comparative study of detergent-dispersant additives ИХП-101, АКІ-114 and АКІ -218 high functional properties, which are barium and calcium salts of condensation products of alkyl phenol with formaldehyde and other amines. [1, 2]

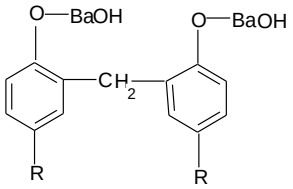
Б $_2$ group of engine oil for ship, locomotive and stationery diesel engines includes М-12ВБ, М-20Бп and $Г_2$ group includes -10$Г_2$ЦС, М-14ГБ, М-14$Г_2$, М-14$Г_2$ЦС, М-16$Г_2$ЦС and М-20$Г_2$ oil. Formulating and producing new analogues of М-20Бп diesel oil used in ship diesel engines is a very important and actual issue. М-20Бп engine oil used in Russian-made 42-56 ЧНСП 16/17 marine diesels (М-503, 504 and М-507 engines) is produced in the composition below: 3,5% ЦИАТИМ-339, 2% ДФ-1, 1,5% ПМС«Я» and 0,005% ПМС-200А additives and 93,5% МС-20 base oil. Physicochemical indicators of the oil: kinematic viscosity – 19,5-21,5 mm^2/s, viscosity index – 85, alkalinity – 2,7-3,0 mgKOH/g, ash content – 0,9%, freezing temperature – minus 15^0C.

Researches were conducted on two directions: on one hand, selection of base oil appropriate for viscosity and viscosity index of МС-20, on the other hand, formation of a new additive package based on the research of multifunctional alkylphenolate type ИХП -101, АКІ-114 and АКІ-218 additives.[3,4,5,6]

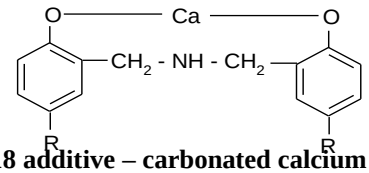
АКІ-114 and АКІ-218 additives with higher alkalinity in comparison with ИХП -101 additive which is barium and calcium salts of condensation product of recently synthesized alkyl phenols with formaldehyde and various amines as detergent-dispersant additives were used in the studies conducted on formulation of new analogues of different type М-20Бп, М-20$В_2$ф engine oils used in ship diesels, their test results were analyzed in comparison with base oils and new lubricating oils were formulated on the basis of positive results of the most suitable ratios of additive packages (table 1) [7].

It was determined that each three additive compositions of М-20Бп oil with indicators defined by ГОСТ and international ASTM methods meet important requirements.

ИХП-101 additive – Di-(oxyalkylfenil)-barium salt of methane. Alkalinity 60-70 mgKOH/g.

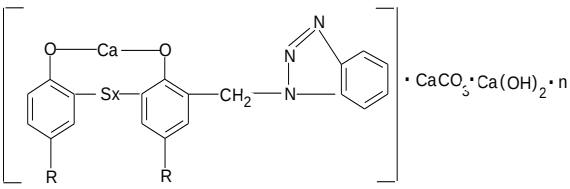


АКІ-114 additive – calcium salt of condensation product of alkylphenol with formaldehyde and ammonia. Alkalinity 80-90 mgKOH/g:



АКІ-218 additive – carbonated calcium salt of condensation product of sulfurized alkylphenol with formaldehyde and benzotriazole. Alkalinity 154 mgKOH/g.

Formula of **АКІ-218** alkaline:



where

x=1.2 R=C_8-C_{12}

Compositions have been compiled from primary additives necessary for production and composition of above mentioned oil – zinc salt of ИХП -101 additive that is able to replace detergent-dispersant ЦИАТИМ-339 additive and dialkyl dithiophosphoric acid – ДФ-11 and detergent-dispersant additive С-400 in different proportions, indicators that characterize their important physicochemical properties and operational peculiarities were defined. [8]

Table 1. Comparative test results of important physicochemical indicators of new lubricating compositions

Indicators	M-20Бп engine oil	Lubricating compositions of M-20Бп engine oil			Test method
		I	II	III	
		ИХП -101 ДФ -11 С-400 Viscoplex-5-309 ПМС-200А	АКИ-114 Мх-3103 С-400 Viscoplex-5-309 ПМС-200А	АКИ-218 Мх-3103 С-400 Viscoplex-5-309 ПМС-200А	
1.Kinematic viscosity, 100^0C, mm^2/s	19,5-21,5	20,71	20,12	21,02	ASTM445
2.Viscosity index	85	85	85	87	ASTM 2270
3.Alkalinity, mg KOH/g, not less than	2,7	2,75	3,0	3,2	ASTM 4739
4. Sulphate ash, %, not more than	0,9	0,85	0,79	0,72	ASTM 874
5.Flash point in an open pot, ^{0}C, not lower than	220	270	270	275	ASTM D 92
6.Freezing point, ^{0}C, not higher than	Minus 15	Minus 15	Minus 15	Minus 15	ASTM D 97
8.Colour, ЦНТ unit in ЦНТ colorimeter, point	Not normalized	8,0	8,0	8,0	ASTM D1500
9.Density, 20^0C, kg/m^3, not more than	902	899	895	896	ASTM 4052

It should be noted that oxidation, corrosion resistance properties of lubricants – sediment formation percentage during oxidation resists for 40 hours, corrosion is not observed in tests conducted with the participation of copper naphthenate catalyst at 140^0C alkalines and 25 hours at the optimum rate. Determination of detergent potential at 250^0C indicates that unlike industrial oil, indicators of detergent potential of formulated lubricating compositions consist of 85, 90 and 95 % appropriately. Table 2

Table 2. Indicators characterizing operational properties of newly-formulated lubricating compositions

Indicators	M-20 Бп engine oil	Lubricating compositions of M-20Бп engine oil			Test method
		I	II	III	
1.Corrosion on C1 and C2 type lead plates under ГОСТ 3778-77, g/m^2, not more than	10	N/A	N/A	N/A	ГОСТ 0502
2.Stability on induction period for sediment formation (ИПО), 35 hours	Resistance	Resistance	Resistance	Resistance 40 hours	ГОСТ 11063
3.Detergent potential 250^0C, %	Not normalized	85	90	95	ГОСТ 5726
4.Detergent property, by ПЗВ method, point	Not normalized	0	0	0	ГОСТ 5726
5.Purity degree, for 100g oil, mg, not more than	250	-	230	225	ГОСТ 2275

We can conclude that the fact that lubricating compositions formulated with AKI-218 additive have advantages such as 2.7 mgKOH/g alkalinity, 40 hours resistance property to oxidation compared to 35 hours

and 95% detergent property enables to produce the above mentioned additive package by an economically and environmentally effective method [8].

It should be noted that the duration of the induction of sediment formation in the new lubricating compositions of M-20Бп motor oils ИХП-101, AKI-114 is 35 hours per roll, lasts 40 hours in a composition with AKI-218 additive. Determination of washing capacity at 250 ^{0}C shows that, unlike commercial oil, the indicators of washing capacity of lubricant compositions created with additives ИХП-101, AKI-114, AKI-218 were 85, 90, 95%, respectively (Table 2).

Thus, it was determined that M-20Бп motor oil developed with AKI-218 additive is superior in high detergent dispersant, ignition temperature and alkalinity, resistance to oxidation and low ash content. This oil completely replaces the oil M-20Бп used in M-503, M-504, M-507 engines of ship diesels 42-56 ЧНСП 16/17, and the organization of production is considered possible .

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