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EFFECT OF DAKS-D ADDITIVE ON THE PROPERTIES OF PETROLEUM OILS

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The sharp increase in the viscosity of lube oils with a decrease in the temperature is due to cross-linking processes caused by association of the individual groups of hydrocarbons in the oils. These processes significantly impede starting and normal operation of engines in winter.

To ensure the performance of machinery in a wide range of temperatures, it is necessary to prevent an abrupt increase in viscosity when the temperature decreases, i.e., to provide for a viscosity—temperature dependence in the form of a gently sloping curve. Depressant and viscosity additives are incorporated in petroleum oil for this purpose. The former prevent cross-linking by decreasing the solid point *ts* of the oil, and the latter cause a smooth change in viscosity ν with the temperature.

Different polymers are used as such additives: homo- and copolymers of higher acrylic and methacrylic acid esters, polyisobutene, copolymers of ethylene and propylene, or styrene and butadiene, etc. [1, 2]. Polymethacrylates are used in Russia as the bases for viscosity (PMA-V-1, PMA-V-2) and depressant (PMA-D) additives. There are few published data on the use of copolymers of ethylene with vinyl acetate, propylene, or alkylmethacrylates.

This suggests their lower efficiency in comparison to higher alkyl(meth)acrylate polymers. For example, for a 0.3 wt. % concentration of the copolymer of ethylene with propylene, which has an average molecular weight of 80,000 and contains 35 mole % propylene units, the solid point *ts* of M-11 base oil is reduced by a total of 5 – 6°C [2].

TABLE 1

Indexes	Base oil	
	I-20A	M-11
Density at 20°C, kg/m^3	800	800
Viscosity, mm^2/sec		
at 40°C	31.67	94.75
at 100°C	5.21	10.45
Viscosity index	91	91
Acid number, mg KOH/g	0.02	–
Temperature, °C		
flash point	202	222
solid point	–15	–15
Color, CST units	2	2
Content		
water		None
particulate contaminants		None

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TABLE 2

Additive in concentration, wt. %	t_s, °C	Δt_s, deg	ν, mm²/sec		Δν, mm²/sec		VI	ΔVI
			at 40°C	at 100°C	at 40°C	at 100°C		
			I-20A oil					
DAKS-D								
0.1	−15	0	31.67	5.33	0	0.12	98	7
0.5	−30	−15	33.46	5.64	1.79	0.43	100	9
1.0	−40	−25	35.99	5.89	4.32	0.68	106	15
VK-100								
0.1	−15	0	32.55	5.34	0.88	0.13	91.8	0.8
0.5	−30	−15	34.07	5.54	2.40	0.33	95.36	4.64
1.0	−40	−25	35.89	6.01	4.22	0.80	111.6	20.6
PMA-D								
0.1	−25	−10	32.76	5.19	1.09	−0.02	73.6	17.4
0.5	−30	−15	37.55	5.59	5.88	0.38	94	3
1.0	−35	−20	37.85	5.70	–	0.49	102	11
			M-11 oil					
DAKS-D								
0.1	−19	−4	95.29	10.60	0.54	0.15	93	2
0.5	−21	−6	99.11	10.89	4.36	0.44	93.4	2.4
1.0	−25	−10	100.07	11.02	5.32	0.57	93.7	2.7
VK-100								
0.1	−15	0	–	–	–	–	–	–
0.5	−35	−20	98.10	11.05	3.35	0.6	96	5
1.0	−38	−23	102.25	11.45	7.50	1.0	114	23

We investigated copolymers of ethylene with á-olefins, which have a maximum average molecular weight of 20,000, DAKS-D additives, as oil depressant and viscosity additive. Two brands of oils were used as the base oils for evaluating its efficiency: I-20A industrial (GOST 20799—88) and M-11 motor (USSR Technical Specification TU 38.101523—80). Their physicochemical properties are reported in Table 1.

The effect of the concentration of DAKS-D in the oils on their *ts* is shown in Table 2. The elevated depressant effect of this additive is manifested in I-20 oil: for a concentration of 0.5 and 1 wt. %, *ts* decreases by 15 and 25°C, respectively. In M-11 oil, DAKS-D additive in the same concentrations is less effective: *ts* decreases by 6 and 10°C, respectively.

For comparison, the results of studying the effectiveness of other additives are also reported in Table 2: domestic PMA-D and foreign Viskokrip-100 (VK-100). DAKS-D is comparable to VK-100 with respect to the depressant effect in I-20A oil, but is not as good in M-11 oil.

The effect of the concentration of particulate contaminants on viscosity *v* of M-11 and I-20A oils at 40 and 100°C and on the viscosity index (VI) is also shown in Table 2. The thickening effect of DAKS-D additive in both oils is comparable to VK-100 additive. The effectiveness of PMA-D is much lower.

DAKS-D additive, highly effective as a depressant in diesel fuels [3], can thus be used in lube oils as a bifunctional additive that improves their low-temperature and viscosity properties.

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