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EFFECT OF NITROGENOUS BASES ON THE THERMAL STABILITY OF JET FUELS

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16. Abstract

Fuels from naphthenic petroleums had more N bases than those paraffinic ones (0.00024 and 0.000009% N, respectively). The removal of the N bases improved significantly the thermal stability and reduced the residue formation during oxidation of the fuel. The improvement depended on both content and composition of the bases. Thus, fuels with similar con-content of N bases (0.00058% N) and thermal stability had oxidation residues of 17.5 and 5.6 and sol. gum of 13 and 1.5 mg/100 ml, before and after removing the N bases, respectively.

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Nitrogenous bases contained in jet fuels, together with neutral nitrogenous /9* compounds, take an active part in the formation of residue and gum during the heating of fuels [1,2]. Therefore, it was of certain importance to explain within what limits the content of nitrogenous bases changes in different samples of fuel TS-1 and T-1. The nitrogenous bases in fuels were determined by titration 0.02N solution of 57% perchloric acid in glacial acetic acid with the addition of acetic anhydride in the presence of the indicator "crystalline violet" [3].

It follows from the data presented below that the content of nitrogenous bases in fuels TS-1, produced from different petroleums, increases with the weighting of their fractional composition:

Petroleums (boiling limits, °C):	% nitrogen /10
Chalk precipitates of Checheno-Ingush ASSR:	
139-236	0.000023
140-224	0.00001
137-224	0.0001
Mixture of tuymazin, devonian, arlan:	
138-222	0.00001
139-222	0.00001
Mixture of tuymazin, arlano-chekmagush (137-222)	0.000019
Volgograd:	
137-230	0.000004
141-230	0.00001
Mixture of romashkin and permian--15% (139-220)	0.000009
Romashkin (141-235)	0.00003
Mixture of romashkin, tyumen and shkapov (137-234)	0.00001
The same, and 10% vuktyl condensate (136-223)	0.000009
In fuels T-1	
Mixture of azerbaydzan and turkmen:	
142-265	0.00049
142-270	0.00062
140-266	0.00067
142-262	0.00057
138-263	0.00071

* Numbers in margin indicate pagination in original foreign text.

Ekhabinsk:	
148-248	0.00059
149-253	0.00058
147-245	0.00027
146-255	0.00053
Mixture of krasnodar and grozny (140-264)	0.00071
In alkalized distillates of azerbaydzan petroleums	
Binagadin, balakhan:	
143-220	0.00024
159-279	0.0015
Shirvan:	
151-222	0.00024
132-225	0.00024
Sangachal (130-254)	0.0004
Buzovnin (181-241)	0.00094
Neftyanyye Kamni (170-275)	0.00126
Ostrov Peschanyy (ligroin)	0.00023
In 10-degree fractions of mixture of turkmen petroleums	
120-130	0.00004
180-190	0.00006
220-230	0.00022
250-260	0.00079
280-290	0.00266

With the same boiling limits the fuels of naphthenic base contain more nitrogenous bases than fuels of paraffin base. Thus, the distillate of shirvan petroleum which boils in the limits 132-225°C contains 0.00024% base nitrogen, while distillate of romashkin and permian petroleums which boil within 139-220°C only 0.000009%. / 11

If one assumes that the molecular weight of nitrogenous bases contained in jet fuels is 10 times greater than the atomic weight of nitrogen, then in fuels T-1 the content of nitrogenous bases is 0.0024-0.015%. It can be assumed that with such a content the nitrogenous bases will have an essential effect on the thermal stability of the fuel. For confirmation of this, after back-titration of fuel by perchloric acid and careful washing, its thermal stability was determined (GOST 9144-59 and GOST 11802-66). It is apparent from the data in the table that as a result of the removal of the nitrogenous bases the thermal stability of the fuels was considerably improved, moreover the amount of residue

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Petroleums	Fuel (boiling points), °C	% nitrogen	Thermal stability (GOST 9144-59), residue, mg/100 ml		Thermal stability (GOST 11802-66), mg/100 ml			
					residue		soluble gums	
			before removal of bases	after removal of bases	before removal of bases	after rem of bases	before rem. of bases	after rem. of bases
Binagadin	143-220	0.00024	15.4	5.1	-	-	-	-
Balakhan	159-279	0.0015	28.4	7.8	-	-	-	-
Shirvan	151-222	0.00024	10.8	5.8	-	-	-	-
	132-225	0.00024	10.0	3.4	-	-	-	-
Sangachal	130-254	0.0004	15.2	8.6	-	-	-	-
Buzovnin	181-241	0.00094	23.0	6.6	-	-	-	-
Heftyan.	170-275	0.00126	12.6	6.2	-	-	-	-
Kamni Ostrov Peschan.	ligroin	0.00023	5.4	1.0	-	-	-	-
Ekhabin	149-253	0.00058	-	-	30.7	13.4	26.7	25.2
Mixture	142-265	0.00049	-	-	25.9	18.6	17.0	17.2
of azer-	142-270	0.00062	-	-	31.9	20.6	21.5	17.7
baydzan	140-268	0.00058	-	-	30.5	24.9	33.0	20.0
and	140-266	0.00067	-	-	24.9	18.6	20.0	20.5
turkmen	142-262	0.00057	-	-	29.0	17.6	19.5	20.2
	140-256	0.00065	-	-	28.5	22.9	25.5	20.5

formed during oxidation of the fuel was reduced. The degree of improvement of thermal stability after removal of the nitrogenous bases depends not only on their content, but also on the composition of nitrogenous bases. Thus, with equal content of nitrogenous bases in the samples of fuel T-1 produced from ekhabin petroleum and a mixture of azerbaydzan and turkmen petroleums (0.00058%N), and practically similar thermal stability evaluated according to the amount of residue, with the removal of nitrogenous bases from fuel T-1 of ekhabin petroleum the amount of residue formed in it is reduced by 17.3 mg , while in fuel T-1 of a mixture of azerbaydzan and turkmen petroleums only by 5.6 mg/100 ml. In the latter case, as a result of the removal of nitrogenous bases there is a significant reduction in the amount of soluble gums (13.0 and 1.5 mg/100 ml respectively).

Despite the fact that in the distillates made of petroleum from the deposit Neftyanyye Kamni the content of base nitrogen reached 0.00126%, the amount of residue formed during oxidation was only 12.6 mg/100 ml and therefore after removal of the nitrogenous bases the amount of residue was only reduced by 6.0 mg.

The obtained data indicate that nitrogenous bases impair the thermal stability of fuel and therefore their removal from jet fuels would permit improvement of the thermal stability of fuel.

References

1. Oswald, A. and F. Noel, Chem. Eng. Data, 6, No. 2 (1961), 294.

2. Vol'f, M. B., Khimicheskaya stabilizatsiya motornykh i reaktivnykh topliv ["Chemical Stabilization of Engine and Jet Fuels"], Moscow:"Khimiya," 1970.

3. Suslennikova, V. M. and Ye. K. Kiseleva, Rukovodstvo po prigotovleniyu titrovannykh rastvorov ["Manual on Preparing Titrants"], Moscow: "Khimiya," 1968, p. 137.