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# OIL FROM THE JURUBCHENSKY DEPOSIT IS A POTENTIAL RAW MATERIAL FOR THE PRODUCTION OF JET A-1 AVIATION FUEL

*The development of oil deposits in the Evenki Autonomous Area is connected with study of the properties and quality index of extracted crude oil and oil fuels.*

*The ecological requirements to oil products become more stringent today. Measures for lower oil extraction costs, oil processing and equipment exploitation are also to be met. Therefore, the study of crude oil and oil fuel properties is very important.*

*Keywords: oil, manufacturing of Jet A-1aviation fuel, hydrogen sulfide, thiols.*

The Evenki oil was studied at different stages of oilfield development. Reportedly, the Yurubchen oil of the Baykit area has a low-sulfur (total sulfur 0.18…0.24 %), low-resinous (silica gel resins 2.50 to 4.76 %, asphaltenes – up to 0.10 %), paraffinic (paraffin 2.03 to 3.26 %) concentration. The potential content of the boil off fractions at temperatures up to 200 °C is 27.00 to 32.50 % and at temperatures below 350 °C – 54.60 to 67.00 %. According to the hydrocarbon composition group, the enhancement of fractions leads to increase of the aromatic hydrocarbon content 0 to 15 % while paraffin hydrocarbons predominate in all the fractions.

The Yurubchen oil is of high-gravity, low sulphuric and low paraffinic. It is rich in lighter fractions and is related to the methane-naphthenic class. Consequently, this oil gasoil meets the requirements of GOST R 52050–2006 «Jet A-1 air fuel gas turbine engines. Specifications» by sulfuric contents. Gasoil obtained in accordance with GOST 2177–99 (method B) has been preliminarily studied. With low contents of sulfur, the Yurubchen gasoil indicated elemental sulfur and trace quantities of thiols.

The availability of jet fuels that complies with the requirements of GOST R 52050–2006 has been studied, on the basis of the Evenki gasoil from atmospheric distillation of oil.

The following procedures have been accomplished**:**

– representative samples of oil have been selected;

– quality indices of the Evenki gasoil obtained through atmospheric distillation (boil off temperature of 180 to 300 °C) according to GOST 2177–99 (method B) have been obtained. Naphtha light end was studied for comparison (boil-off temperature of 40 to 204 °C);

– analysis of the corrosive activity of these fractions (i. e. the copper plate test, the content of hydrogen sulfide, methyl and ethylthiol tests, the total sulfur) have been carried out by standard methods.

It had been discovered that hydrogen sulfide was one of the corrosive agents of crude oil atmospheric distillation at all stages. This proves that the Yurubchen primary oil does not contain any significant amounts of hydrogen sulfide (GOST 50802–95 «Oil. The method for determining hydrogen sulfide, methyl and ethylmerkaptans»).

The defining of oil fractional composition implied its distillation in the ARNS-E apparatus and resulted in obtaining gasoline, gasoil and fuel oil. The boiling point of naphtha varied 40 °C to 205 °C and gasoil – 180 to 300 °C.

In the process of oil refining, hydrogen sulfide was released at the temperature of 100 to 120 °C up to the end of the process (at 300 °C). Elemental sulfur was detected in naphtha and gasoil.

Defining the corrosive activity was carried out according to GOST 6321 «Fuel for the engines. Test Method for Copper», see table 1.

According to the testing results, gasoline derived from the Yurubchen oil (Class 3a) mostly impacted on copper. The Yurubchen oil passed the copper plate test.

The Yurubchen gasoline (naphtha) and gasoil obtained from atmospheric oil distillation were tested for the total sulfur contents (GOST 50442 «Oil and petroleum products. The X-ray fluorescence method for determining sulfur») and for hydrogen sulfide and mercaptan contents (GOST 50802 «Oil. The method for determining hydrogen sulfide, methyl and ethylmerkaptanes»), see table 2.

*Table 1*

**Determination of the corrosion activity of oil according to GOST 6321**

| The fraction of oil | Description of the plates color after the corrosion testing | Corrosion level, the classification |
|---|---|---|
| Yurubchen gasoline (naphtha) | Purplish-red spread on a brass-like color plate | Strong eclipse, 3a |
| Yurubchen gasoil | Deep-orange | Slight eclipse, 1b |

*Table 2*

**Mercaptans, hydrogen sulfide and total sulfur contents in the Yurubchen gasoline (naphtha) and gasoil**

| Oil sample | Mercaptans, hydrogen sulfide and total sulfur contents | | | |
|---|---|---|---|---|
| | Methylmerkaptan, ppm (% weight) | Ethylmerkaptan, ppm (% weight) | Hydrogen sulfide, ppm (% weight) | Total sulfur, ppm (% weight) |
| Gasoline (naphtha) | 2.06 ($2.06{\cdot}10^{-4}$) | 18.5 ($18.5{\cdot}10^{-4}$) | 0.111 ($0.111{\cdot}10^{-4}$) | 345 ($345{\cdot}10^{-4}$) |
| Gasoil | 0.237 ($0.237{\cdot}10^{-4}$) | 0.167 ($0.167{\cdot}10^{-4}$) | not found | 485 ($485{\cdot}10^{-4}$) |

Studies have shown the presence of sulfur fractions in gasoil: total sulfur – 485 ppm (under the maximum allowed under GOST 52050–2006). In addition, the presence of gasoil of methyl – (0.237 ppm) and ethylmerkaptans (0.167 ppm) was revealed.

The Yurubchen gasoil also contained a small amount of 1-octadekanethiol. It was found during the analysis of sulfuric acid fraction extract through chromatography-mass spectrometry (GC/MS) ($H_2SO_4$, 93 % extraction, diluting the extract with water, re-extraction diethyl ether). Organic sulfides were not present in the extract.

The corrosiveness of the Yurubchen oil light fractions results from the content of hydrogen sulfide, mercaptans, and elemental sulfur.

The initial presence of thiols (merkaptans) in the petroleum is usually low. In the Yurubchen oil, there was only ethylmerkaptan at a concentration of 0.136 ppm (GOST 50802 «Petroleum. Method for determination hydrogen sulfide, methyl and ethylmercaptans»).

Oil containing thiols is characterized by a high content of thiol and total sulfur in gasoline fractions with relatively low content of the total sulfur in the original oil. For the Yurubchen oil, the following ratio could be observed: the total oil sulfur – 0.196 %, total gasoline (naphtha) sulfur – 0.0345 % (GOST R 51947–2002 «Petroleum and petroleum products. Sulfur identification by the method for energy-dispersive X-ray fluorescence spectrometry»).

Hydrogen sulfide, mercaptans and elemental sulfur formed the Yurubchen oil gasoil as secondary decomposition products of organic sulfur compounds under thermal impact in the process of distillation.

Hydrogen sulfide is released under oil heating up to 120 °C and higher; the amount of hydrogen sulfide increases with elemental sulfur, for example, as shown in the following reaction:

$$RH + S \rightarrow RSH$$

$$2RSH \rightarrow RSR + H_2S$$

Based on the aforementioned research in conclusion we imply a possibility of additional methods for treatment (removal of elemental sulfur, demercaptanisation (sweetening), alkaline extraction of hydrogen sulfide), in order to adjust the fraction quality indices in accordance with the requirements of GOST R 52050–2006.



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## RESEARCH THE INFLUENCE FINISHING CANAL SHAPE TO FLOW MEDIA FOR ABRASIVE FLOW MACHINING PROCESS*

*Visual research flow media nature as with abrasive tool put in to practice. To establish facts the influence degree finishing canal shape and form losses for flow character. The guidelines for processing environment leveling developed.*

*Keywords: abrasive flow machining, improved surface quality, flow of abrasive media, visual research, form losses, cross-sectional shaped.*

The analysis of constructional features of aircraft's details has revealed the presence wide nomenclature of passageways with cross sections of various shapes and the presence of different local resistances like blades, form losses, etc. 28 standard elements with different geometrical shape of cross sections, which can be found in aircraft, were discovered.

The main purpose of visual research was the fixing the process of abrasive media flowing in channel's different configuration and its flowing of different local resistances, and the fixing of pressure media's measurement Input $P_1$ and output $P_2$ sample.

The device was for the visual studies (fig. 1). It consists of the body *1*, in which the groove set specimens-simulators *2*, caps *3* and two adapters *4* and *5*.

For the experiments the media was used with this composition: Silicon rubber (GOST 14680–74) – 48 %, PTFE-4 – 2 %; black silicon carbide 53 C (grain size = 250 microns) – 50 %. Visually, the media of this composition has a dark gray color. On its surface, placed in a device, rectangular mesh size 15 × 15 mm and a depth of 2 mm, which is filled with white fused 25A with grain size = 250 microns, applied by the bursting pattern. White mesh has a good contrast with the surface of media, which provides a clear picture. The Scheme of application (fig. 2) simulates a chain of abrasive grains. Filming was carried out with a speed of 48 frames per second at high contrast, negative film.

Based on studies of the flow on the waveform, film, photographs and scratches at the window 6 of Plexiglas identified characteristics of media, evaluated and the degree of deformation grid on, and direct observation of the flow. Figure 3 shows the flow patterns and schemes of the media in the tested channels. The arrows indicate the direction of flow, a dark color – the stagnant zone.

Each sample has a definite influence on the flow, the value of which can be expressed by the coefficient of local resistance $\xi_m$

$$\xi_m = \xi_{cg} + \gamma_c/\text{Re},$$

* The work within the federal purpose program "Scientific, scientific-pedagogical cadres Innovative Russia".