The depth of ore deposit occurring varies within a wide range - from 300 m (Beshkok, Loyliken, most part of Shimoliy Bukinoy, part of Ketmonchi, Aitimski site of Uchkuduk) and more than 300 m (Severni Kanimekh, most part of Janubiy Bukinoy, Sugrali, part of Sabirsoy, etc.). Mineralization is often multilayer, which is characteristic for deposits of the Bukinoy - Kanimekh ore field where there are up to six ore-bearing subaquifers. The ore is carbonate-free and with low carbonate content (CO_2 - up to 2.5%) (Beshkok, Loyliken, Bukinoy, most part of Severni Kanimekh, part of Ketmonchi, etc.) as well as carbonaceous and highly carbonaceous (CO_2 - up to 5% and more) (Sugrali, Meylisay, part of Janubiy Bukinoy, Ketmonchi and Sabirsoy). The thickness of permeable rock of ore-bearing subhorizons is mainly up to 20 m (from 8 to 30 m); the thickness of uranium deposits varies from 0.5 to 20 m, mostly 3-5 m; ore thickness to permeable host rock ratio is from 1:2 to 1:10, mostly 1:3-1:7. The uranium content is from 1 to 20 kg/m^2, mainly 2-6 kg/m^2, in Meylisay, Beshkok, Loyliken uranium content is less. Uranium content of ore varies from 0.01 to 0.1% seldom higher, the average value being0.03-0.7%.

High uranium content is in Sugrali, Ketmonchi, Sabirsoy formed with participation of reducing epigenesis. The width of ore deposits is 50-300 m; the minimum width is registered in Severni Kanimekh, Janubiy Bukinoy i and Terekuduk, etc. All ore-bearing aquifers are confining, the minimum underground water pressure on the roof is in Beshkok, Loyliken, partially in Ketmonchi, and the Aitim site of Uchkuduk (20-250 m). The minimum depth of underground water is In Loyliken (partially spontaneous discharge of underground water), Beshkok, Kuhnur, Meylisay, locally in Ketmonchi, Shimoliy and Janubiy Bukinoy (up to 50 m). The maximum depth is in Severni Kanimekh, Janubiy Bukinoy, Sugrali, partially Ketmonchi (mainly 100 and more meters). The bed water is as a rule low saline (the solid residue is 1-7 g/l).

The main geotechnological type of ore hosting rocks is sand, more seldom gravel (part of Sabirsoy, Ketmonchi) and sandstones with clay (part of Loyliken) and carbonate (part of Sugrali, Ketmonchi) cement. Filtration coefficient of sand is from 2 to 10 m/day, more seldom 0.1-1.0 m/day.

Ore hosting rocks are composed of minerals mostly inert to acid water solutions and salts of alkaline or alkaline-earth metals. As for terrigene components quartz is predominant (65-80%), feldspar (6-22%), chloride, biotite, muscovite, debris of siliceous (1-5%) and alumosilicate (5-16%) rocks, clay minerals like hydromica with admixture of kaolinite montmorillonite (1-15%) also occur. As for authigeneous minerals the main are calcite and dolomite (up to 10%), pyrite and marcasite (up to 3.5%), sometimes siderite, ankerite, glauconite and other occur.

For many years uranium was considered to be the main useful component of deposits of Central- Kyzyl-Kum. At the same time selenium (native, selinides) 0.01-0.2%, mainly 0.03-0.07%, rhenium (presumably ReS_2 + ReO_2) - 0.5-2.1 - up to 15 g/t, scandium (presumably hydroxide as well as Sc containing apatite, etc.) - 0.05-0.5% more seldom more; in the deposits of Bukinoy -Kanimekh ore field in ore sand yttrium (up to 120 g/t), lanthanoids (up to 50 g/t), cerium (up to 150 g/t), samarium, europium up to 3 g/t), gadolinium, terbium (up to 1.5 g/t) dysprosium, erbium, thulium, ytterbium (up to 10 g/t) also occur. Useful components in sandy aquifers (subaquifers) form complex ore deposits 100-500 m in width.

By the chemical composition the ore is mainly silicate (SiO_2 - 63-85%); in Sugrali, Janubiy Bukinoy, Severni Kanimekh, Sabirsoy there are the sites with substantially carbonate ore. The phosphorus content of ore is 0.03-0.4%, reaching 4-6% in some parts of Ketmonchi; the pyrite sulphur content varies within 0.05-3% (maximum value is in a number of sites of Sugrali and Sabirsoy); the organic carbon content is from 0.03-0.1 to 10% (in some sites of Sabirsoy and Ketmonchi). Bitumen is well developed in Sabirsoy.

The rock temperature within mineralization varies from 20 to 40°C (minimum is in Beshkok, Loyliken, parts of Ketmonchi and Bukinoy, maximum temperature in Severni Kanimekh, Sugrali, in the north-eastern part).

The described principles of grouping of natural factors of uranium deposits make it possible:

- to draw necessary conclusion about the possibility to use underground leaching already at an early stage of geologic study;
- at the stage of detail exploration to carry out zonation of deposit in order to evaluate geotechnical parameters in technical-economic calculations;
- to carry out field underground leaching tests in one selected region and applying the results for other regions with allowance for natural factors;
- almost all polyelement sandstone deposits of Uzbekistan are suitable for underground leaching.

MATHEMATICAL MODELLING OF THERMAL EFFECT IN HYDROTREATING REACTOR WITH QUENCHING

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Hydrotreating of diesel fuel is a process that deserves special attention in the field of petroleum refining. This is due to the increase of production of oils with high sulfur content, as well as tightening regulatory requirements for the quality of the diesel fuel and the content of organosulfur compounds in it. The need for optimization of the process poses engineer in front of a computer modeling problem, which would identify patterns of chemical reactions in the process of hydrotreating without the expense of full-scale experiments and give the possibility to form recommendations for process improvement.

The purpose of this study is to identify the patterns of technological parameters influence on activity of the catalyst loaded into the reactor of hydrotreating unit "LG-24/7", and accordingly, influence on the quality of the product – hydrotreated diesel fraction. Such sulfur-containing substances as homologues of benzothiophenes (C_1BT; C_2BT; C_3BT) and homologues of dibenzothiophenes (DBT; C_1DBT; C_2DBT; C_3DBT) are chosen for study.

Experimental data allowed to prepare a list of possible chemical reactions. The change of the Gibbs energy for each reaction was calculated using the Gaussian 09 and HyperChem software packages. In previously published studies calculation of kinetic parameters by solving the inverse kinetic problem was conducted [1, 2]. The resulting kinetic parameters are shown in Table 1 and are used in a mathematical model of the current process.

Table 1

Gibbs energy change and chemical rate constants of organosulfur substances hydrogenation

No.	Gibbs energy change $\Delta G, \frac{k]}{mole}$	Chemical rate constant, k, h^{-1}	Reaction equation
1	-95,3	2,114	$(C_1BT)\ C_9H_9S + 3H_2 \rightarrow C_9H_{13} + H_2S$
2	-83,5	2,065	$(C_2BT)\ C_{10}H_{11}S + 3H_2 \rightarrow C_{10}H_{15} + H_2S$
3	-71,1	1,956	$(C_3BT)\ C_{11}H_{13}S + 3H_2 \rightarrow C_{11}H_{17} + H_2S$
4	-65,1	1,907	$(DBT)\ C_{12}H_8S + 2H_2 \rightarrow C_{12}H_{10} + H_2S$
5	-54,3	1,877	$(C_1DBT)\ C_{13}H_{11}S + 2H_2 \rightarrow C_{13}H_{13} + H_2S$
6	-53,7	1,761	$(C_2DBT)\ C_{14}H_{13}S + 2H_2 \rightarrow C_{14}H_{15} + H_2S$
7	-49,4	0,968	$(C_3DBT)\ C_{15}H_{15}S + 2H_2 \rightarrow C_{15}H_{17} + H_2S$

The LG-24/7 hydtrotreating set has a reactor with quenching of hydrogen and diesel fraction feed into the middle of the reactor between first and second catalyst beds according to feed flow direction (Fig.1).

After the moment when heated feed leaves furnace it flows to the first bed of catalyst where it undergoes an exothermic reaction with hydrogen during desulphurization process. The second smaller flow of feed is forwarded into the section in the middle of reactor between upper and lower catalyst layers.

The mathematical model of hydrotreating process with quenching is developed by using the law of acting masses and thermodynamic parameters of chemical substances which undergo a series of reactions. The system of differential equations was prepared, which is presented in the table 2.

Table 2

Mathematical model of hydrotreating thermal effect

Benzothiophenes (BT)	Dibenzothiophenes (DBT)
$W_1 = k_{C_1BT} C_{C_1BT} C_{H_2}^{V}$ $W_2 = k_{C_1BT} C_{C_1BT} C_{H_2}^{V}$ $W_3 = k_{C_2BT} C_{C_2BT} C_{H_2}^{V}$	$W_4 = k_{DBT} C_{DBT} C_{H_2}^{V}$ $W_5 = k_{C_1DBT} C_{C_1DBT} C_{H_2}^{V}$ $W_6 = k_{C_2DBT} C_{C_2DBT} C_{H_2}^{V}$ $W_7 = k_{C_3DBT} C_{C_3DBT} C_{H_2}^{V}$
$\frac{dT}{d\tau} = \frac{\sum_{i=1}^{N} Q_i W_i}{p C_p^{feed}}$	
Initial conditions: $dC_i = C_{i,0};\ t = 0$	

The variables, presented in the table 2 are: W_i – speed of chemical reaction; k_i – chemical rate constant; C_i – concentration of the reactant; Q_i – thermodynamic effect of the reaction; p – density of feed; C_p^{feed} – thermal capacity of feed; τ – duration of the reactants residue in the reactor; v – stoichiometric coefficient.

The supposed temperature profile of the reactor (Fig. 2) will have two stages of temperature rising because of exothermic hydrogenation reactions which occur in two layers of catalyst.

This research can be useful in determining imperfections in the hydrotreatment technological parameters or reactor construction. The new catalyst or different flowchart can be supposed for modification of "LG-24/7" hydrotreating unit to compensate these imperfections and to make the process more effective.

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