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PROBLEMS OF THE DEVELOPMENT OF RUSSIAN OIL SHALE INDUSTRY

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In the territory of Russia, over eighty oil shale deposits have been discovered and explored to a different degree. Nevertheless, shale is mined only in one deposit located in Leningrad district and belonging to the Baltic shale basin. Mined shale is processed in the Slantsy Oil Shale Processing Plant and partly burned at the thermoelectric plant of the same enterprise.

Deposits of Volga-Pechersk oil shale province with their explored reserves are the most perspective ones for the development of Russian oil shale industry. These shales differ essentially from Baltic ones. Perelyub-Blagodatovsk, Kotsebinsk and Rubezhinsk deposits, belonging to Saratov and Orenburg districts, are first-rate deposits for industrial application. These deposits are characterized by four 0.8 to 2.6 m productive seams. Shales are rich in sulphur and ashes. The content of sulphur may reach 4-6 %, on dry shale basis. Ash content varies between 46-66 %, and the heating value - between 12.5 and 8.5 MJ/kg.

Exploitation of Volga Basin shales was started in 30's of this century. The first pits were constructed and in the village Kashpir a small-capacity oil shale processing plant was erected.

A little later the utilization of this shale as the fuel for burning in Saratov and thereafter in Syzran thermoelectric power plants began. Due to environmental pollution with SO₂, the burning was stopped. The oil shale processing plant in Syzran is still in operation, however, its throughput does not exceed 50,000 tonnes of shale per year.

The deficiency of organic fuels in the European part of Russia has brought forward the need to include Volga Basin shales into the energy and raw material balance of the Russian Federation.

Two kinds of difficulties may arise at solving these problems.

Firstly, the environmental hazard has to be avoided both at mining and at any possible route or stage of the utilization of this sulphur-rich shale.

Secondly, the optimum technology for processing sulphur-rich shales to produce the products hard to prepare from other raw materials has to be worked out.

The results of investigations on mining and processing Volga Basin shales reported at this conference permit to count on a successful mastering of the difficulties hindering the development of Russian oil shale industry.

The most perspective for exploitation shale deposits in Volga Basin are situated in the region of the highly developed agricultural production. The area of arable land used for mining should be minimal. Because of that the well method being tested under field conditions is of a great interest. It enables selective mining of shale, without excavation of dead rock. The corresponding equipment has to be constructed to mine shales in amounts sufficient for holding the first oil shale processing plant in operation.

There are favourable conditions for raising the rate of open-pit mining with immediate recultivation of overburden at the Kotsebinsk deposit.

Volga Basin shales were used as fuel for power generation in Saratov and Syzran thermoelectric power plants. High-sulphur shales proved to be not suitable for burning in chamber furnaces equipped with hammer mills as the content of SO_2 in flue gases exceeded 3 g/m^3 . These plants were closed down due to inadmissibly high emissions of SO_2 into atmosphere.

Studies carried out during the last years have shown that circulated-fluidized-bed (CFB) boilers are very suitable for burning sulphur-rich shales. Advantages of these boilers became especially evident at burning carbonate-containing fuels. Shales also belong to those fuels.

In CFB boilers, there exist favourable conditions for the interaction between SO_2 and destruction products of carbonates - CaO and MgO . Calcium and magnesium sulphides are formed and oxidized to sulphates - environmentally harmless products.

SO_2 content of flue gases decreases below the established standards. The equipment of power plants with CFB boilers enables to include Volga Basin shales into heat and power balance of this district.

Potential resources of oil estimated for oil shale deposits located in the European part of Russia are about ten milliard tonnes.

In spite of the present organic fuel deficiency in this district, there exists no possibility to consider oil shales as raw material for liquid fuel production. As a matter of fact, retorting of sulphur-rich shales, the process widely used in Estonia, gives too much heterocompounds in the produced oil. Sulphur content exceeds 6 %, e.g. the oil cannot replace liquid fuel. The methods for refining crude oil cannot be applied to sulphur-rich shale oils, because they require very high capital outlays and represent a threat to the environment.

The studies carried out at Saratov State Technical University have shown that the best technical solution for processing sulphur-rich shales, typical for Volga Basin, is their pyrolysis at $850\text{-}900^\circ\text{C}$. High-calorific gas of an elevated content of hydrogen sulphide and gas naphtha are the main

products of pyrolysis. The latter consists of aromatic hydrocarbons of benzene series and heterocyclic compounds of thiophene series (mainly thiophene and its methyl derivatives). Gas purified from hydrogen sulphide may be used as a universal energy carrier, and sulphur represents a good replenishment to sulphur resources.

At present, thiophene is not produced in Russia. High-temperature processing of high-sulphur shales renders the possibility to produce thiophene and its derivatives in amounts sufficient for developing new routes in organic synthesis, first of all for preparing bioactive compounds for human and veterinary medicine. Their importance for Russia cannot be underestimated.

At the Institute of Organic Chemistry of the Russian Academy of Sciences new effective methods for obtaining a thiophene-aromatics concentrate from gas naphtha have been worked out. Methods for synthesis of various chemicals from this concentrate have been proposed.

Some other possibilities to utilize Volga Basin shales were also discussed at the conference.

Shales with an elevated content of organics could be used as filling materials in production of rubber products and composite materials.

Ash residue remaining after burning and processing Volga Basin shales is suitable for producing building and binding materials. The great demand for these materials in Russia guarantees the complete utilization of mineral residues during a large-scale processing of Volga Basin shales both for energetics and oil shale chemistry.

Discussion about the developmental problems of oil shale industry in Russia revealed new, scientifically founded approaches to their solution and demonstrated the need and possibilities to establish enterprises utilizing Volga Basin shales with the help of ecologically safe and non-waste technology.

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