

New developments in oil shale technology

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The prospective method of oil shale processing with obtaining the liquid fuel is a method of its pyrolysis. Application of this method with a solid heat carrier accordingly to ENIN required carrying out the many-year laboratory and pilot investigations of the technology and equipment with testing the samples of different oil shale of the world for the development of industrial plants – modules, which have passed the industrial approbation (UTT-200, UTT-500, UTT-3000, Demo Plant with Spout Fluidized bed).

The process parameters and the processing regime are determined by the physical and chemical properties of the primary shale, the physical and chemical properties of the final and intermediate products, the quality of waste, and ecological characteristics of discharges.

Apart from the low calorific value of oil shale, when the process can't be provided by its own heat, *i.e.* it is not autothermal, the cause hindering their processing by means of solid heat carrier may be also

- weak looseness of concrete oil shale,
- tendency to early bituminization,
- possible caking quality in the plant's reactor,
- caking quality of ash in spout fluidized bed,
- the composition of emission in atmosphere, *etc.*

These indices can be revealed only in the tests carried out on the laboratories and pilot stands and installations modeling or reproducing adequately the real process.

For this purpose, the laboratory and pilot plants and stands for the full or reduced scheme of pyrolysis with solid heat carrier were erected in ENIN and at its experimental bases in Estonia (Tallinn, Kiviily) as well as at the Ukrainian Verkhne-Sinevidnoye settlement.

The products and waste obtained from pyrolysis - liquid, gaseous products, mineral residue (ash) and pyrogenetic water - were comprehensively studied, and the ways of their utilization or further processing have been outlined. The technology of oil shale processing for about 30 deposits of different countries has been checked on the above-mentioned plants in accordance with ENIN method.

UTT-500 was in industrial operation for 107,350 hrs;
2,095,000 t of Baltic shale ($Q_i^r = 1800-2000$ kcal/kg)

were processed; 286,000 t of tar and 109 million nm^3 of highly calorific gas were obtained. The maximum annual number of unit's operation was more than 6,000 hours. Based on the long-term experience of UTT-500 operation and the design modification, two advanced UTT-3000 units were created and constructed at the Estonian TPP. The units have been in operation since 1990. Each of them can process 3,340 tons of Baltic shale a day and produce about 130,000 t of various fractions of oil shale tar and 42 million nm^3 of highly calorific gas. The production cost of one shale oil barrel constitutes from \$14-17 US that allows construction of the competitive industrial units practically with unlimited number.

Thus, the industrial technology and unit were created and worked out and allow to solve the problem of obtaining the artificial oil and thereby the problem of 21st century – the reduction of oil production volume.