INVESTIGATION OF THE THERMOBITUMINIZATION OF ESTONIAN OIL SHALE IN OPEN AND CLOSED SYSTEMS

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The retorting technologies of kukersite currently used for the industrial production of shale oil lose with semicoke formed during the secondary cracking of an intermediate product, thermobitumen (TB), more than one third of organic feedstock to liquid fuels.

In this work, the theoretical basis for a new technology consisting in the extraction of the TB soluble in organic solvents in the stage of thermobituminization was developed. Under the optimum conditions more than 80% of organic matter was liquefied, and the demand for oil shale and amount of hazardous semicoke wastes per oil unit were substantially decreased.

Laboratory experiments to elucidate the effect of temperature and process duration on the yield of volatiles, benzene (and methanol) extract and solid residue during the low-temperature pyrolysis (340–410 °C) of powdered kukersite in autoclaves and open retorts were described.

A new kinetic model was elaborated simulating a complex pyrolysis process by the first-order parallel phase transformations of kerogen into volatiles (gas and oil in open retorts, and gas in autoclaves) and extract (TB in open retorts and TBO in autoclaves), and the secondary cracking of the extract into volatiles and coke.

The rate factors (k_1-k_4) and distribution factors (B_i) of phase components at various temperatures, and the apparent activation energies (E_1-E_4) and frequency factors (A_1-A_4) were estimated for the phase transformations in autoclaves and open retorts.

The time-dependence of products yield was calculated at different nominal temperatures based on the model developed. The obtained results revealed that the rate of formation of and optimum conditions for a maximum yield of the target product TBO in open and closed devices at unified heating regimes were practically similar.

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