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Features of Fossil Fuels Generation from Bazhenov Formation Source Rocks by Hydropyrolysis

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Abstract : Nowadays, most oil reserves in Russia and all over the world are hard to recover. That is the reason oil companies are searching for new sources for hydrocarbon production. One of the sources might be high-carbon formations with unconventional reservoirs. Bazhenov formation is a huge source rock formation located in West Siberia, which contains unconventional reservoirs on some of the areas. These reservoirs are formed by secondary processes with low predicting ratio. Only one of five wells is drilled through unconventional reservoirs, in others kerogen has low thermal maturity, and they are of low petroliferous. Therefore, there was a request for tertiary methods for in-situ cracking of kerogen and production of oil. Laboratory experiments of Bazhenov formation rock hydrous pyrolysis were used to investigate features of the oil generation process. Experiments on Bazhenov rocks with a different mineral composition (silica concentration from 15 to 90 wt.%, clays – 5-50 wt.%, carbonates – 0-30 wt.%, kerogen – 1-25 wt.%) and thermal maturity (from immature to late oil window kerogen) were performed in a retort under reservoir conditions. Rock samples of 50 g weight were placed in retort, covered with water and heated to the different temperature varied from 250 to 400°C with the durability of the experiments from several hours to one week. After the experiments, the retort was cooled to room temperature; generated hydrocarbons were extracted with hexane, then separated from the solvent and weighted. The molecular composition of this synthesized oil was then investigated via GC-MS chromatography Characteristics of rock samples after the heating was measured via the Rock-Eval method. It was found, that the amount of synthesized oil and its composition depending on the experimental conditions and composition of rocks. The highest amount of oil was produced at a temperature of 350°C after 12 hours of heating and was up to 12 wt.% of initial organic matter content in the rocks. At the higher temperatures and within longer heating time secondary cracking of generated hydrocarbons occurs, the mass of produced oil is lowering, and the composition contains more hydrocarbons that need to be recovered by catalytical processes. If the temperature is lower than 300°C, the amount of produced oil is too low for the process to be economically effective. It was also found that silica and clay minerals work as catalysts. Selection of heating conditions allows producing synthesized oil with specified composition. Kerogen investigations after heating have shown that thermal maturity increases, but the yield is only up to 35% of the maximum amount of synthetic oil. This yield is the result of gaseous hydrocarbons formation due to secondary cracking and aromatization and coaling of kerogen. Future investigations will allow the increase in the yield of synthetic oil. The results are in a good agreement with theoretical data on kerogen maturation during oil production. Evaluated trends could be tooled up for in-situ oil generation by shale rocks thermal action.

Keywords : Bazhenov formation, fossil fuels, hydropyrolysis, synthetic oil
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