

LIQUEFACTION AND GASIFICATION OF ESTONIAN OIL SHALES IN THE MEDIUM OF HOT COMPRESSED WATER

Dr Kristjan KRUUSEMENT, TUT Hans Luik(a), TUT Lea Luik(b), TUT Vilja Palu(c), TUT Natalia Vink(d), Paul Scherrer Institute Frédéric Vogel(e)

Laboratory of Oil Shale and Renewables at Tallinn University of Technology, Researcher, Ehitajate tee 5, 19086, Tallinn, Estonia, kristjan.kruusement@mail.ee

- (a) Dr
- (b) Ms
- (c) Ms
- (d) Ms
- (e) Dr

Water conversion has been developed as an alternative method for oil shale liquefaction and gasification.

The former, carried out at Laboratory of Oil Shale and Renewables Research at Tallinn University of Technology, was applied for Kukersite, Dictyonema shale, and their blend (1:1 on organic matter (OM) basis) during 4 h in 0.5 l autoclave at 380 °C without catalyst. After cooling of autoclave the gases were determined, the reaction mixture was washed consequently with water, benzene and acetone. Yield of liquid products was determined as the sum of solubles, solid residue as insoluble matter.

The latter, carried out at Laboratory for Energy and Materials Cycles at Paul Scherrer Institute, was applied only for Kukersite during 0.5 h in 30 ml autoclave at 400 °C with Raney-Nickel catalyst. After cooling of autoclave the gases were determined, the reaction mixture was filtered, washed with methanol and the content of carbon was determined from the solubles and solid residue.

In liquefaction of Kukersite the oil yield was 62.7% (hereafter on OM basis), 84.9% of it is benzene soluble as the most similar to natural oil. 30.8% of OM transferred to gas and 6.5% remained in solid residue. From Dictyonema shale only 20.5% of OM transferred to oil and 46.6% to gas, 32.9% remained in solid residue. The content of benzene solubles is 59.3% of total oil. The dominating gas from both oil shales was CO₂ – ~70 vol% of total gas amount from Kukersite and ~40 vol% from Dictyonema shale. In co-processing of carbonaceous Kukersite and argillaceous Dictyonema shale in the ratio used there was no synergy in total oil as well as its group yield. The yield of solid residue was 40% higher and the gas yield even twice lower than the corresponding additive yields. Probably this synergic effect is caused by the action of oil shales mineral matter to the process.

In gasification of Kukersite with catalyst 41.9% OM transferred to gas. Methane as the target product constitutes only 8.4 vol% of total gas amount. Instead of methane the dominating gas was hydrogen: ~60 vol%. This phenomenon may be related to the composition of mineral matter of Kukersite.