

18.17 **Chemical changes in Huadian oil shale during x-ray irradiation in the presence of water**

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In this study, x-ray radiation-induced chemical conversion of organic and inorganic components of oil shale from Huadian (China) has been examined under hydrous conditions. Granulated oil shale (50-g) and water (100-mL) were combined in open, 250-mL beakers and exposed to x-ray radiation at a dose rate of 5 kGy/s. Following irradiation the samples were stored at room temperature for one week prior to characterization by thermogravimetric analysis, infrared spectroscopy, x-ray diffraction and proximate analysis to determine changes in hydrocarbon content. The proximate analysis data show that volatile content decreased from 38% to 33% and the calorific value changed from 12.6 to 11.0 MJ/kg following irradiation. This indicates aqueous x-ray irradiation led to hydrocarbon cracking. XRD data indicated little change in the mineralogy of Huadian oil shale following irradiation. The DSC curves determined on the treated oil shale can be divided into four major temperature ranges: I-Dehydration ($>100^{\circ}\text{C}$), II-Burnout of organics ($300\text{-}500^{\circ}\text{C}$), III- Combustion of fixed carbon ($600\text{-}700^{\circ}\text{C}$) and IV-Pyrolysis of calcite ($> 700^{\circ}\text{C}$). Samples that did not undergo x-ray treatment had higher range II calorific values. At the same time, after irradiation the range III exothermic peak almost disappeared, indicating that fixed carbon had been degraded by the x-ray treatment. Infrared spectra showed that the 3600 cm^{-1} (hydroxyl peaks) and $1400\text{-}1600\text{ cm}^{-1}$ (aromatic peaks) regions were significantly less intense after irradiation. This shows that x-ray processing of oil shale can alter organic matter structure.