

## **Sub-critical water extraction of bitumen from Huadian oil shale lumps**

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Different sized lumps of Huadian oil shale, ranging in diameter from 1 to 10 cm, were extracted using sub-critical water (SCW) at 350 °C and 16 MPa for 2 to 100 h. Shale lumps were fractured along the shale texture in the condition of SCW. It greatly increased the surface area of the oil shale with water and the bitumen released from kerogen inside the oil shale could be spread out along these cracks. Therefore, the SCW extraction of large sized oil shale became easier and more practicable. The extract yields of bitumen from different sized of oil shale samples became similar when the duration was longer than 20 h, although more maltene could be obtained from the same-sized sample. Meanwhile, the composition of the bitumen changed with increasing extraction time. The asphaltene and pre-asphaltene components gradually decomposed to maltene in SCW. The comparison of the classical pyrolyzate and the SCW extracts showed that SCW could extract more long-chain compounds. As a result, a high yield of bitumen could be obtained by SCW extraction.