

Microwave pyrolysis of Yaojie oil shale

Yonghui Song¹, Jianmei She², Xinzhe Lan¹, Wenzhi Shang¹, Xicheng Zhao¹, Rick Sherritt¹, Jimmy Jia³

¹*School of Metallurgical Engineering, Xi'an University of Architecture & Technology, China,* ²*Shenmu Sanjiang Coal Chemical Liability Co., Ltd., China,* ³*PROCOM Consultants Ltd., Australia*

Yaojie oil shale is a coalmine by-product and has high organic matter content. The oil yield of Yaojie oil shale determined by Fischer Assay varies from 6.15 to 25.73 wt% (average 12.67%) and gas yield varies from 2.91 to 6.20 wt% (average 4.70%). There is great economic and environmental interest in the utilization of Yaojie oil shale for oil production. Microwave pyrolysis technology (MPT) uses microwave energy to heat oil shale to pyrolysis temperatures, producing oil and gas. In this study, MPT has been investigated for processing Yaojie oil shale, focusing on the temperature characteristics and the influence of microwave power on the components and yields of semi-coke, shale oil and gas. We found that the pyrolysis temperature inside the retort can reach as high as 800°C and higher oil yield and higher gas yield are expected. Microwave power levels ranging from 180W to 800W have been tested and oil and gas yields and composition at different power levels showed significant differences. The maximum concentration of hydrogen, methane and carbon monoxide was achieved when the microwave power was 480W. Gas yield increases steadily with increasing microwave power; a gas yield of 10% was achieved at 480W. Oil yield increases gradually with increasing power and the maximum oil yield (13.8%) was achieved at 480W; beyond this power level oil yield decreased gradually due to oil cracking reactions. The yield of semi-coke decreased steadily with increasing microwave power. This study shows that microwave pyrolysis of Yaojie oil shale can achieve oil yield and gas yields that exceed those of Fischer Assay under optimum conditions.