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PYROLYSYS OF COAL AND RESIDUES AFTER CS_2-NMP SOLVENT EXTRACTION AND ITS SIGNIFICANCE FOR GAS GENERATION

Changyi ZHAO[1], Wenzhi ZHAO[1], Yunpeng WANG[2], Yan-Rong ZOU[2], Jinzhong LIU[2] and Shaobo LIU[1]

1. Research Institute of Petroleum Exploration and Development, PetroChina, Beijing 100083, China
2.SKLOG,Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 510640,China

Coal is a substance of high-enriching organic matter and very developed and complex pores/micro-pores, which decides it a very special gas source rock. The interaction between the hydrocarbon generated in the maturation process and the host coal is of great strength and complexity. In many cases, the coal-derived oil-like liquid hydrocarbons generated are restrained in coal and its expelling efficiency is very low. Even in laboratory conditions, they are not easy to be isolated completely from their host coal by routine extraction methods. Most of these compounds are occurring in coal through non-covalent bond interactions with the macro-molecular frames, and can be isolated by using mixture of carbon disulfide and N-methyl-2-pyrrolidinone (CS_2/NMP) solvent extraction.

The main objective of this paper is to investigate the gas generation potential of the CS_2/NMP extracts and its significance for coal-derived gases through laboratory-based pyrolysis technique. The yields of hydrocarbon gases generated from a humic Jurassic coal from Kuqa Depression of Tarim Basin (China) was experimentally determined using the confined or closed system. The experiments were conducted from 300 to 550^{o}C under the pressure of 50 MPa and 13 points were set in whole heating range with the interval of 20 ^{o}C. Two experiments were designed: one is a pyrolysis of the low-maturity coal through the whole temperature range, and the other one is a serious of stepwise experiments. In each designed point, the experiment was paused and the samples were taken out. The coal was extracted using CS_2/NMP mixture solvent ultrasonically at room temperature. Then the residues were sealed again in a gold tube and the experiments continued from the stop temperatures. After analysing the gas compositions, the gas yield in each designed point were calculated through differencing method.

After comparing the gas yield from the whole coal and the residues at different heating ranges, it can be found that the gas yields of CS_2/NMP were around 4-8 ml/g at each heating interval before 460 ^{o}C (1.52%Ro), which account for 70-90% of the total gas yields of the whole coal. After this temperature, both the gas yields and the amount of extracts decrease rapidly. The percentage of the gas yield from the CS_2/NMP extracts in the gas yields from the whole coal decrease to 39%, 12% and almost less than 5% (Fig. 1). The results suggest that

the CS_2/NMP extracts are the main contributor to the coal gases before 460 ^oC (1.52%Ro), and the macro-molecular frames gradually become the main gas contributor after then. In the high maturity stages (Ro>2.0%), the macro-molecular frames in the coal are absolutely the dominant gas contributor.

This experiment show that liquid most of hydrocarbons generated during “oil window” is restrained in coal due to the strong adsorption. And the routine extraction methods (i.e. chloroform) cannot isolate them from their host coal because they exist in coal through non-covalent bond interactions between polar and non-polar fractions. They may be cracked in a proper maturity stages and act as the main gas source of the coal-derived gases. However, the macro-molecular frame is still the main gas contributor in very high maturity stages (Ro>2.0%).

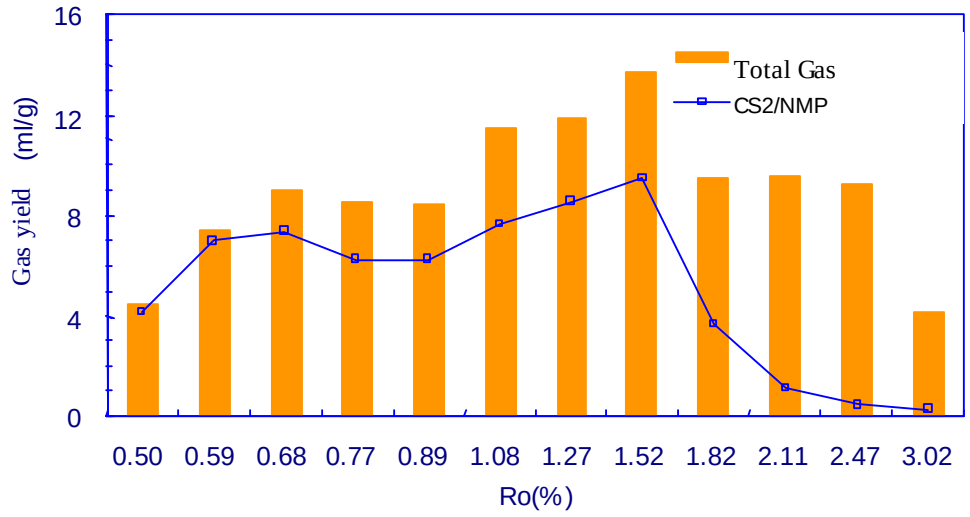

Figure 1. Gas yield generated from whole coal and CS_2/NMP extracts