Quantitative analysis for affecting factors of gas adsorption capacity measurement on the shales

MA XINGZHI[1], LIU SHAOBO[1], JIANG LIN[1] & HONG FENG[1], HAO JIAQING[1]

[1] Research Institute of Petroleum Exploration and Development, PetroChina, Beijing 100083, China

Shale gas, storage in micro- nano pore system in free state and clay and organic matter in sorption state, is one important type of unconventional natural gas resource. Accurate determination of adsorption gas content is a key parameter to evaluate the gas content and resources potential of shale. Usually the method of isothermal adsorption experiment is adopted to determine the adsorption capacity of the shale. However, obviously different with previous knowledge in the field of coalbed methane, the adsorption capacity of the shale at high pressure is negative, and the curve of isothermal adsorption curve decreases with pressure increasing in most cases. In order to correctly explain this phenomenon, this study selected various shale samples from standard samples of international inter-laboratory comparison (e.g. Kimmeridge shale, Posidonia shale), Longmaxi Formation in Silurian in Sichuan basin and Ordovician in Tarim basin. Isothermal adsorption experiments on shale and numerical error analysis are performed. Results show that equation of state (EOS), void volume, pressure sensor accuracy and blank test are identified as major factors to affect the accurate measurement of gas adsorption capacity on shale. In the EOS, the Se-W equation is the most suitable for the calculation of the methane adsorption capacity of the shale, and the second is the S-R-K equation. P-R equation is the worst. Adsorption capacity of shale is negatively related with void volume. The void volume has an error that measurement value is larger than real, which would result in reducing adsorption capacity of the shale in test. Under the condition of high pressure, the effect of void volume error on the adsorption quantity is more serious. Comparison with the temperature sensor, the influence of pressure sensor accuracy on the shale methane adsorption capacity is more prominent. The adsorption capacity test accuracy and stability of measurement system with 10^{-4} precision pressure sensor superior to that with 10^{-3} precision pressure sensor. In addition, the test adsorption capacity of the shale which is not corrected by the blank test is usually lower than the actual adsorption capacity, and possibly leads to negative values of adsorption.