

Study on the Difference of Pore Structure of Coal and Shale and Its Effect on Methane Adsorption

Authors : Jun Li, Zhengfu Ning, Qiang Li

Abstract : An introductory statement that outlines the background and significance of the study: Unconventional natural gas, as a new energy source, is widely occurring in the world. Due to its clean advantages, it is being continuously promoted and developed. Coalbed methane and shale gas are a kind of unconventional natural gas resources in the form of adsorption in coal reservoirs. Increasing the development and utilization of unconventional natural gas can effectively supplement the energy gap and optimize the energy structure. A succinct description of the basic methodologies: Coal samples from Houwenjialiang Coal mine in Inner Mongolia and shale outcrop samples from Longmaxi Formation in China were selected as the research objects. A low-temperature nitrogen adsorption experiment was used to explore the differences between coal and shale pores, and an isothermal adsorption experiment was used to explore the differences in the methane adsorption characteristics of rocks. Then, based on the self-constructed 3D model of coal and 3D model of shale kerogen, the differences in methane adsorption mechanism between coal and shale are further explored based on Monte Carlo algorithm and molecular dynamics method. A clear indication of the major findings of the study: The results show that slit pores are mainly developed in coal and ink bottle pores are mainly developed in shale. The pore structure of coal, shale and sandstone is very different. Although the pore structure of coal and shale is different, pores <10 nm are the main contributor to the specific surface area. The degree of micropore development in coal is much greater than that in shale. Micropores provide most of the pore volume and specific surface area of coal. The pore volume of shale is mainly provided by mesoporous pores. The specific surface area of coal is 22.461m²/g. The specific surface area of shale is 13.931 m²/g. The adsorption capacity of coal for methane is stronger than that of shale, and the molecular simulation also shows the same results. Micropores provide more space and adsorption sites for methane adsorption by coal, so the adsorption capacity of coal for methane is much greater than that of shale, and the maximum adsorption capacity has a strong positive correlation with the specific surface area size of nano-pores. A concluding statement: The research results provide theoretical basis for the effective exploitation of coalbed methane and shale gas.

Keywords : coal, shale, pore structure, isothermal adsorption, molecular simulation

Conference Title : ICAE 2025 : International Conference on Applied Energy

Conference Location : Istanbul, Türkiye

Conference Dates : May 01-02, 2025