Effect of the Pore Structure on Diffusion Migration of Different Rank Coal Samples

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Extended Abstract

Existing experimental equipment was used to conduct high-temperature and high-pressure diffusion tests on four coal samples with different low, middle, and high ranks. Then, the characteristics of the diffusion kinetics of coal samples under different temperatures and pressures are discussed by using the results. Meanwhile, a high-temperature and high-pressure methane diffusion model was derived and established by combining with the molecular simulation of methane adsorption and diffusion. Finally, the mechanism of methane diffusion in coal samples is discussed by combining the pore structure and heterogeneity of coal samples. The results show that the adsorption capacity and isosteric heat of adsorption calculated by molecular simulation gradually decrease as the temperature increases. Comparing the methane self-diffusion coefficient and corrected diffusion coefficient with the transfer diffusion coefficient of coal samples at different temperatures, it can be seen that the values of three diffusion coefficients all increase with the increase of temperature. Under the same temperature and different pressures, the initial diffusion coefficient calculated by the new model gradually increases with the increase of pressure. With the increase of temperature, the attenuation coefficient by using new models first increases and then decreases under the conditions of 2, 6, and 12 MPa; it gradually decreases under the condition of 20 MPa. As the degree of coal rank increases, the diffusion coefficient, specific surface area, and fractal dimension all first decrease and then increase later. Then, the diffusion coefficient gradually increases with the increase of the fractal dimension, and there is a positive correlation between the two parameters. It shows that the more complex the pore structure of coal and the rougher the surface, the greater the impact on the methane diffusion coefficient.

The fractal dimensions obtained by high-pressure mercury intrusion and low-temperature liquid nitrogen tests all show a trend of first decreasing and then increasing as coal rank increases, and the variation of fractal dimension is consistent. Under the same temperature and different pressures, the initial diffusion coefficient in the new model gradually increases with the increase of pressure. With the increase of pressure, the attenuation coefficient gradually increases at 30°C and 70°C. Under the same pressure and different temperatures, the initial diffusion coefficients in the new model gradually increase with the increase of temperature. With the increase of temperature, the attenuation coefficient first increases and then decreases under the conditions of 2, 6 and 12. However, the value gradually decreases under the condition of 20 MPa. As the coal rank, the methane diffusion coefficient, specific surface area, and fractal dimension all first decreasing and then increasing. The diffusion coefficient gradually increases with the increase of the fractal dimension, and those two parameters have a positive correlation. It shows that the more complex the pore structure of coal and the rougher the surface, the greater the impact on the methane diffusion coefficient.

References

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