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Experimental measurement of permeability in porous medium containing methane hydrate

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Natural Gas Hydrate (NGH) widely distributed in marine sediments and permafrost areas has attracted global attentions as potential energy resources. Permeability is a critical parameter that influences the gas production potential from hydrate reservoirs. The hydrate saturation affects the characteristics of the porous media, which is also the key factor determining the permeability. In this study, the absolute permeability and the relative permeability of water were experimentally measured at varying hydrate saturations (0-0.347) in porous medium made of quartz sands and the porosity was 0.3. During permeability measurement, the steady flow and stable differential pressure were obtained under certain water injection rate. Hydrate saturations were controlled and calculated precisely based on the amount of injected and produced gas/water, the system pressure and temperature.

The result indicated that the water relative permeability reduced exponentially with the increase of methane hydrate saturation, and the reduction exponent value of 7.9 was obtained in the Masuda's permeability model. In addition, hydrate with different saturation in porous media is stored with different forms, which exerts considerable influence on permeability as well. Therefore, a new permeability model based on the weighted combination of pro-filling and grain-coating model was proposed. The weight of pro-filling model is defined as the N-th power of hydrate saturation, and the weight of grain-coating model is defined as the N-th power of non-hydrate saturation. In this work, the calculated index N was 5.6. Compared with the Masuda's model, the new model not only shows the relationship between permeability and hydrate saturation, but also reflects the aggregate performance of hydrate in porous media.

References

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