World Academy of Science, Engineering and Technology
International Journal of Energy and Power Engineering
Vol:16, No:05, 2022

Understanding the Role of Gas Hydrate Morphology on the Producibility of a Hydrate-Bearing Reservoir

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Abstract : Numerical modeling of gas production from hydrate-bearing reservoirs requires the solution of various thermal, hydrological, chemical, and mechanical phenomena in a coupled manner. Among the various reservoir properties that influence gas production estimates, the distribution of permeability across the domain is one of the most crucial parameters since it determines both heat transfer and mass transfer. The aspect of permeability in hydrate-bearing reservoirs is particularly complex compared to conventional reservoirs since it depends on the saturation of gas hydrates and hence, is dynamic during production. The dependence of permeability on hydrate saturation is mathematically represented using permeability-reduction models, which are specific to the expected morphology of hydrate accumulations (such as grain-coating or pore-filling hydrates). In this study, we demonstrate the impact of various permeability-reduction models, and consequently, different morphologies of hydrate deposits on the estimates of gas production using depressurization at the reservoir scale. We observe significant differences in produced water volumes and cumulative mass of produced gas between the models, thereby highlighting the uncertainty in production behavior arising from the ambiguity in the prevalent gas hydrate morphology.

Keywords : gas hydrate morphology, multi-scale modeling, THMC, fluid flow in porous media
Conference Title : ICNGH 2022 : International Conference on Natural Gas Hydrates
Conference Location : Sydney, Australia
Conference Dates : May 16-17, 2022