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Effects of Fluid Saturation on Gas Recovery from Class-3 Hydrate Accumulations Using Depressurization: Case Study of Yuan-An Ridge Site in Southwestern Offshore Taiwan

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Gas hydrates are crystalline compounds in which guest gas molecules are trapped in host lattices of ice crystals. In Taiwan, the significant efforts have recently begun to evaluate the reserves of hydrate because the vast accumulations of gas hydrates had been recognized in southwestern offshore Taiwan.
Class-3 type hydrate accumulations are referred to an isolated hydrate layer without an underlying zone of mobile fluids, and the entire hydrate layer may be well within the hydrate stability zone. The depressurization method is a useful dissociation method for gas production from Class-3 hydrate accumulations. The dissociation efficiency is controlled by the responses of hydrate to the propagating pressure disturbance, and the pressure propagation is relating to the amount (or saturation) of the mobile fluid in pore space of the hydrate layer. The purpose of this study is to study the effects of fluid saturation on the gas recovery from a class-3 hydrate accumulation using depressurization method. The case of a class-3 hydrate deposit of Yuan-An Ridge in southwestern offshore Taiwan is studied.
The numerical method was used in this study. The reservoir simulator we used to study the dissociation of hydrate and the production of gas was the STARS simulator developed by CMG, which coupled heat transfer, geo-chemical, geo-mechanical, and multiphase fluid flow mechanisms.
The study case of Yuan-An Ridge is located in southwestern offshore Taiwan. The hydrate deposit was found by the bottom simulating reflectors (BSRs). The geological structure of the studied hydrate deposit was digitized to build the geological model (grids) of the case. The formation parameters, phase behavior data, rock and fluid properties, and formation's initial conditions were assigned sequentially to grid blocks, and the completion and operation conditions were designed to wellbore blocks to finish the numerical model. The changes of reservoir pressure, temperature, saturation due to the hydrate dissociation and the fluid production were calculated by the simulator.
The operation of constant-pressure production was considered in this case study. The assumed pressure decline was 70%, 60%, 50% and 40%, of the initial pressure value, respectively. The calculated results showed that, in the case of 70% pressure decline, the recovery factor (RF, the value of cumulative gas production (Qg) divided by the original gas in place (OGIP)) was 37.32%, 46.75%, 49%, 50.58%, 12.48% and 0% when the initial hydrate saturation of 30%, 40%, 50%, 60%, 70% and 80% are assumed, respectively. In the case of hydrate saturation of 60%, the RF was 50.58%, 31.60%, 4.21% and 0.21% when the pressure decline of 70%, 60%, 50% and 40% are assumed, respectively. For this case study, the best gas recovery was from the initial hydrate saturation of 60% with the operation of pressure decline of 70%. Based on our findings, the depressurization method might not be suitable for a Class-3 hydrate deposit with high hydrate saturation of above 80%.