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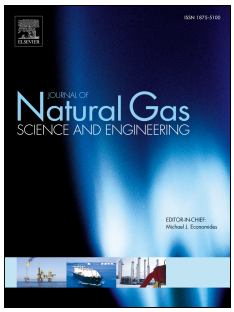

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Determination of Dissociation Front and Operational Optimization for Hydrate Development by Combining Depressurization and Hot Brine Stimulation

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ABSTRACT

Techniques have been developed to determine dissociation front (i.e., the boundary where hydrate saturation is decreased to 0) for hydrate development by combining depressurization and hot brine stimulation. Experimentally, hydrate dissociation is determined with a one-dimensional (1D) model by gradually injecting hot brine to examine gas and water production. Theoretically, simulation techniques are employed to determine the decay rate and relative permeability by fitting the experimental measurements. Subsequently, the numerical techniques are well matched with field test data and then extended to field applications by applying two different development methods (i.e., depressurization and combining it with hot brine injection). It is found that the combination method greatly improves gas recovery by approximately 35.00%, higher water production rate, and lower gas water ratio compared with those of depressurization alone. The orthogonal design method is then used to perform sensitivity analysis and optimize operational parameters by maximizing energy efficiency as the objective function. The most sensitive parameters are found to be the brine temperature, producer bottomhole pressure, brine injection rate, and injection time. Two dissociation fronts are formed separately near the producer and