Review

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A review of gas hydrate growth kinetic models

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Abstract

Research on gas hydrates has progressed over the past several decades as a technology enabler for several innovative applications in the areas of water, energy and environmental aspects. In this review, we present a systematic review of literature on the kinetic models describing the behaviour of gas hydrate growth. We reviewed a total of 27 classical and state-of-the-art models with their variations. These models were categorized into groups according to their controlling mechanism postulated (heat transfer, mass transfer, or intrinsic kinetic reaction), solution methods adopted (semi-empirical, analytical, or numerical) and reactor configurations (stirred-tank, packed-bed, flow reactor or hydrate film). We examined in-depth the main features of each kinetic model including its formulation, assumptions, governing equations, solution method, strengths and limitations. In addition, we summarized the critical transport parameters of heat and mass transfer, and the intrinsic kinetic rate parameters associated with hydrate growth in these models for benchmarking and application. Knowledge gap still exists in understanding the controlling mechanism of hydrate growth, which is further augmented by the dynamic multiphase fluids flow behaviour, the thermodynamics of hydrate-forming system and the compounding interfacial phenomena. Future efforts need to be devoted to recognize the coupling effect of heat and mass transfer,