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Modeling of Gas Extraction from a Partially Gas-Saturated Porous Gas Hydrate Reservoir with Respect to Thermal Interactions with Surrounding Rocks

Authors : Angelina Chiglintseva, Vladislav Shagapov

Abstract : We know from the geological data that quite sufficient gas reserves are concentrated in hydrates that occur on the Earth and on the ocean floor. Therefore, the development of these sources of energy and the storage of large reserves of gas hydrates is an acute global problem. An advanced technology for utilizing gas is to store it in a gas-hydrate state. Under natural conditions, storage facilities can be established, e.g., in underground reservoirs, where quite large volumes of gas can be conserved compared with reservoirs of pure gas. An analysis of the available experimental data of the kinetics and the mechanism of the gas-hydrate formation process shows the self-conservation effect that allows gas to be stored at negative temperatures and low values of pressures of up to several atmospheres. A theoretical model has been constructed for the gas-hydrate reservoir that represents a unique natural chemical reactor, and the principal possibility of the full extraction of gas from a hydrate due to the thermal reserves of the reservoirs themselves and the surrounding rocks has been analyzed. The influence exerted on the evolution of a gas hydrate reservoir by the reservoir thicknesses and the parameters that determine its initial state (a temperature, pressure, hydrate saturation) has been studied. It has been established that the shortest time of exploitation required by the reservoirs with a thickness of a few meters for the total hydrate decomposition is recorded in the cyclic regime when gas extraction alternated with the subsequent conservation of the gas hydrate deposit. The study was performed by a grant from the Russian Science Foundation (project No.15-11-20022).

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