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能源和环境工程

多孔介质中水合物生成与分解二维实验研究

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摘要

采用电容、压力、温度测试作为监测手段，自行研制了一套天然气水合物二维开采模拟系统，可用于水合物生成与分解过程中温度场、压力场、分布状态、分解前沿推进速度等动态特性的研究。水合物生成与分解实验表明，温度是影响水合物大量生成的主要因素；重复实验会加长生成时间，往往首次实验所耗总时间最短，说明水的记忆效应并不是对于所有实验系统存在的普遍现象；实验表现出来的特殊的压力变化曲线和规律还表明晶核形成对水合物晶体的生成并非绝对重要。理论分析和实验表明，电容法在测试单相水体相变过程中是有效的，水量是影响电容量变化的关键。在水合物生成过程中，随水合物饱和度的增加、水量的不断减少，电容量总体减小趋势明显。电容测试方法在水合物实验方面有一定的可行性，尤其对于研究多孔介质中水合物生成分解过程中各相的流动特性极有意义，但是要实现在水合物研究方面的有效利用还需要大量的切实的实验验证。

关键词 天然气水合物 二维 多孔介质 电容

分类号

Experimental studies of natural gas hydrate formation and dissociation in porous media with 2D experimental system

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Abstract

A new two-dimensional experimental system was developed，in which capacitance，pressure，and temperature were used to monitor the formation and dissociation of natural gas hydrate（NGH）.The system can simulate the hydrate formation and dissociation process in a 2D reservoir，which included the temperature and pressure field，the advancement of hydrate dissociation front，and the distribution of hydrate.From the results of formation and dissociation，it was observed that temperature was the key factor contributing to the formation of NGH.Annealing process would lengthen the formation and the first experiment was always the most time saving，which suggested that memory effects did not exist widely.Special development curves of pressure showed that nucleation was not always essential for the complete growth of hydrate crystals.Based on the dielectric theory and experimental results，it was found that capacitance method can be used to measure the single-phase development and water was the most important key.In the formation experiment，capacitance became lower as water volume decreased because of formation of NGH.The validity of the capacitance method used in NGH was proved，especially its significance in investigating the flow characteristics of gas and water in formation and dissociation in porous rock.But a lot of further work needs to done for the effective use of capacitance method in NGH.

Key words natural gas hydrate two-dimensional porous media capacity

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