化工学报 2008 59 (6): 1502-1507 ISSN: 0438-1157 CN: 11-1946/TQ

能源和环境工程

间壁换热分解开采天然气水合物的实验模拟

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收稿日期 2007-7-27 修回日期 2008-3-5 网络版发布日期 2008-6-6 接受日期

摘要

在自制3.5 L带内置换热器的可视化反应釜中，进行了不同间壁换热温度（84.8、72.2、50.5、30.9℃）的定容分解开采丙烷水合物实验模拟。分解初始时釜内气体压力迅速上升，随着分解的进行，压力增加的幅度逐渐减小，最后压力保持一定值。因此，将水合物分解过程分为释放气体阶段和分解尾声阶段。在释放气体阶段，气体大量产出，釜内压力迅速升高;在分解尾声阶段，釜内压力趋于平缓。计算得到总分解过程平均分解速率介于0.16～0.46 mol·min^{-1}·m^{-2}之间、总分解过程的能量效率介于1.33～3.74之间;释放气体阶段分解速率介于0.27～2.56 mol·min^{-1}·m^{-2}之间、水合物分解的能量效率介于2.25～5.58之间。与相关文献比较，间壁换热分解水合物的能量效率有很大程度提高。在实际应用中，存在一个最佳间壁换热分解温度，既提高水合物分解速率又提高能量效率。

关键词

热激 丙烷水合物 分解 实验模拟

分类号

Experimental simulation investigation on production behavior of natural gas hydrate with surface heat exchanger

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Abstract

The simulation experiment with a surface heat exchanger was carried out on a self-setup visual equipment with constant volume, and the heating temperature was 84.8℃, 72.2℃, 50.5℃, 30.9℃.From the experiment observation, dissociation process can be divided into two stages: gas release stage and end of dissociation stage.At the beginning of the dissociation, the pressure increased rapidly, then with the dissociation proceeding towards the end the pressure gradually leveled off.Computation showed that in the whole process of hydrate dissociation, average rate of dissociation was about 0.16—0.46 mol·min^{-1}·m^{-2}, and energy efficiency was between 1.33 and 3.74.At the gas release stage average dissociation rate was 0.27—2.56 mol·min^{-1}·m^{-2}, and energy efficiency was between 2.25 and 5.58.Compared with related literature, the energy efficiency of thermal dissociation increased obviously.In practical application, there is an optimizing thermal dissociation temperature which not only increases rate of hydrate dissociation but also improves energy efficiency and save energy.

Key words

thermal stimulation propane hydrate dissociation experimental simulation

DOI:

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