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Dissociation Rate Analysis from Methane Hydrate-bearing Core Samples by Using Depressurization or Depressurization with Well-wall Heating Method

Hiroyuki OYAMA, Takao EBINUMA, Jiro NAGAO, Kiyofumi SUZUKI and Hideo NARITA / Metahne Hydrate Research Labortory, National Institute of Advanced Industrial Science and Technology (AIST)
Yoshihiro KONNO, Yoshihiro MASUDA / University of Tokyo

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Abstract

This research presents an experimental study of gas production to clarify the dissociation characteristics of depressurization or depressurization with well-wall heating methods. To clarify the dissociation characteristics, we used an artificial core specimen that was produced using the properties of a natural core recovered at a site in the Nankai Trough near Japan. A pressure vessel was used in which confining and pore pressures were applied independently to the artificial core using a rubber sleeve and syringe pumps. Time change of production volume of gas and water, temperature and pressure were measured. The initial experimental parameters were set to simulate the conditions at near Japan sea sediments. The dissociation analysis was evaluated by the overall methane hydrate dissociation rate coefficient that calculated from production gas volume.

As a result, the rate constants were increase at the conditions of degree of depressurization or well-wall heating temperature increasing. The overall dissociation rate constant is express as a function of chemical potential and gas volume changes at the production conditions, and its formula is described with a simple form. A heat transfer from ambient area causes the mainly part of chemical potential change. Therefore, the well-wall heating helps methane hydrate dissociation, but the influence is not so large because of its heat transmitting to only small dissociation area. Our result is shown that the gas production rate is a sensitive function of well pressure and temperature. Our equation is verified under the different sensible heat condition experiments.

Introduction

Methane hydrates are crystalline, ice like compounds of methane gas and water molecules that are formed under certain thermodynamic condition. Methane hydrates in the earth's subsurface within permafrost and sub-sea environments are thought to hold a vast amount of potentially producible natural gas. A number of recovery processes have been suggested for producing gas from hydrates in sediments. Sloan has presented an extensive review of the suggested methods including depressurization, thermal simulation, and inhibitor injection[1)].

In Japan, methane hydrate has also considerable potential for use as a new energy resource. As a production method of natural gas from methane hydrate-bearing layer, depressurization or depressurization with well-wall heating method seems to be effective in economical efficiency. The depressurization method is decreasing the system pressure below the pressure of hydrate formation at a specified temperature. The depressurization with well-wall heating method is combined the thermal simulation method and depressurization method. This method only heats the well wall at the hydrate bearing layer, it is considered that initial and running cost becomes low. Therefore, a number of dissociation data are necessary for the assessment of the efficiency and to establish decomposition method[2)].

In this study, we carried out an experimental study of gas production to clarify the dissociation characteristics of both depressurization and depressurization with well-wall heating method. An artificial core specimen was used and its properties of a natural core recovered at a site in the Nankai Trough near Japan. We measure the time change of production volume of gas and water, temperature and pressure. The dissociation analysis was evaluated by the overall methane hydrate dissociation rate coefficient that calculated from production gas volume. Our main target is the obtained the informations for gas production from sub-sea sediments. Thus the initial experimental parameters were set to simulate the conditions at near Japan