Safety Science
Volume 50, Issue 4, April 2012, Pages 865 – 868
First International Symposium on Mine Safety Science and Engineering 2011

Influence of super-absorbent polymer on the growth rate of gas hydrate ☆

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http://dx.doi.org/10.1016/j.ssci.2011.08.017, How to Cite or Link Using DOI

Abstract

The growth rate of hydrate and morphology of methane hydrate formation were studied in a visual pressure cell at 5.5 MPa. The gas hydrate formation was carried out (coal mine methane (CMM) + tetrahydrofuran (THF) + sodium dodecyl sulphate (SDS) + H_2O) with and without SAP. Experimental data on the hydrate growth rate and induction time were obtained for three different CMM samples. The influence of SAP on hydrate growth rate was determined. Results showed that after the addition of SAP, with the methane concentration increased in CMM, the induction time was reduced by 9 min, 10 min and 3 min, and the growth rate was shortened by 0.56 × 10^{-6}/m^3 min^{-1}, 0.53 × 10^{-6}/m^3 min^{-1} and 1.42 × 10^{-6}/m^3 min^{-1}, respectively. This study could be useful for the recovery of methane from CMM by forming hydrate in the chemical and mining industry.

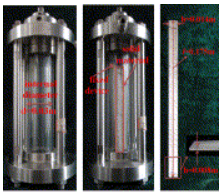
Highlights

► The growth rate of hydrate and morphology of methane hydrate formation were studied in a visual pressure cell at 5.5 MPa. ► A new method to promote the mass transfer in hydrate formation. ► The experimental work was concentrated around measuring the growth rate of hydrate in different gas samples with or without SAP. ► Experimental data on the hydrate growth rate and induction time were obtained for three different CMM samples.

Keywords

Coal mine methane separation; Gas hydrate; Induction time; Growth rate; SAP

Figures and tables from this article:



(a) (b) (c)

Fig. 1. 3D rendering of the experimental system. (a)the reactor, (b) the super-absorbent polymer in the reactor, and (c) the super-absorbent polymer.

Figure options

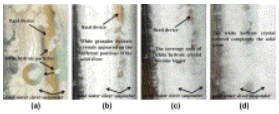


Fig. 2. Gas hydrate formation phenomena in test 1 – 1 (with SAP). (a) time = 31 min, (b) time = 38 min, (c) time = 42 min, (d) time = 134 min.

Figure options

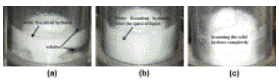


Fig. 3. Gas hydrate formation phenomena in test 1 – 2 (without SAP). (a) time = 40 min, (b) time = 64 min, (c) time = 322 min.

Figure options

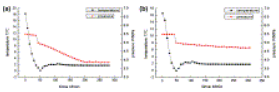


Fig. 4. Correlation of pressure, temperature and time during gas hydrate formation in test 1-1 and 1-2. (a) with SAP and (b) without SAP.

Figure options

Table 1. Gas and reagent samples used in the tests.

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Table 2. Kinetic parameters for CH_4 – N_2 – O_2 – THF – SDS – H_2O systems.

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The First International Symposium on Mine Safety Science and Engineering (ISMSSE2011) will be held in Beijing on October 26 – 29, 2011. The symposium is authorized by the State Administration of Work Safety and is sponsored by China Academy of Safety Science; Technology (CASST), China University of Mining; Technology (Beijing) (CUMTB), Datong Coal Mine Group, McGill University (Canada) and University of Wollongong (Australia) with participation from several other universities from round the world, research institutes, professional associations and large enterprises. The topics will focus on mines safety field: theory on mine safety science and engineering technology, coal mine safety science; engineering technology, metal and nonmetal mines safety science; engineering technology, petroleum and natural gas exploitation safety science; engineering technology, mine safety management and safety standardization science; technology, occupational health and safety in mine, emergent rescue engineering technology in mine, etc.

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