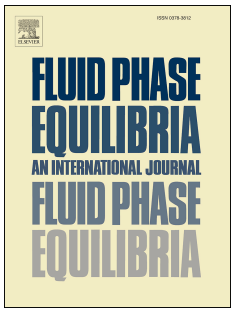

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Muhammad Saad Khan, Behzad Partoon, Cornelius B. Bavoh, Bhajan Lal, Nurhayati Bt Mellon

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Influence of Tetramethylammonium Hydroxide on Methane and Carbon Dioxide Gas Hydrate Phase Equilibrium Conditions

Muhammad Saad Khan [a,b], Behzad Partoon [a,b], Cornelius B. Bavoh [a,b], Bhajan Lal [a,b,*], Nurhayati Bt Mellon [b]

[a] Research Centre for CO_2 Capture (RCCO$_2$C), Chemical Engineering Department, Universiti Teknologi PETRONAS, Bandar Seri Iskandar, 32610, Perak, Malaysia.

[b] Chemical Engineering Department, Universiti Teknologi PETRONAS, Bandar Seri Iskandar, 32610, Perak, Malaysia.

*Corresponding author: bhajan.lal@utp.edu.my
Telephone/Fax: +6053687684; +60103858473 /+6053656176

Abstract

In this experimental work, the phase boundaries of TMAOH + H_2O + CH_4 and TMAOH + H_2O + CO_2 hydrates are measured at different concentrations of aqueous TMAOH solution. The temperature-cycle (T-cycle) method is applied to measure the hydrate equilibrium temperature of TMAOH + H_2O + CH_4 and TMAOH + H_2O + CO_2 systems within the ranges of 3.5-8.0 MPa and 1.8-4.2 MPa, respectively. Results reveals that, TMAOH acts as a thermodynamic inhibitor for both gases. In the presence of 10 wt% of TMAOH, the inhibition effect appears to be very substantial for CO_2 with an average suppression temperature (ΔT) of 2.24 K. An ample inhibition influence is observed for CH_4 hydrate at 10 wt% with ΔT of 1.52 K. The inhibition effect of TMAOH is observed to increase with increasing TMAOH concentration. Confirmed via COSMO-RS analysis, the TMAOH inhibition effect is due to its hydrogen bonding affinity for water molecules. Furthermore, the calculated hydrate dissociation enthalpies in both systems revealed that TMAOH does not participate in the hydrate crystalline structure.

Keywords: Ammonium based ionic liquids; COSMO-RS; gas hydrate; inhibitor; phase equilibrium; TMAOH.

1. Introduction

Gas hydrates are crystal-like solids in which gas molecules are encased in cages formed by hydrogen bonded water molecules and stabilized by van der Waals forces. They are non-