

# Phase Equilibria of R-22 ( $\text{CHClF}_2$ ) Hydrate in the presence of Acetone + Water

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## ABSTRACT

The effect of acetone on  $\text{CHClF}_2$  hydrate equilibrium conditions has been investigated. A full view equilibrium cell and associated equipment are designed, fabricated and used for this purpose. Adding acetone caused an increase of the equilibrium pressure. The equilibrium conditions were measured in the pressure range of 32 to 112 psia. The investigated concentrations of acetone in water were 2, 4, and 6 mole%. In contrast to methane hydrate in the presence of acetone, the system of  $\text{CHClF}_2$  + acetone + water shows inhibition effect for all of the above concentration of acetone. The existing model for structure II hydrates in the ternary mixtures of methane + water + acetone has been applied for the above system. The measured dissociation temperatures have been compared with the results of this model.

**KEYWORDS:** Gaseous Hydrate, R-22, Acetone, Equilibrium

## INTRODUCTION

Ice-like structures can be formed in the presence of small molecules, such as methane, nitrogen, etc. and water molecules. In order to stabilize this crystalline structure, it is a prerequisite that the cavities host these small molecules. The cage structure of this compound is formed because of hydrogen bonding between water molecules. The resulting crystalline structures belong to the class of clathrates that thermodynamically are solid solutions and are named *gaseous hydrate*.

Some solutions of mixed organic compounds in water such as 1,4-dioxane and acetone act as a *methane* hydrate promoter at concentrations not exceeding 6-mole %. Up to higher concentrations, this effect gradually changes and the organic will become a hydrate inhibitor [1] through[4].

At the present study, the effect of acetone on  $\text{CHClF}_2$  hydrate equilibrium conditions has been investigated. The objective of this work is then to obtain the three phase

equilibria, H-L<sub>w</sub>-V, of the  $\text{CHClF}_2$  hydrate former in the presence of acetone + water. The results show the inhibition effect of acetone for this system.

The model developed by Javanmardi et al. [4] for structure II hydrates in the ternary mixtures methane + water + acetone has been extended for the above system. The chemical potential of the hydrate phase and the water activity have been represented using van der Waals and Platteeuw theory and van Laar activity model, respectively.

## EXPERIMENTAL SETUP

### a) Materials

The R-22 gas used for this study was supplied by Rhodia Chemical Co, with purity equal to 99.8 mole% (at least). The double distilled water was used for preparing the required solutions. Acetone with a minimum purity equal to 99.0% was supplied by Merck Chemical Co.