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Methanol and Sodium Chloride inhibitors impact on Carbon Dioxide hydrate formation

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Abstract

Given the importance of hydrate formation, scientists have studied its nature and dealt with its formation in the operating systems and so far many compounds have been studied and applied in this regard including alcohols and salts. Determining thermodynamic equilibrium conditions for hydrate formation will be the subject of this study and the additives such as methanol, sodium chloride and their mixture within the weight percentages of 5% to 20% is used that changes the thermodynamic conditions governing the problem including temperature and pressure and causes the formation pressure of methane and carbon dioxide gas hydrates to be higher than the case without additives.

MATLAB and Hydrate software programs are used for solving equations and obtaining the relevant results. The results indicated that the proposed model is capable of anticipating the pure carbon dioxide hydrate formation and also to make sure, the obtained results were compared with the results obtained by the experimental and laboratory in this field and the results indicated that the accuracy of the model is very desirable and could be used in the process and the mentioned conditions with high reliability. Maximum error was 5% and the minimum error with experimental data was 1.55%.

Key words: Hydrates, Carbon dioxide, Temperature, Pressure, Modeling

1. Introduction

Water molecules due to their hydrogen bonds form a lattice-like structure by forming cavities. This structure known as the hollow hydrate lattice is unstable. In their crystal lattice gas molecules (guests) with molecular diameters smaller than the diameter of the cavities are trapped inside cages by water molecules (host) by hydrogen bonds between them and due to the interactions created between the host and guest molecules, the created structure becomes stable and this crystal formed material is known as the gas hydrate. Natural gas hydrate formation in pipelines increases pressure drop, obstruction and sometimes burst in the pipeline and leads to many losses and costs for the oil and gas industry in Iran and the whole world. To prevent the obstruction in the pipelines hydrates formation should be prevented. One way to prevent hydrate formation is the use of inhibitors.

Methanol has the highest usage because it is dispersed in the gas flow well and it is easy to keep it in the tank. It is cost effective economically and does not require any recovery and recycling. However, methanol can result in purity issues in designing and since most enhancers are recovered and recycled, the recycled methanol is not affordable. Methanol injection is very beneficial in cases where enhancer gas volume to prevent hydrate formation is low [1].

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