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CO_2 hydrate slurry is a promising phase change material for secondary refrigeration cold distribution issues, due to its high latent heat (about 500 kJ.kg-1 of water, higher than that of ice - 333 kJ.kg-1) and wide melting temperature range suitable for air conditioning application. While the thermodynamic properties of CO_2 hydrates are now well established, knowledge of crystallization kinetics phenomena is still a challenge. Trying to understand and control the formation of gas hydrates is a key factor since their discovery in pipeline plugs by Hammerschmidt, but unlike that case, the goal here is to promote the rate of CO_2 hydrate formation. Most laboratory-scale hydrate reactors are equipped with pressure and temperature loggers, and mass balance on CO_2 allows formation kinetic studies, but with assumptions on CO_2 concentration in liquid phase in the liquid phase and the hydration number.

The present work investigates the kinetics of CO_2 hydrate crystallization for different types of stirrers and stirring speed conditions in a jacketed stirred batch reactor. Heat balance obtain experimentally using a specially developed sensor installed on the cooling jacket. The mass fraction of crystallized hydrate determine directly from the heat balance on the cooling jacket. First, tests on water heating and cooling steps and ice crystallization allowed the method validation before to apply it to CO_2 hydrate crystallization. Experimental results described with an empirical model and compared to other mass balance based kinetic determinations. Finally, the development of a simplified thermal model improved this kinetic determination by estimating heat flows inside the reactor and with the environment.

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