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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 in various applications, such as flow assurance in pipelines. The goal here is to promote the rate of CO_2 hydrate formation to increase the energy density of CO2-hydrate-based system.

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 by heat transfer measurement. After a validation on water using heating and cooling steps, the mass fraction of crystallized hydrate was determined directly from the heat balance on the cooling jacket, with a specific differential thermal analysis protocol. Those results were compared to a classical mass balance approach based on pressure and temperature measurements, and suitable assumptions on CO_2 concentration and hydrate composition. Finally, a thermal model was developed to determine hydrate formation kinetics by estimating heat flows inside the reactor and with the environment.