An efficient approach to separate CO2 using supersonic flows for carbon capture and storage - DTU Orbit (05/05/2019)

An efficient approach to separate CO₂ using supersonic flows for carbon capture and storage

The mitigation of CO₂ emissions is an effective measure to solve the climate change issue. In the present study, we propose an alternative approach for CO₂ capture by employing supersonic flows. For this purpose, we first develop a computational fluid dynamics (CFD) model to predict the CO₂ condensing flow in a supersonic nozzle. Adding two transport equations to describe the liquid fraction and droplet number, the detailed numerical model can describe the heat and mass transfer characteristics during the CO₂ phase change process under the supersonic expansion conditions. A comparative study is performed to evaluate the effect of CO₂ condensation using the condensation model and dry gas assumption. The results show that the developed CFD model predicts accurately the distribution of the static temperature contrary to the dry gas assumption. Furthermore, the condensing flow model predicts a CO₂ liquid fraction up to 18.6% of the total mass, which leads to the release of the latent heat to the vapour phase. The investigation performed in this study suggests that the CO₂ condensation in supersonic flows provides an efficient and eco-friendly way to mitigate the CO₂ emissions to the environment.

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