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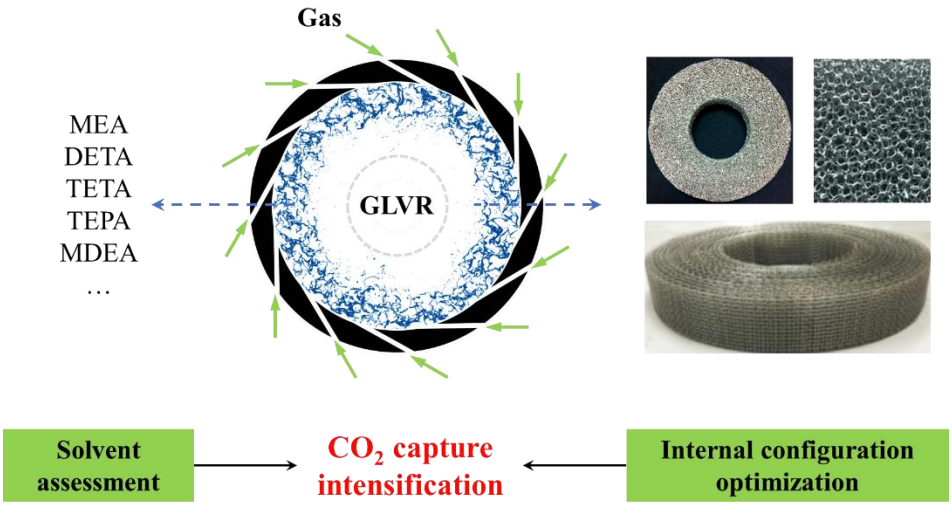
CO2 capture intensification in a gas-liquid vortex reactor: solvent assessment and internal configuration optimization

Aim

Experimental assessment of various chemical solvents will be carried out for the CO_2 capture intensification in a gas-liquid vortex reactor. In addition, to further improve the gas-liquid mass transfer efficiency, internal configuration optimization of the vortex reactor will be investigated.

Justification

Current state-of-the art for CO_2 capture applies an energy-intensive absorption/desorption technology using monoethanolamine (MEA) or alternative solvents, in which the gas-liquid mass transfer is the key to develop new and intensified technologies that allow feasible and cost-effective CO_2 capture. It is believed that a gas-liquid vortex reactor can achieve process intensification of interphase mass transfer in the context of CO_2 capture and has the advantage of a simple structure, low cost and easy scale-up. As previous studies of gas-liquid hydrodynamics have demonstrated the promising potential of the vortex reactor for CO_2 absorption in view, this project will therefore focus on two further aspects that have a significant influence on the capture efficiency. (1) Various amine-based chemical solvents, such as monoethanolamine (MEA), diethylenetriamine (DETA), triethylenetetramine (TETA), tetraethylenepentamine (TEPA), methyldiethanolamine (MDEA), will be assessed in the vortex reactor. Some commercial solvents will be assessed as well. (2) To further improve the gas-liquid mass transfer efficiency, internal configurations in the vortex chamber will be considered, one example being using structured packing, e.g. wire mesh and nickel foam to improve gas-liquid contact.



Program

- Literature review on traditional chemical solvents and commercial solvents with the specific focus on the absorption rate, loading capacity and regeneration energy consumption.
- Literature review on the internal configuration in novel reactors to improve gas-liquid contact.
- Experimental assessment of various solvents on CO_2 absorption efficiency.
- Development of internal configuration in the vortex chamber to further improve interphase mass transfer efficiency.

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