Pressurized loop reactor for effective absorption of CO$_2$: A process development study

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Carbon dioxide capture and storage (CCS) is considered to be one of the main solutions for reducing anthropogenic CO$_2$. CCS includes CO$_2$ capture from a point source, such as power plants, and transportation to a suitable site, where it is stored permanently and safely. Many projects for CO$_2$ storage are based on direct injection of CO$_2$ into underground formations, where it is stored by hydrodynamic, solubility, or mineral trapping. However, the development of CO$_2$ geological storage has been slow with respect to potential environmental impact and regulation for CO$_2$ injection and monitoring. Moreover, some countries, such as Finland and India, do not have sufficient storage capacity or lack suitable storage formations. Therefore, there has been increasing interest in CO$_2$ storage in the form of mineral carbonation. Though many methods are being used in carbonation process, it needs longer time to react with alkali salts. In order to reduce the time and CO$_2$ absorption rate, the present method focused a development of a pressurized loop reactor. At first step, a stainless steel loop reactor with ejector was tested at normal pressure. Then, the CO$_2$ capture has been studied at different pressure in the form of carbonation with Na$_2$SO$_4$ and NH$_3$ solution. The reaction time was monitored at each process. The reaction completion was identified by pH change in the pressurized reactor. The carbonation yield and morphology of NaHCO$_3$ was correlated and discussed with pressure. Finally, the CO$_2$ absorption rate was compared with pressure.

Key words: CO$_2$ capture, pressurized loop reactor, Particle size, NaHCO$_3$.
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