University of Brighton

Centre for Automotive Engineering

Measuring CO_2 capture efficiency inside a spray tower using laser diagnostics

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Aqueous solutions of alkanolamines are widely used as solvents for the capture of acid gases. The high reaction rate of monoethanolamine (MEA) with acid gases, and its capability to remove trace concentrations of CO_2, make this particular compound one of the most promising technologies for the removal of carbon dioxide from incinerator exhaust gases. Whilst many authors have evaluated the sustainability of CO_2 scrubbing using MEA solutions in packed towers, it appears obvious that a significant improvement in separation technology is required to obtain highly efficient, compact, and operationally flexible contactors. Recent findings suggest that, compared to packed tower, spray towers can offer a higher efficiency for the capture of SO_2. This improvement is obtained through an increase in the exchange area between the liquid and gas phases, and a reduction of the gas head loss in the contactor.

The aim of this study is to locally characterize the mass flux (CO_2 absorbed) using a spray tower during the capture process. We used Global Rainbow Refractometry, a non-intrusive laser diagnostic technique, to measure the refractive index of aqueous MEA droplets during the CO_2 absorption process. The change in refractive index in the spray is linked to a change in density, which could be caused by a change in liquid temperature and/or an evolution in composition. With the calibration of refractive index as function of temperature and CO_2 absorbed, the measurement of refractive index can then provide a measurement of composition at a known temperature. We measured the concentration of captured CO_2 during the absorption inside a spray tower for different CO_2 concentrations, and compared the experimental results with a theoretical model of CO_2 absorption as a function of CO_2 partial pressure.

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