Quantitative Evaluation of the Effect of Uncertainty in Property Models on the Simulated Performance of Solvent-Based CO₂-Capture

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Process modelling has increasingly become the basis for the quantitative design and evaluation of chemical processes in general and CO₂-capture processes in particular. How good are the available tools? Where are they weak and where are they strong? Which data are best to develop reliable models? How accurate should the data be? How large should the safety factors be? An effective way to answer these important questions is through uncertainty analysis, and this work attempts to do so. The approach taken here is first to ensure that the model used properly meets asymptotic limits (e.g., predicts equilibrium behavior for high kinetics or long contact times), and then to devise practical perturbations of the properties to establish quantitative connections between property variation and key design indicators (e.g., the heat rate, which is the reboiler duty divided by the CO₂ production). This work has focused on a CO₂-capture process using aqueous AMP (2-Amino-2-methyl-1-propanol, CAS Registry Number: 124-68-5) as the chemical solvent. The first and very important step is to evaluate the property uncertainties so that the uncertainty analysis can effectively estimate the confidence limit of the design. The properties varied are chemical equilibrium, chemical kinetics, viscosity, and thermal conductivity. The study enables understanding of the accuracy needed for property measurement and the confidence limit in the design of CO₂-capture processes.