A process simulation study of the heat exchangeable multi-stage fluidized bed process for carbon capture

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A process simulation study for the heat exchangeable multi-stage fluidized bed process was conducted from first principles. The process exhibits heat integration to alleviate energy penalty in two hierarchies: intra- and inter-process heat integration. For the intra-process heat integration, the circulating solid sensible energy is recovered by heat transfer fluid between absorber and regenerator. For the inter-process heat integration, the absorption energy in higher temperature sub-process is transferred to the regeneration energy in lower temperature sub-process. In order to evaluate the process, the flow-sheet simulator was developed using Aspen Custom Modeler. We considered the flue gas stream from 500 MWe Power Plant to capture more than 90 % of CO_2. Three multitude sub-processes were considered and sorbents of K_2CO_3, MgO, and CaO were selected for each sub-process, respectively. The hydrodynamic models of fluidized bed take into account the material and energy balance of gas and solid phases. The process performance was compared with those of the amine scrubbing and calcium looping process.