Hybridization of Chemical Absorption and Membrane Technology for CO_2 Capture from Blast Furnace Gas

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As iron & steel industry is one of the major CO_2 emission sectors, it is necessary to apply carbon capture and storage (CCS) to mitigate CO_2 emission to slow down global warming. Amine-based chemical absorption technology is one of the attractive options for CO_2 capture due to its technical maturity, high CO_2 selectivity, and extra-high CO_2 purity (>99 mol.%). However, high reboiler duty is one of the major drawbacks, which leads to high operating cost. To overcome such obstacle, hybridization of amine-based chemical absorption and membrane technology has been suggested recently. This idea intends to improve the performance of chemical absorption by raising CO_2 concentration of feed gas and CO_2/amine loading while producing high purity CO_2 for storage. This work focuses on the application of such hybrid system to blast furnace gas (BFG). The entire hybrid system is composed of three units connected in a series: (1) a membrane for H_2 pre-separation, (2) 8m piperazine-based scrubber for CO_2 capture, and (3) another membrane for CO_2 post-separation. Process design and simulation is carried out to evaluate how much reboiler duty and operating cost are reduced.