Novel Low-Temperature Carbon Capture Using Aqueous Ammonia and Organic Solvents

Novek, Ethan

Current post-combustion CO2 capture technologies are energy intensive, require high temperature heat sources, and dramatically increase the cost of power generation. This work introduces a new carbon capture process requiring signi? cantly lower temperatures and less energy, creating further impetus to reduce CO2 emissions from power generation. In this process, high-purity CO2 is generated through the addition of an organic solvent (acetone, dimethoxymethane, or acetaldehyde) to a CO2 rich, aqueous ammonia/carbon dioxide solution under room-temperature and -pressure conditions. The organic solvent and CO2-absorbing solution are then regenerated using low-temperature heat. When acetone, dimethoxymethane, or acetaldehyde was added at a concentration of 16.7% (v/v) to 2 M aqueous ammonium bicarbonate, 39.8, 48.6, or 86.5%, respectively, of the aqueous CO2 species transformed into high-purity CO2 gas over 3 h. Thermal energy and temperature requirements for recovering acetaldehyde, the best performing organic solvent investigated, and the CO2-absorbing solution were 1.39 MJ/kg of CO2 generated and 68 °C, respectively, 75% less energy than the amount used in a pilot chilled ammonia process and a temperature 53 °C lower. The ?ndings exhibit the promise of economically viable carbon capture powered entirely by abundant low temperature waste heat.

Awards Won: