

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

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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 significantly 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 findings exhibit the promise of economically viable carbon capture powered entirely by abundant low temperature waste heat.