4.219 Role of Various Factors in the UV Photochemical Treatment of N-Nitrosamines Related to CO2 Capture.

Early Career Scientist

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Abstract:

Post-combustion CO_2 capture using amine solvents is the most feasible method of reducing anthropogenic CO_2 emissions, which are the largest contributor to global warming. The formation of carcinogenic *N*-nitrosamines (i.e., by-products) can hinder the industrial application of this technology. In this study, the effects of the *N*-nitrosamine concentration, amines, H_2O_2, and O_3 on the UV photolysis of three specific *N*-nitrosamines that are commonplace in amine-based CO_2 capture (i.e., *N*-nitrosodiethylamine (NDEA), *N*-nitrosodiethanolamine (NDELA), and *N*-nitrosomorpholine (NMOR) were examined. The *N*-nitrosamine photodegradation experiments were conducted in a cylindrical water-jacketed glass batch reactor (i.d. 8.5 cm x L 15 cm), exposing a 700 mL solution to UV irradiation from a 4 W low-pressure Hg lamp (GL4WP, UV Nature, Korea). The working solution was heated using a hot plate coupled with a magnetic stirrer (HMS100, Yhana, Korea) and a temperature controller (TZ4ST, Autonics, USA) with a K-type thermocouple to control the temperature (40°C) and ensure even mixing. A peristaltic pump (BT 100-2J, Longer Pump, China) was used to transport the reaction solution to the fraction collector (2110, Bio-Rad, USA) at predetermined time intervals. A significant decrease in the photodegradation rate constants was observed for NDEA (1.02×10^{0} to 2.94×10^{-1} min^{-1}), NDELA (1.52×10^{0} to 3.32×10^{-1} min^{-1}), and NMOR (1.93×10^{0} to 2.20×10^{-1} min^{-1}) as their concentrations increased within 1–50 mg/L. This is the first report of a significant increase in the degradation rate constants of *N*-nitrosamine with an increase in amine concentrations (i.e., monoethanolamine (MEA), diethanolamine (DEA), and morpholine (MOR)) within 10–200 mM. The photodegradation rate constants increased as the molar ratio of H_2O_2 to *N*-nitrosamine increased to 20, but then decreased at molar ratios beyond this. O_3 had a negligible effect on the photodegradation of *N*-nitrosamines.