

Electrochemical NO_3^- Capture & Conversion from Agricultural Runoff: A Technoeconomic & Global Warming Potential Analysis

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Abstract

Nitrates from agricultural wastewater are harmful to human health and result in eutrophication. Several emerging electrochemical technologies have been developed independently to enable efficient recovery and recycling of nitrate waste; however, it remains unclear whether the implementation of such combined technologies can be economically viable. Herein, we perform a technoeconomic and global warming potential analysis on several hypothetical nitrate capture and conversion (NCC) systems for the recovery of nitrates from agricultural wastewater and conversion of nitrate to ammonia. The energy efficient technologies incorporated include: electrodialysis for nitrate separation, electrocatalysis for ambient ammonia production, and agrophotovoltaics as a clean energy source. Our technoeconomic analysis reveals that despite advancements in nitrate separation and conversion, capital investments for system installation cannot be recovered by the financial benefit of on-site fertilizer production. Our analysis highlights the necessity of government intervention to promote nitrate abatement technologies to ensure environmental compliance and protect public health.

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