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Evaluating the Water Quality Impacts of Hydrothermal Liquefaction: Assessment of Carbon, Nitrogen, and Energy Recovery Impacts

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Abstract

This research evaluates possible water impacts arising from creation of potent wastewaters during hydrothermal liquefaction (HTL) of organic wastes. ACPs arising from HTL of eight feedstocks contained very high concentrations of traditional wastewater pollutants: 100-3300 mg/L total nitrogen (N), 45-3600 mg/L total phosphorus (P), and 16,000-234,000 mg/L chemical oxygen demand (COD). pH was 4.4-8.8. These characteristics render ACP more noxious than relevant benchmark wastewaters. Adjustment of published energy ratio metrics to account for ACP treatment reveals that energy yield is moderately decreased, and energy consumption for COD, TN, and TP removal is of the same order of magnitude as liquefaction. Recovery of valuable nutrients (i.e., N and P) from ACP via precipitation could reduce the energy intensity of ACP management and mitigate its impact on EROI. In particular, precipitation-based nutrient recovery could enhance HTL's appeal as means to valorize waste into renewable energy and valuable scarce materials.

Keywords

hydrothermal liquefaction; waste feedstock; aqueous co-product; EROI

1.0 Introduction

Next-generation biofuels produced from non-food feedstocks could help meet growing energy demand without exacerbating competition with global food supply. It is especially desirable to leverage organic "wastes" as feedstocks for energy production, and it has been demonstrated that many wastes are suitable for conversion into liquid fuels via hydrothermal liquefaction (HTL) (Elliott, et al., 2014' Toor et al., 2011). HTL and other thermochemical conversion processes (e.g., gasification and pyrolysis) are appealing for alternative energy production from organic wastes because they make use of the entire feedstock (Bhutto et al., 2016; Elliott et al., 2014; Toor et al., 2011). HTL of is particular relevance for wet wastes (i.e.,