Design of a High-Rate Wastewater Treatment Process for Energy and Water Recovery at Biorefineries

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Background/Objective

- Biorefinery development has been impeded by uncertainty around financial viability and resource requirements.
- When applied to high-strength wastewaters such as those produced by biorefineries, conventional wastewater treatment (WWT) technologies may present a prohibitively high economic and environmental burden.
- This study explores the implications of alternative high-rate WWT systems, with and without policy support, on the financial and environmental sustainability of biorefineries.

Approach

Researchers designed a high-rate WWT process leveraging experimental data from biorefinery wastewaters. They simulated integration of this process into seven biorefinery designs using a range of conventional, cellulosic, and novel feedstocks. Techno-economic analysis and life cycle assessment were used to characterize economic and environmental sustainability metrics of the generated biofuels/bioproducts and, by extension, the biorefinery wastewater.

Results

The new WWT design has the potential to substantially improve biorefinery financial viability and reduce life cycle greenhouse gas emissions over use of a conventional, low-rate anaerobic-aerobic design. While policy incentives might further improve financial viability, potential economic-environmental tradeoffs should be carefully considered in decision making and policy design. Authors note that future improvements in biorefinery design could balance these trade-offs.

Significance/Impacts

This study illustrates how high-rate, multistage anaerobic WWT can enhance the sustainability of biorefineries and contribute to the advancement of the bioeconomy across industries.

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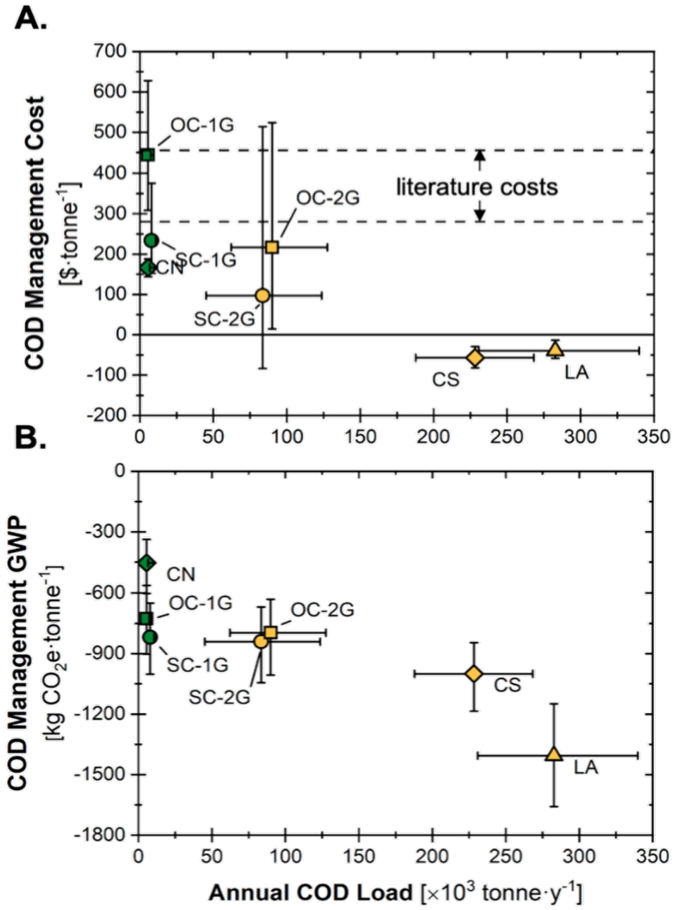

Management cost (A) and global warming potential (GWP) (B) of biorefinery wastewater under the new design. Dashed lines (A) show COD management costs of a U.S. metropolitan region. COD, chemical oxygen demand; CN: corn; SC-1G/2G: 1G/2G sugarcane; OC-1G/2G: 1G/2G oilcane; CS: corn stover; LA: lactic acid.