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EFFICIENT LOW-TEMPERATURE NUTRIENT REMOVAL FROM AGRICULTURAL DIGESTATE USING MICROALGAE

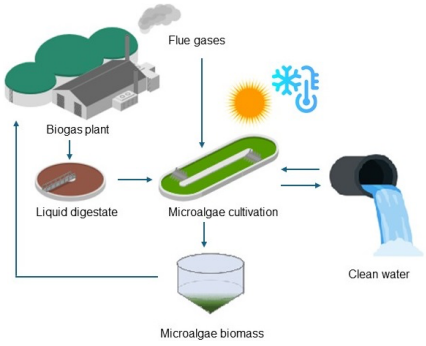
Baiba IEVINA[1*], Francesco ROMAGNOLI[2]

[1, 2] *Institute of Energy Systems and Environment, Riga Technical University, Āzenes iela 12/1, Riga, LV-1048, Latvia*

[*] ***Corresponding author.*** *Email address: Baiba.ievina@rtu.lv*

Abstract – Humanity is facing an energy crisis triggered by the depletion of fossil fuels, rapid industrialization, and the growth of the global population. These trends put an emphasis on searching for alternative energy sources. Additionally, the rising concentration of carbon dioxide in the atmosphere is driving climate change, which poses serious threats. In this scenario, microalgae emerge as a promising solution for both sustainable energy production and CO_2 sequestration. Digestate, a nutrient-rich by-product of anaerobic digestion, is considered a cost-effective nutrient source for microalgae cultivation. Utilizing digestate not only enhances the sustainability and economic feasibility of microalgal biofuels but also offers a method for wastewater treatment. Nevertheless, the application of digestate is limited by its high optical density and substantial number of total solids. In this study, several pretreatment methods were tested to increase the feasibility of digestate application for microalgae cultivation. Our findings show that various centrifugation methods and vacuum filtration decrease the content of total solids but are not effective in reducing optical density. Although the use of microalgae in treating various wastewaters has shown promising outcomes, the effectiveness of nutrient removal at low temperatures remains largely unexplored. To fill this gap, green microalga *Chlorella sorokiniana* was cultivated in pretreated diluted liquid digestate in dynamic springtime weather conditions in a covered open race-way pond integrated into a biogas plant. During the cultivation, high solar irradiance and low temperatures were recorded resulting in suboptimal conditions for *C. sorokiniana* growth. Although low productivity of *C. sorokiniana* was detected, the nutrient removal efficiency was high. *C. sorokiniana* could efficiently remove 83 % of nitrogen and 85 % of phosphorus, showing very promising results of the use of microalgae for wastewater treatment in high latitude regions.

Keywords – Bioeconomy; biogas; biomass; Chlorella sorokiniana; circular economy; open raceway pond; wastewater treatment



Nutrient removal from agricultural digestate by integrating microalgae cultivation into a biogas plant offers a closed-loop circular economy perspective also in low-temperature regions.

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