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Evaluation of flocculants for the recovery of freshwater microalgae

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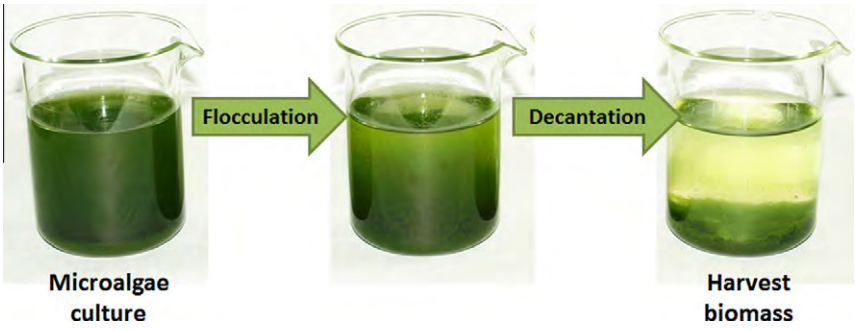
HIGHLIGHTS

- Cationic polyelectrolytes are efficient flocculants for freshwater microalgae.
- Low doses allows recover 90% of microalgae biomass with concentration factors of 35.
- Polyelectrolytes improves the viability of producing biofuels from microalgae.

GRAPHICAL ABSTRACT



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ABSTRACT

The use flocculants on the recovery of freshwater microalgae is studied. Flocculants tested include metal salts, chitosan, and polyelectrolytes used in wastewater treatment processes. Influence of flocculant, but also the doses and biomass concentrations affecting biomass recovery as well as the concentration factor has been evaluated. Results showed that the use of metal salts or chitosan was not efficient, whereas polyelectrolytes allow the efficient recovery of biomass, at doses of 2–25 mg per gram of microalgae biomass. The required doses depend on the particular polyelectrolyte and the freshwater strain present; but cationic polyelectrolytes are generally recommended. The use of polyelectrolytes does not adversely affect water reuse in the production process. The concentration factors obtained are higher than 35 in most cases. Such high concentration factors allow a reduction in the equipment size necessary for biomass dewatering, thus improving the viability of using these microorganisms in biofuel or wastewater processes.

1. Introduction

Microalgae biomass harvesting is a bottleneck in the development of the large-scale production systems required for biofuel production or microalgae-based wastewater treatment processes (Uduman et al., 2010). In these processes, it is imperative to use cheap, low-energy technologies capable both of managing large volumes of culture and efficiently recovering the biomass. For this reason, microalgae biomass harvesting requires the use of several solid–liquid separation steps to obtain sludge concentrate of 200–250 g/l from diluted cultures with biomass concentrations of 0.5–2.5 g/l – meaning that concentration factors of 100–500 are required. To achieve these high concentration factors, several steps are necessary; therefore the adequate selection of unit operations is critical. No single harvest method can be suited to every case given that the right process is reliant on the particular strain, culture conditions and final product. Biomass recovery has been claimed to contribute 20–30% to the total cost of biomass production (Grima et al., 2003; Kim et al., 2005); it is therefore a critical factor in the feasibility of large-scale process.

Although microalgae biomass can be harvested using several unit operations, flocculation combined with flotation/sedimentation and finally dewatering by centrifugation or filtration appears

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