Rheology of microalgae concentrates and its influence on the power consumption of enzymatic hydrolysis processing

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Abstract

The optimization of downstream processing is a critical step in any microalgae-related process. The microalgal biomass is separated from the initial diluted cultures to form a concentrated slurry, the properties of which greatly influence the design and performance of further processing steps, such as enzymatic hydrolysis. In this work, the rheological behaviour of two microalgae concentrates produced both in freshwater (Scenedesmus almeriensis) and seawater (Nannochloropsis gaditana) were studied. Measurements were performed on the entire range of biomass concentrations, from 0.5 g/L to 264 g/L. Non-Newtonian behaviour was observed whatever the water type and biomass concentration used, especially at high biomass concentrations above 10 g/L. The rheological data were adjusted to the Power Law model, and the consistency and flow behaviour indexes were correlated with the biomass concentration. The results show that the freshwater and seawater biomass exhibited different behaviour, with freshwater slurries being more viscous than seawater ones. The high viscosity of freshwater slurries requires increased energy consumption for mixing, with an estimated cost increase of 60% when using them under the non-Newtonian conditions considered. These findings highlight the considerable effect of algae biomass rheology on the mixing power required during microalgae biomass processing.

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