

Exploiting cryogels combined with *Tetraselmis convolutae* for cadmium phycoremediation of marine waters

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Abstract

Lightweight porous materials such as cryogels, aerogels, and xerogels are highly suitable to absorb contaminants like Ca, Zn, and Pb. The 3D structure with high surface area and pore volume can bind di-cationic metals through physic and chemical sorption (Riley and Chong, 2020; Lin et al, 2021). Pascua and Romero (2020) used synthetic cryogels to extract lead ions (Pb²⁺) from water.

The present study aimed to use biopolymers, namely alginate, to develop cryogels and their combination with microalgae (*Tetraselmis convolutae*) for application in the bioremediation of marine environments. This Chlorophyceae have a cell wall mainly made of cellulose-pectin complexes and hydroxyproline-rich glycoproteins that make the species able to bind di-cationic metals, thus increasing the chemical functionality to polymeric sorbents.

Briefly, cryogels were prepared adopting the ice-templating technique and the previously optimised protocol using increasing biopolymer concentrations (0.5, 1 and 3 w/v %) with and without adding dried microalgae cells. All samples were crosslinked using 3% w/v of calcium chloride (CaCl₂); cryogels were stored dry until the experiment. The cryogel structures were characterised by scanning electron microscopy (SEM) and microtomography, and their cadmium (Cd²⁺) absorption capacity was analysed through ICP-MS. Cryogels were put in contact with sterile seawater with and without CaCl₂, 400 μmolar, for 24h. The [Cd²⁺] was assessed by inductively coupled plasma mass spectrometry (ICP-MS) in supernatants and cryogels. Cryogels without and with microalgae (dried at 3%) were effectively obtained, with increasing alginate concentrations (0.5 to 3 w/v %), both with high porosity and microstructure (SEM analysis). Preliminary ICP-MS results indicate the ability of the cryogels to adsorb Cd²⁺, with a slight decrease of [Cd²⁺] in all seawater samples after 24h. However, the results show no significant increase in metal adsorption when microalgae are added to the cryogels. Further optimization is required to optimize the microalgae content.

References

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Key words

Criogels, Microalgae, Phycoremediation, SEM, Tomography