11th International Conference on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25
ICAM2009

CHARACTERIZATION AND EVALUATION OF CU^{2+} AND NI^{2+} BIOSORPTION ON ACIDIC ALGAE *SARGASSUM FILIPENDULA*

S. J. Kleinubing[(1)], R. S. Vieira[(1)], M. Beppu[(1)], E. Guibal[(2)], and M. G. C. da Silva[(1)*]

(1) School of Chemical Engineering, State University, Caixa Postal 6066, CEP 13081-970, Campinas, SP, Brazil, jaiana@feq.unicamp.br, meuris@feq.unicamp.br
(2) Ecole de Mines d'Alès, Laboratoire Gènie de l'Environnemental Industriel, 6 avenue de Clavières, F-30319 Alès Cedex, France.
* Corresponding author.

Abstract – The biosorption mechanisms of Cu^{2+} and Ni^{2+} ions onto acidic algae Sargassum *filipendula* were examined using various analytical techniques. The marine algae *Sargassum filipendula* was collected from São Paulo seashore (Brazil) and was submitted to treatment with acid. Alginate was extracted from raw algae and the two types of acids present (β-D-mannuronic (M) and α-L-guluronic (G) acid) were determined. The FT-IR analyses showed that the main chemical groups involved in the biosorption were carboxylic, alcoholic, sulphonate and amino groups. According MEV/EDX analysis, the Cu^{2+} and Ni^{2+} are homogeneously adsorbed in the algae.

Seaweed cells have a large superficial area with sites that are able to provide fast and reversible bonding with cations. *Sargassum* sp. is a widespread and common kind of marine brown algae that has been used for metal recovery, due to the high content of polysaccharides in the cell wall, which are responsible for the high sorption capacity [1]. A complete chemical characterization of brown algae substrate is necessary to emphasize the advantages of biosorption in relation the conventional technique of ion-exchange using resins and others materials.

The alginate composition can be determined by using the relation of total area: G-4+G-2+G-3+G-5 (guluronic) for M-4+M-2+M-3+M-5 (mannuronic) (Table 1). The M/G ratio was found to be 0.50. This relation is a very important parameter to choose an alga for application in heavy metal treatments. It varies according to the extraction methodology and the location from which the algae was collected, as well as according to seasonal and growth conditions [2]. A controlled acid treatment, at appropriate pH (pH 5.0), prevents the release of organic material during metal sorption and keep the sorption capacities of the same order of magnitude of raw algal material. Additionally, this pre-treatment allows limiting pH variation during the sorption process (especially for column application). According the pH_{ZPC} (pH of zero point charge) analysis, at a pH higher than 7.0 the algae surface presents a negative charge. The metal chemical speciation diagrams indicate that the precipitation of Cu^{2+} and Ni^{2+} can take place at pH values higher than 5.0 and 6.0, respectively. The presence of diatoms outer shell was observed (Figure 1), though the presence of this diatom not have significant impact in copper and nickel binding.

Table 1: Peak intensity obtained by analysis of MAS ^{13}C resonances attributed to residues of α-L-guluronic (G) and β-D-mannuronic acid (M) in sodium alginate of *Sargassum filipendula*

	M Peaks				G Peaks				M/G ratio
	M-5	M-4	M-3	M-2	G-5	G-4	G-3	G-2	
Peak (ppm)	81.3	83.0	79.4	75.8	68.8	83.3	71.0	66.0	0.50
Intensity	2.9	3.3	3.0	5.1	12.5	3.4	7.7	5.1	

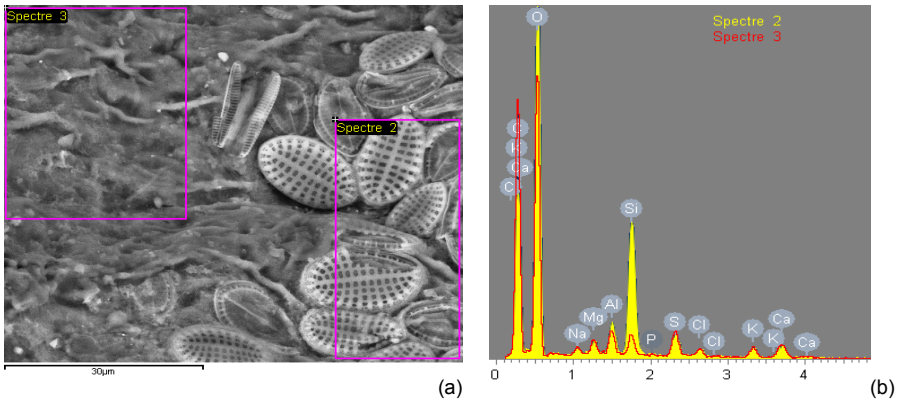

Figure 1: a) Scanning electron microscopy(SEM) micrographs of *Sargassum filipendula* treated pH 5.0, and **b)** energy dispersive X-ray spectroscopy (EDX) in the regions of spectra 2 and 3 of the SEM.

[1] T. A. Davis, B. Volesky A. Mucci. Water Research, 37 (2003), 4311-4330.
[2] M. Indergaard, G. Skjak-Braek. Hydrobiologia, 151/152 (1987), 541-549.