BIOLOGICAL TREATMENTS OF CADMIUM CONTAMINATION CONTINENTAL WATERS WITH SPIRULINA PLATENSIS (NORDST.) GEITL. IMMOBILIZED IN NA-ALGINATE BEADS

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Introduction

Bioremediation, as a non-conventional adsorption techniques, being in situ treatment, provides a safe and economic alternative to commonly used physicochemical strategies (Eccles,1995). The special surface properties of microorganisms enable them to adsorb different kinds of pollutants from solutions (Aksu, 2001). Biological elements such as algae can profoundly influence the distribution of trace metals in natural waters. Biosorption algae was studied using *Spirulina platensis* (Nordst.) Geitl. on alginate gel. Their use as a bio-sorbent for cadmium is an effective, ecofriendly and economical alternative to existing treatments (Tangaromsuk, J., Pokethitiyook, P., Kruatrachue, M., & Upatham., 2002) .The central aim of this study is to enhance the utilization of blue-green algae strains for cadmium removal at very low concentration (µg/L) in natural waters. Various kinetic and equilibrium aspects of cadmium (II) metal ions biosorption were studied. The pseudo-first order and pseudo-second order kinetic models were used and the equilibrium results are given in terms of the units of adsorbed metal ion concentration.

Methods

A blue-green algae *Spirulina platensis* (Nordst.) Geitl., collected in stationary phase, was used in our experiments. Algal cells was immobilized in a 4% w/v sodium alginate (AppliChem, PanReac), high viscosity by into solution (0,5 M $CaCl_2$) with a peristaltic pump. Algae beads were suspended in a precisely volume of water solution from the basin of Scheld river (French side) preventive filtrated and sterilized (exposure to UV). The solution was stirred continuous at 150rpm to prevent aggregation of the algal biomass providing a 29,0±1,1°C temperature, continuous illumination of 144 W/m^2,ambiental pH and natural water elemental concentrations. The range of concentrations of prepared cadmium (II) in experimental solutions of Nalgene Erlenmeyer flasks is between 25 , 50 and 75 µg/L. After a first 5 mL samples (at t=0 time) taken, a mix of the biosorbent immobilized algae and cadmium (II) ion previously prepared solutions is performed. At pre-determined time intervals (10 min, 20 min, 40min, , 1h, 1h30, 2h, 3h, 6h, 9h and 24h) the samples for the determination of residual metal ion concentration in solution were collected. For the durability economic reasons an seven adsorption-regeneration cycles experiments was subjected.

Results

The equilibrium uptake of cadmium (II) ion and adsorption yield (Ad%) for all cycles is shown in Table 1**.** The maximum adsorption yield was found to be 39.7 % for *Spirulina platensis* and 13.9 % for alginate of the initial cadmium ion concentration .For the alginate matrix, adsorption is limited by available sites; further increase in initial concentration (C_0) does not show much effect on the adsorption yield .

Table 1: Comparison of the equilibrium adsorbed quantities and adsorption yields for each species at different initial cadmium ion concentration

Biosorbent	Co	I Cycle Ad(%)	I Cycle qe(mg/g)	II Cycle Ad(%)	II Cycle qe(mg/g)	III Cycle Ad(%)	III Cycle qe(mg/g)	IV Cycle Ad(%)	IV Cycle qe(mg/g)	VII Cycle Ad(%)	VII Cycle qe(mg/g)
Spirulina platensis	25	36,5	0,019	26,2	0,016	25,9	0,019	24,6	0,019	3,4	0,008
	50	29,2	0,015	22,6	0,012	23,3	0,013	23,1	0,013	11,5	0,008
	75	30,1	0,046	22,6	0,049	19,8	0,049	39,7	0,049	11,5	0,030
Alginat	25	7,0	0,005	9,9	0,007	13,9	0,010	11,2	0,010	4,4	0,001
	50	9,9	0,007	8,2	0,006	11,2	0,007	12,6	0,007	6,1	0,005
	75	12,0	0,022	7,8	0,028	11,9	0,031	12,9	0,031	6,1	0,016

Regarding the influence of the initial concentration of cadmium ions, in the Fig. 1 we can observe that the equilibrium sorption capacity of the biomass increased with increasing of the initial cadmium ions concentration. An increase in the cadmium concentration from 25 µg/L up to 75 µg/L leads to proportional fractions of cadmium sorption capacity from 20 up to 70 µg for a dry gram equivalent of immobilized algae for all the cycles.

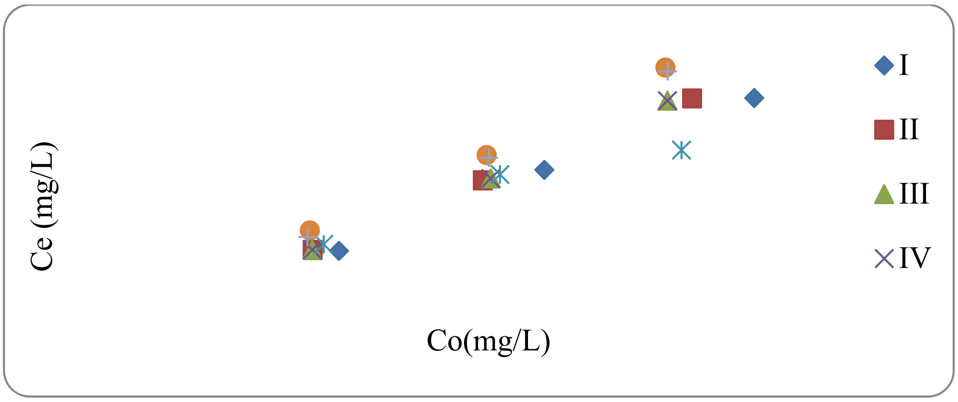

Fig.1. Evolution of equilibrium concentration of metal ions in the solution (Ceq) as function of initial concentration (C_0) of metal ions, at a given process conditions, mg/L

Conclusion

Being natural, abundant, and cheap algae biomass such as *Spirulina platensis* (Nordst.) Geitl. can be utilized successfully in selective removal of toxic metal ions from metal contaminated or other kind of wastewaters. The results showed that immobilized cells could be repeatedly used in the sorption process up to five times. The rapid basification of algae-solution system enhances the cadmium uptake process.

References

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