

Biosorption of Cadmium (II) From Aqueous Solutions by Brown Algae

Ali A. Al-Homaidan* and Abdullah A. Al-Ghanayem

Department of Botany and Microbiology, College of Science, King Saud University, P.O.Box 2455,
Riyadh 11451, Saudi Arabia
homaidan@ksu.edu.sa, ghanayem@hotmail.com

Extended Abstract

Anthropogenic activities may lead to the release of several heavy metals to the surrounding environment. Cadmium is one of the most toxic substances in our environment and it causes many health problems for humans. Removal of heavy metals is a challenging matter. Several species of micro- and macro-algae are used for the adsorption of heavy metals. In this investigation, three species of brown algae (*Cystoseira myrica*, *Sargassum filipendula* and *Padina boryana*) were collected from the Saudi coast of the Arabian Gulf on several occasions during 2013. They were transferred to the laboratory, cleaned, dried, and the dry biomass were used for the removal of cadmium ions from aqueous solutions. The experiments were carried out in triplicate in 250 ml conical flasks using an orbital incubator at 150 oscillation/minute. The biosorption characteristics were investigated as a function of pH (2, 3, 4, 5, 6,7), contact time (30, 60, 90, 120 minutes), initial concentration of cadmium (5, 10, 20, 30, 40, 50 mg/l) and initial concentration of algal dry biomass (0.5, 1, 2, 4, 8 g/l). Concentrations of the metal were measured using Atomic Absorption Spectrophotometer.

The removal was solution pH dependent. At low pH (2) there was a competition between hydrogen ions (H^+) and cadmium ions (Cd^{2+}) on binding sites. As the pH increased the number of H^+ decreased and the number of available binding sites increased which leads to the increase of biosorption until we reached equilibrium at pH 5. Contact time was also important and the biosorption increased with time and the maximum removal was obtained after 90 minutes of incubation. The biosorption was affected also by the initial concentration of the metal. The highest level of removal was achieved at 10 mg/l. After that, the removal was decreased and the lowest removal level was at 50 mg/l. The dry biomass concentration was very important. Low biomass levels ($\leq 2g/l$) ensured metal removal up to 97%. At higher concentrations the removal was not greatly affected and this is probably attributed to the occupation of binding sites by metal ions.

Very high levels of cadmium removal were obtained by the three species of algae. The highest level (97.16%) was achieved by using *S. filipendula*. The adsorption levels by *C. myrica* and *P. boryana* were also very high and they were 96.09% and 94.64%, respectively. The ideal conditions for cadmium removal were: pH 5, 90 minutes of contact time, 10 mg/l of cadmium initial concentration and 2 g/l of dry biomass. The results of this study indicated that brown algae are good candidate for cadmium removal from polluted waters; they are very effective, cheap and eco-friendly.