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Optimization, Characterization and Implementation of Immobilized *Cladophora Sp* Alga Biosorbents of Mercury from Aqueous Solutions

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Extended Abstract

Mercury pollution of environmental waters is a serious ecological concern. Biosorption using algae is emerging technology for the remediation of metal-polluted waters because algae are widely abundant and have high adsorption capacities. Algae can also be immobilized on polymeric supports to enhance their performance, selectivity, and industrial applicability.

Novel algal-based biosorbents via the immobilisation of *Cladophora sp alga* in silica gel and alginate beads for the removal of mercury from waters under batch equilibrium and continuous flow modes was developed. The modified and unaltered algae were characterized for biosorption of mercury using several techniques (FTIR, BET, SEM, EDX). The first attempt was made to elucidate the mechanism for mercury biosorption using pristine and modified forms of *Cladophora sp alga*. The best performing modified biosorbent (alga immobilized in alginate beads) was used to construct biotraps utilized for mercury removal from acid mine waters.

Batch equilibrium studies revealed that the optimum conditions for metal biosorption were pH 5, 10 gL^{-1} biosorbent dosage and 25˚C for the modified forms of *Cladophora sp alga*. The equilibrium agitation time and initial metal concentration using the biosorbents were 30 minutes and 100 mg L^{-1}, respectively. The maximum biosorption capacities were 121.3 and 183.4 mg g^{-1} for the alga immobilized in silica gel and alga immobilized in alginate beads with removal efficiencies of 82.75 and 86.6%, respectively. Biosorption experimental data fitted the pseudo-second kinetic model, the Langmuir, and Dubinin-Radushkevich isotherms suggesting that biosorption occurs on a homogeneous layer and is limited by chemisorptive ion exchange mechanism. Modeling using the Webber-Morris model showed that intraparticle diffusion is rate limiting only at the start of the process. Mercury adsorption using biosorbents involved several functional groups with amine, sulfonate and carboxyl groups being key players and ion exchange the most dominant mechanism. The biosorbents were also effective in retrieving mercury from multi-elemental aqueous solutions. However, the alga immobilized in alginate beads was more selective for mercury removal than that immobilized in silica gel.

Optimal removal under continuous flow operation was determined. Application of the biotraps to acid-impacted environmental waters significantly reduced the mercury uptake. The adsorption capacity and removal efficiency were 6.081 mg g^{-1} and 67.81% respectively. These results demonstrated that *Cladophora sp* algal-based biotraps have potential for use in remediation technologies for mercury in environmental samples. They can be used to augment wetlands by offering protective screens that will reduce the direct impact of wastewaters.