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Acidic dye wastewater treatment onto a marine macroalga, *Nizamuddina zanardini* (Phylum: Ochrophyta)

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HIGHLIGHTS

- Acid Black 1 biosorption was studied onto marine macroalga.
- The maximum dye removal efficiency was observed at pH 2.0.
- Freundlich isotherm model showed the best fit with the equilibrium data.
- A decrease in particle size of *N. zanardini* biomass increased AB1 removal capacity.
- Addition of NaCl (0–40 g/L) to the dye solution increased dye removal efficiency.

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ABSTRACT

Biosorption of Acid Black 1 (AB1) onto brown macroalgae, *Nizamuddina zanardinii*, was investigated. The effects of different parameters including pH, biomass loading, dye concentration, temperature, and salinity on the biosorption capacity were studies. The result at equilibrium was successfully described by the Freundlich model, and the estimated biosorption capacity was 29.79 mg/g. The kinetic of biosorption at different agitation speeds (70–180 rpm) and particle sizes (56–500 μm) were evaluated by pseudo-second-order, pseudo-first-order, and intraparticle diffusion kinetic models. The results showed that the pseudo-second-order model could be used as a successful model for the biosorption kinetics. Thermodynamics of sorption was investigated at different temperatures from 283 to 313 K. The negative values of Gibbs free energy, ΔG^0, and positive value of enthalpy, ΔH^0, confirm the possibility of the biosorption process and the spontaneous nature of the biosorption. A decrease in particle size of *N. zanardinii* biomass increased AB1 biosorption capacity. Furthermore, addition of NaCl (0–40 g/L) resulted in minor improvement in the dye biosorption. Role of different functional groups on the surface of biomass for biosorption of AB1 was investigated using FTIR.

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1. Introduction

Different industries such as textile, paper and pulp, printing, iron-steel, coke, petroleum, pesticide, paint, solvent, pharmaceutics, and wood preserving use dyes and pigments to color their products [1,2]. Dyes are the first pollutants that have been recognized in industrial wastewaters which influence water quality [3]. The discharged dyes can reduce light penetration in the wastewaters and affect photosynthetic activity in aquatic life [1,4]. Different dyes used in textile industries are very stable and difficult to be biodegraded [5,6]. They are severe contaminants and their removal is important in textile wastewater treatment [7]. Acid Black 1 is an amino acid staining diazo dye containing both NN and CC chromophore groups (pyrazolone dye). This synthetic acidic dye can be used for staining natural fibers such as cotton, wool silk, inks, paints, plastics and leather [8]. Due to adverse and harmful effects of AB1 on skin, eye, and respiratory system, it is necessary to entirely remove this dye from the wastewaters.

Several techniques have been employed for removal of dye from industrial effluents. The most commonly used methods are ozonation, photo-oxidation, electro-coagulation, adsorption (using activated carbon), froth flotation, reverse osmosis, ion exchange, membrane filtration, and flocculation [8–10]. However, these processes usually involve some disadvantages, including complicated

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