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Removal of methylene blue by invasive marine seaweed: *Caulerpa racemosa* var. *cylindracea*

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Abstract

Caulerpa racemosa var. *cylindracea* is one of the well-known invasive species in the Mediterranean Sea. In the present study, dried biomass of *C. racemosa* var. *cylindracea* was shown to have adsorption capacity for methylene blue. The adsorption reached equilibrium at 90 min for all studied concentrations (5–100 mg/L). The pseudo-second-order model is well in line with our experimental results. There was a sharp increase in the adsorbed dye amount per adsorbent amount from 3.3 to 16.7 g/L, then a slight increase up to 66.7 g/L was observed. Langmuir and Freundlich's models were applied to the data related to adsorption isotherm. According to Langmuir's model data, the observed maximum adsorption capacity (q_m) was 5.23 mg/g at 18 °C. The enthalpy of adsorption was found to be 33 kJ/mol, which indicated a chemical adsorption between dye molecules and *C. racemosa* var. *cylindracea* functional groups.

Keywords: Biosorption; *Caulerpa racemosa* var. *cylindracea*; Dye removal; Methylene blue; Waste waters

1. Introduction

Caulerpa racemosa var. *cylindracea* is a green marine macroalga and is one of the well-known invasive species in the Mediterranean Sea. Since 1991, this species showed invasive property in Mediterranean Sea. Eleven Mediterranean countries are still threatened by this species (Verlaque et al., 2003). In as much as there is no valid eradication method and also no well-consumers for this species, *C. racemosa* var. *cylindracea* has gone on its dangerous invasion in Mediterranean since 1991 (Verlaque et al., 2003). Many of Turkish coastlines are also invaded by *C. racemosa* var. *cylindracea* (Cavas and Yurdakoc, 2005a,b). This species can be easily collected from shallow waters (0.5–1 m) from Seferihisar (Turkey) coastlines. Dyes used in textile industry are important causes of pollution in aquatic ecosystems. Dyes generally consist of complex aromatic complexes which provide stability against biodegradation in aquatic ecosystems. The dyes which are released into the aquatic environment without any treatment inhibit development of aquatic animals and plants by blocking sunlight penetration (Raghuvanshi et al., 2004). Therefore, removal of dyes from the effluents of textile industries is of paramount importance for the proper maintenance of the health of the ecosystem. Over 7×10^5 tons dyes and about 10,000 different types are produced in the world. Unfortunately, about 10–15% of the total produced dyes is released into the aquatic ecosystems without being removed from the effluents (Senthilkumaar et al., 2006; Hoda et al., 2006; Bukallah et al., 2007). Methylene blue (MB) has lots of application areas such as coloring paper,dyeing cottons,wools and coating for paper stocks (Vadivelan and Vasanth Kumar, 2005). Although MB is not considered to be a very toxic dye, it can reveal very harmful effects on living things. After inhalation, symptoms such as difficulties in breathing, vomiting, diarrhea and nausea can occur in humans (Bhattacharyya and Sharma, 2005). MB is generally used to test the adsorption capacity of various sorbents inasmuch as this dye has a reasonably simple structure which allows examination of the adsorption mechanism. It also permits a quantitative comparison

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