Adsorption of Textile Dye Effluents through *Chara* Species

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Dyes and pigments represent chronic ecological problems as they are toxic and carcinogenic. Removal of dyes from the effluents is a major problem. Biosorption through algal biomass is an effective and cheap process for the removal of dyes from industrial effluents. In the present study, biosorption of red dye textile effluent has been carried out using different doses of the dried biomass of *Chara* sp. High dose of algal biomass (100 mg) showed the higher percent adsorption as compared to lower dose (50 mg) of algal biomass. Maximum specific uptake value was observed at 40% red dye effluent through 100 mg biomass and at 80% red dye effluent through 50 mg biomass. The results of Freundlich isotherm model showed better biosorption than Langmuir isotherm model. FTIR studies demonstrated that aromatic azo, C=S, sulfur and carbonyl groups could be associated with the adsorption mechanism of red dye.

**Key words:** Textile dye effluent, biosorption, *Chara* sp., adsorption isotherms

Introduction

Water pollution is caused by the release of various pollutants as a consequence of industrial progress (Ayangbenro and Babulola, 2017) which has now become a serious threat to lives dependent on it. A lot of chemicals including dyes, pigments and aromatic molecular structural compounds are extensively used for several industrial applications such as textiles, printing, pharmaceuticals, food, toys, paper, plastic and cosmetics (Mohana et al., 2008, Boudechiche et al., 2016).²⁴

Worldwide over 10,000 different dyes and pigments are used in dyeing and printing industries (Pandya et al., 2017).²⁷ The total world colorant production is estimated to be 8,00,000 tons per year and at least 10% of the used dyestuff enters the environment through waste (Palmer et al., 2005; Kalaarasi et al., 2012).²⁶,²⁷ The dyes of synthetic origin are of complex aromatic structure and specifically designed to be recalcitrant with poor biodegradability, they are very stable and difficult to degrade by conventional aerobic biological treatments, such as the activated sludge process (Nadaoglu et al., 2013, Kalkan et al., 2015).²⁸,²⁹

Various physical, chemical and biological methods, namely adsorption, biosorption, coagulation, precipitation, membrane filtration, solvent extraction, chemical oxidation, and photochemical degradation have been used for the treatment of dye containing wastewater. Among these methods, the adsorption process using low-cost absorbent materials is proved to be an effective process for color removal from wastewater (Ravikumar et al., 2006, Elizalde-gonzalez et al., 2009).³⁰,³¹ Worldwide more than 50,000 algal species have been identified and the list is increasing in number with the development of new technologies in the field of algal taxonomy (Kumar and Ahluwalia, 2017).³² Identification and selection of an ideal algal species are fundamentally important for effective and economic bioremediation process of pollutants e.g. dyes, heavy metals etc. An ideal species should have the high growth rate, easy to harvest, wide range of tolerance of environmental stress. Algae have been found potential and suitable biosorbent because of their fast and easy growth as well as their wide availability. Biosorption using biomass of photosynthetic aquatic organisms, such as algae and aquatic plants or mosses, represents an alternative of cheap and readily available sorbents for the removal of contaminants from wastewaters or polluted water systems (Renuka et al., 2015).³³ Algae are ubiquitous naturally and serve as one of the biomaterials with high capacity for removing dye from contaminated waters (Daneshwar et al., 2007).³⁴

Microalgae are known to remove dyes by biodegradation, biodegradation and bioconversion. Microalgae degrade dyes for nitrogen source by removing nitrogen, phosphorous and carbon from water, it can help in reducing eutrophication in the aquatic environment (Olgun, 2003; Ruiz et al., 2011)³⁵,³⁶ and are unique in sequestering carbon dioxide (Mata et al., 2011)³⁷. Both living and non-viable algae have been used in color removal from wastewaters. Microalgae have been identified as potent metal and dyes biosorbent due to presence of binding sites such as carboxyl, sulfonate, amine and hydroxyl groups (Davis et al., 2003; Celekli et al., 2011 and 2013).³⁸,³⁹ Microalgae *Chara* sp. was investigated as a viable biomaterial for biological treatment of wastewater dye effluent. *Chara* sp. has also been reported for degradation of

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