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TEXTILE DYE BIOSORPTION ONTO NON-LIVING FRESHWATER GREEN BIOMASS: INFLUENCING FACTORS AND ITS EFFICIENCY. A CASE STUDY (I)

BY

CRINUȚA LARISA ORTOVAN and CARMEN ZAHARIA*

“Gheorghe Asachi” Technical University of Iași, “Cristofor Simionescu” Faculty of Chemical Engineering and Environmental Protection, Iași, Romania

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Abstract. This study discusses the experimental results (i.e. discoloration efficiency and Remazol Rosso RB dye removal) performed in application of a biosorption step for treatment of a simulated textile colored wastewater (WW) using dried non-living freshwater green algae-based materials (*Spirogyra* algae, size < 2 mm) as biosorbent in free form (S1) and after heating at 100°C for 6h (S2). Different influencing factors, i.e. pH, biosorbent dosage, dye concentration, temperature, biosorption time, were studied for finding the best operating conditions for highest discoloration and dye removal degrees. The results indicate that the dried green algal-based material is efficient as biosorbent (i.e. removals of dye and color in range of 64-91% by S1 biosorbent, and 54-85% by S2 biosorbent; mean biosorption capacity of 3.325 - 5.435 mg/g) and may be used in the textile WW treatment for decreasing the organic load and discoloration, especially in the case of frequent WW flowrate and chemical composition variation, when is working in the adequate operating conditions.

Keywords: biosorption efficiency, dried non-living green *Spirogyra* algae, influencing factors, process variables, Remazol Rosso RB dye, simulated textile wastewater.

*Corresponding author; *e-mail*: carmen.zaharia@academic.tuiasi.ro

1. Introduction

The modern societies and contemporary economy produce large volumes of different types of wastewaters (WWs) such as industrial, agricultural, and municipal ones which can become viable secondary sources in recovery of useful substances for various technological processes (e.g., by membrane processes, flocculation, hydrometallurgy, electrodeposition, coagulation, bioleaching, chemical precipitation, biosorption, neutralization, ion-exchange, photocatalysis, etc.). Some of these processes are solvent or chemical reagents' consumers, being energy-intensive, fact that increases the overall costs of the process while generating substantial waste and/or toxic sludge volumes. Bio-adsorption (biosorption) may be sustainable and cost-effective for inorganic (heavy metals, persistent and poisoning substances as cyanides, etc.) and organic (emerging organics as dyes, pesticides, polyaromatic hydrocarbons, petroleum products, etc.) load reduction from different WWs, and can be considered as an efficient, low-cost alternative to a conventional WW treatment step (primary, secondary or advanced ones).

Commonly, biosorption is defined as passive interaction of living and non-living biomass surface (biological materials, considered as biosorbents) with ionic and molecular polluting species from aqueous systems in an energy-independent way (Carreira *et al.*, 2023a; Carreira *et al.*, 2023b; Zaharia, 2015). The use of living biomass permits the polluting species removal by *biosorption* (species sorption on surface) and *bioaccumulation* (species actively internalized and accumulated in living organisms, considered to be a promising path for *in situ* remediation of polluted aqueous environments) (Carreira *et al.*, 2023b). Non-living biomass is unaffected by the toxicity of species, and only interacts with species at surface level, thus being permitted the species recovery and desorption, biosorbent regeneration and reuse in multiple cycles. Other WW treatment mechanisms active in removal of emerging pollutants by biomass (active and inactive ones) are based on *biodegradation* and *photodegradation* acting together with the aforementioned ones. In the present study, all findings were focused on the non-living biomass application in industrial WW treatment system for decreasing the persistent organic load to fulfil the discharging limits and imposed treated WW quality norms/standards.

A lot of biosorbents have been studied in the biosorption step of emerging organic pollutants, including peat, fruits, shells, agricultural wastes, plant-based adsorbents, algae, woody waste, metal-organic frameworks, microbial biomass (bacteria, fungi) etc. (Bulgariu and Bulgariu, 2012, 2016; Demirbas, 2009; Praveen *et al.*, 2023; Simionescu *et al.*, 1974; Suteu *et al.*, 2009; Zaharia, 2015; Zaharia and Suteu, 2012). Application of non-living biomass can be done in three different ways: (i) in free form (small particles); (ii) immobilized form as granular particles (e.g., biomass-alginate, or biomass-polyvinyl alcohol (PVA), with high mechanical strength, good mass transfer performance and resistance to biological

decomposition) and/or (iii) algal biofilm (based on specific immobilization type with easy attachment, great density of algae in biofilm, acclimation under certain conditions). Each mentioned application is beneficial due to its easy handling, non-additional nutritional requirements, enhanced biosorption kinetics, biocompatibility, great abundance in certain wet regions, renewability, structural variety and availability (Carreira *et al.*, 2023a, 2003b). From all mentioned biosorbents, algae-based biosorbents have received an increasing interest in the last fifteen years because of their outstanding uptake capacity, absence of toxic waste production, low cost, time and energy saving, year-round occurrence, easy handling, and renewability (Cheng *et al.*, 2019).

Algae (macro- and microalgae) are ubiquitous photosynthetic organisms with rapid growth, disposing of a natural ability to bind and uptake ionic and molecular species but also effective as biosorbent (in active or inactive states) due to their widespread availability, renewability, sustainability, absence of arable/agricultural land requirements and good cost-effectiveness. There are known at European level more than 1700 algae species divided in brown, green, red algae and blue-green (cyanobacteria) ones, but only a small fraction is produced on a large scale, meaning 68% algae directly from wild stocks and the rest from aquaculture (Carreira *et al.*, 2023a, 2023b). In general, the elementary composition of algae consists of carbon (i.e. 26-39% C in macroalgae, 41-48% in microalgae, and 45-50% in cyanobacteria biomass), hydrogen (4-6%, 5-7%, 6-7% in macroalgae, microalgae, and cyanobacteria, respectively), nitrogen (1-4%, 6-8%, 10-12% in macroalgae, microalgae, and cyanobacteria), sulphur (0.4-6%, 0-0.8%, 0.1-0.7% in macroalgae, microalgae, and cyanobacteria), ash (16-37%, 13-20%, 3-7% in macroalgae, microalgae, and cyanobacteria), oxygen (20-40%, 24-27%, 25-37% in macroalgae, microalgae, and cyanobacteria) and a specific C/O ratio (0.9-1.1, 1.5-1.7, 1.2-1.9 in macroalgae, microalgae, and cyanobacteria, respectively) (Carreira *et al.*, 2023a). Algae cell wall has an outer layer composed of cellulose, pectin, ammonium alginate rock polysaccharide and multilayer microfibrils with porous structure (containing cellulose, polypeptides, polysaccharides) with various large functional groups (e.g. phosphate, hydroxyl, aldehyde, sulphur, amino, carboxyl and carbonyl groups) that can combine with polluting ionic and molecular species. Some functional groups can be negatively charged by losing protons and interacting by electrostatic attraction to adsorb ionic species, but other functional groups with lone/free pair electrons can form coordination bonds with ionic species and complexation (organometallic complexes), or act by ion-exchange after species transport to biosorbent surface and free diffusion. The physical-chemical mechanisms involved in biosorption are considered to be physical adsorption, ion exchange, chelation, complexation, microprecipitation, coagulation and flocculation. The scientific literature reported very good biosorption capacity of ionic species (0.39 to 1.66 mmol/g for organics, and even heavy metals) by brown algae, and lower performance by green and red algae (Cheng *et al.*, 2019; Tang *et al.*, 2014).

The present work discusses only the challenge of non-living algae application for emerging pollutant removal from wastewater, providing insight into the biosorptive potential of certain freshwater green algae consortium, i.e. *Spirogyra* algae, to retain persistent organic dyes (i.e. textile Remazol Rosso RB dye) from simulated industrial WWs, or aqueous dye solutions. The pH, remaining/residual dye concentration, biosorbent concentration, contact time and temperature are known to influence the biosorption capacity of algae and its removal performance. Therefore, series of biosorption experiments were performed for finding the adequate variation domains of each influencing factors/process variables and their highest efficiencies in removal of studied dye and color from treating industrial WWs.

2. Materials and methods

2.1. Materials

Studied biosorbent. It was prepared by several washings with water/distilled water, drying in air at laboratory room temperature and grinding/sieving to small sizes (< 2 mm) of the collected freshwater green *Spirogyra* algae (young and old ones, collection of 2022) from Oituz river, Bogdanesti area, Bacau county, Romania. *Spirogyra* is known as a filamentous charophyte green algae (macroalgae) consortium. This biosorbent (Fig. 1) was used in the laboratory setup biosorption experiments applied on different dye solutions, or synthetic textile dye-containing wastewaters (WWs) under the name of S1 (G0S_AB) (i.e. prepared biosorbent sample, without thermal processing) and S2 (G1S_AB100) (i.e. biosorbent sample after heating in oven at 100°C and cooling).



Fig. 1 - Freshwater green *Spirogyra* algae (algae consortium).

Their chemical compositions were determined using a Bruker EDX spectrometer and discussed in previous research works (Zaharia *et al.*, 2023; Ortovan *et al.*, 2024) (i.e. around 36.2% C, 5.0% H, 3.8% N, 4.2% S, 27% ash, 29% O and C/O=1.25). Also, FTIR spectra of both biosorbents used before and after biosorption experiments were discussed in certain previous reports (Zaharia *et al.*, 2023; Ortovan *et al.*, 2024; Ortovan and Zaharia, 2024).

Textile dye – simulated textile dye-containing WW. It was tested a commercial textile azo dye, Remazol Rosso RB (RR-RB), as reference model of emerging pollutant in the textile WW, which was available for use, without further purification, in the dyeing bath formulation of cotton fabrics. The principal characteristics of the RR-RB dye are as follows: $C_{20}H_{12}N_6O_{16}S_5Na_4$ – chemical formula; molecular weight (MW) of 824 g/mol; maximum absorption at 517 nm ($\lambda_{max} = 517$ nm), and purity of 82.60%. There were prepared dye stock solutions of 600 mg/L, working dye solutions (5-100 mg/L of dye), and simulated textile WWs with various RR-RB dye content (10-100 mg/L of dye). The dye content was determined by using a spectrophotometer-based method by direct reading of absorbance at 517 nm under the blank (water) using SP 830 Plus spectrophotometer (Metertech, VIS) and the dye calibration curve. The color of aqueous system (dye solution, or textile WW) was determined by direct reading of absorbance at 436 nm, or 456 nm in case of using the Hazen color units (i.e. an absorbance of 0.056 corresponding to 50 HU) (Zaharia *et al.*, 2009, 2014; Zaharia and Suteu, 2012).

The simulated textile WW was prepared based on specific dyeing bath formulation practice, containing different concentrations of commercial RR-RB dye (2-10%), additives and auxiliaries (i.e. anti-creasing agent, ion acceptor copolymer, pH buffer, binder, neutralization agent, antiperoxide agent and electrolyte such as Na_2CO_3 , Kemapon ERD, NaOH, CH_3COOH , HCl, $Na_2S_2O_3$, NaCl), therefore other chemical reagents were used as solution or in solid form.

Other chemical reagents. There were prepared a few laboratory setup solutions of 0.1N HCl, 0.1N NaOH for pH adjustment, Kemapon ERD, 5% Na_2CO_3 , 1N NaOH, CH_3COOH , 0.01 N $Na_2S_2O_3$, NaCl as additives/auxiliaries, and alcoholic solution for cleaning the spectrophotometer cuvettes.

2.2. Adsorption treatment methodology

There were performed series of ‘batch’ adsorption experiments (static operating regime), organized at laboratory scale setup, to control the principal influencing factors / process variables of the biosorption process for highest RR-RB dye removal and/or discoloration of studied dye solutions, or simulated textile WWs. Therefore, experiments were performed for finding the variation domains of the influencing factors in the textile WW treatment by biosorption and the adequate operating conditions for highest removals of RR-RB dye and color (R,%). Commonly, it was worked with samples of 25, or 50 mL of dye solution, or simulated textile WW treated with a certain amount of prepared biosorbent (S1, or S2). The biosorption treatment efficiency, or removal (R, for dye, or color) was calculated with relation (1) as

$$R (\%) = \frac{c_i - c_f}{c_i} * 100 \quad (1)$$

where, C_f and C_i are the final (or at t working/contact time of biosorption) and initial concentration of RR-RB dye, or color in tested solution, or textile WW (mg/L).

3. Results and discussion

In the scientific literature, some research works have reported good results for removal degree (%) and biosorption capacity in the case of certain emerging pollutants (dyes, or heavy metal ions) by macroalgae, underlining that a strong correlation exists between the carbon, nitrogen and hydrogen content and the functional groups of emerging pollutant (especially carboxyl, hydroxyl (polysaccharides, proteins) and amide groups (proteins), and an insignificant or weak correlation between sulphur and oxygen (sulphate and thiol groups) content and biosorption capacity. Moreover, it was suggested that higher C/O ratios are lower biosorption capacities will be, but that correlations are still not valid since not all elements will be available for emerging pollutant interaction with biomass in certain varying operating conditions.

Usually, the biosorption mechanism depends on the functional groups present in each algae-based biosorbent sample, which were identified in their FTIR spectra, discussed in previous research works (Zaharia *et al.*, 2023; Ortovan *et al.*, 2024) and summarized in Table 1.

Table 1

The main FTIR bands identified in the studied biosorbents based on freshwater green algal biomass (in free form)

Band origin (selection)	Wavenumber (cm ⁻¹)	
	S1 (G0S_AB) biosorbent	S2 (G1S_AB100) biosorbent
-C-C- (aliphatic groups, lignin)	1796.58	1799.58
ν C=O (amide I band)	1653.07 / 1638.17	1643.78
C-H (lignin)	1559.89	-
N-H (amide II band)	1541.25	-
C-H (lignin)	1509.57	-
Methyl, propane groups (lignin)	1455.53	-
δ O-H (carboxyl and hydroxyl)	1425.71 / 1375.39 / 1317.61	1425.71 / 1339.98
C-H, δ O-H (III amide band, proteins)	1209.52	1206.79
ν C-O (aliphatic ether, primary and secondary alcohol)	1161.07 / 1088.52 / 1084.16	1161.07 / 1082.79
ν C-O	874.06	874.06

Both S1 and S2 biosorbents used in the laboratory setup experiments are shown in Fig. 2, before and after the RR-RB dye biosorption, and according to the FTIR spectrum of both biosorbents (Ortovan *et al.*, 2024; Zaharia *et al.*, 2023) have presented O-H and N-H stretching vibrations around 3208 and 3296 cm⁻¹; C=O stretching vibration from amide I band and N-H bending vibrations of amide II band; methyl, methylene and C-H bending vibrations due to lignin group; C-O

stretching vibration of aliphatic ether, primary and secondary alcohols (Table 1). Moreover, these freshwater green algae biosorbents presented functional groups (aliphatic groups - methyl, propane groups) specific to lignin, component not present in the structure of marine algae biomass.

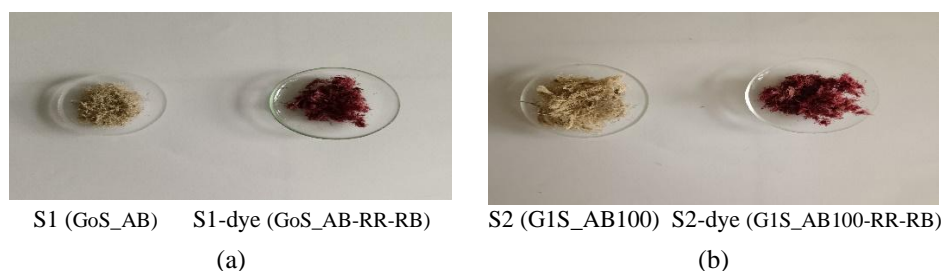


Fig. 2 – Dried green algae-based biosorbents applied for RR-RB dye removal (before and after 2 h of bio-adsorption). (a) S1(GoS_AB); (b) S2 (G1S_AB100).

The amount of organic RR-RB dye sorbed onto algal biomass may not be enough to afford visible changes in the FTIR analysis, but the determination in supernatant of the dye and color removals from studied WWs/dye solutions can select the variation fields of each influencing factor/process variable to perform efficiency higher than 50-75%. Commonly, the biosorption capacity of studied biosorbents (S1/S2) was varying in large limits of 0.929-5.435 mg/g related to the operating conditions and system characteristics. Therefore, each influencing factor was studied further and the main experimental findings underlined.

3.1. Influence of pH on WW discoloration and dye removal

The availability of free sites on the surface of green algal-based biosorbent for dye molecule retaining (bindings of functional groups from biosorbent and dye molecule) by different mechanisms such as physical adsorption, ion exchange, microprecipitation and coagulation, or complexation depends on pH. Therefore, series of biosorption experiments were performed in the pH range of 1.80-12.50 for finding the adequate variation domain for high removals of RR-RB dye and discoloration. The results obtained are shown in Fig. 3.

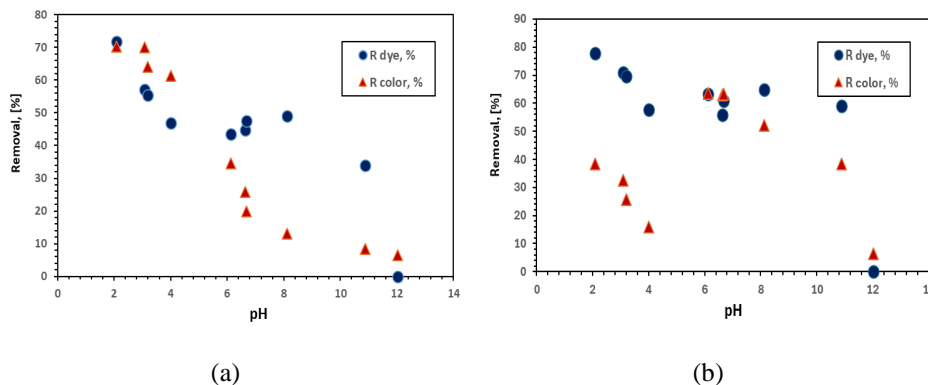


Fig. 3 – Influence of pH onto dye and color removals using S1 (a) and S2 biosorbent (b). Operating conditions: $C_{(\text{adsorbent})} = 5 \text{ g/L}$ (a) or 8 g/L (b); $C_{(\text{dye})} = 50 \text{ mg/L}$; $t_{(\text{contact})} = 24 \text{ h}$; $t = \text{room temperature } (20^{\circ}\text{C})$.

The best removals of RR-RB dye (55.75-77.83% for S1 biosorbent, or 45.75-65.83% for S2 biosorbent) and color (52.17-63.64% for S1 biosorbent, or 51.33-53.64% for S2 biosorbent) were performed at acid pH (2-6) for dye and pH (6-8) for discoloration. As illustrated in Fig. 3, the biosorption performance is better in the case of S1 biosorbent application related to S2 biosorbent, fact that is beneficial in terms of overall costs - removal efficiency. Because of the aqueous environment aggressivity in very acid working conditions and obligatory requirement of minimum residual/remaining emerging pollutant (commercial dye) concentration in the treated WW, the next series of biosorption experiments will be performed in the pH range of 3-4 (exactly, 3.44-3.98).

3.2. Influence of dye concentration on WW discoloration and dye removal

The biosorption efficiency depends a lot of the treating WW characteristics, mainly the main polluting species to be reduced/ eliminated, or the quality indicators to be controlled. Considering as emerging pollutant - the studied RR-RB dye, series of biosorption experiments were performed in different operating conditions considering the recommendable dye concentrations' domain of 10-100 mg dye/L in the textile WWs, among others. The biosorption results obtained at laboratory scale setup are presented in Fig. 4.

Highest removals of RR-RB dye (53.85 – 67.54% for S1 biosorbent and 57.14-68.88% for S2 biosorbent) and color (24.39-28.15% for S1 biosorbent and 43.25-48.66% for S2 biosorbent) were performed when are presented high residual/ remaining RR-RB dye concentrations, especially 50 mg/L or 100 mg/L of RR-RB dye in the simulated dye-containing WWs.

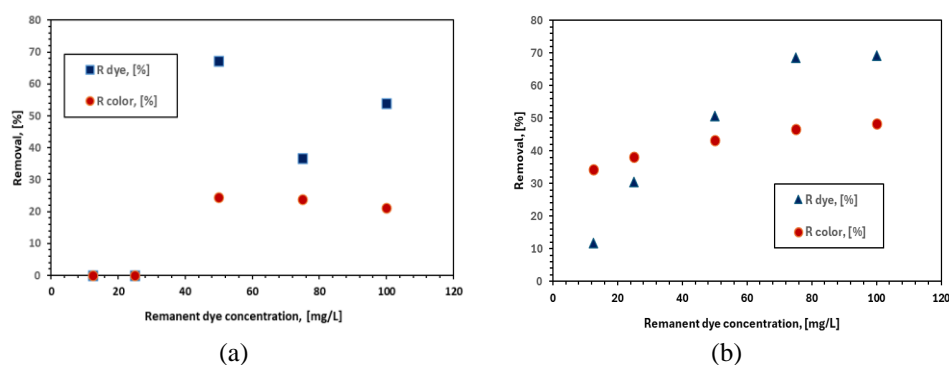


Fig. 4 – Influence of dye concentration on RR-RB dye and color removals using both bio-adsorbents: S1 (a) and S2 (b). Operating conditions: $C_{(\text{bio-adsorbent})} = 5 \text{ g/L}$; $t_{(\text{contact})} = 24 \text{ h}$; $t = \text{room temperature } (22^\circ\text{C})$; $\text{pH} = 3\text{-}4 \text{ (}3.44\text{-}3.98\text{)}$.

The performance of both biosorbents vs. residual/remanent dye concentration (variation) are closed enough, thus can be applied one of studied biosorbents depending on the company economic situation and restrictions. Therefore, the next series of biosorption experiments were performed by working with a reference residual/remanent RR-RB dye concentration in the simulated textile WWs of 50 mg of dye/L which is frequently present in the textile WWs produced after the printing and rinsing of cotton fabrics.

3.3. Influence of biosorbent concentration on WW discoloration and dye removal

The biosorbent dosage in the large-scale applications for emerging organic removal from textile WWs can vary in the range of 2-40 g/L for static 'batch' biosorption treatments. In the case of adsorption onto biosorbents prepared from 'low cost' biological materials, excepting the case of peat, the increasing of biosorbent concentration leads to increasing of dye and color removals from the textile WWs (Zaharia, 2023). The results performed on the biosorption of simulated RR-RB dye-containing WWs onto freshwater green algal-based biosorbents (S1, S2) are shown in Fig. 5.

Higher color (> 53.21%) and RR-RB dye (> 43.21%) removals are obtained working with S1 biosorbent concentration in range of 2.5-15 g/L being indicated the acidic conditions (i.e. pH 3.44-3.98). In the biosorption applications working with the S2 biosorbent, high dye (60.389-81.031%) and color (54.29-62.71%) removals were performed for biosorbent concentrations in range of 11.28 – 19.72 g/L, the best being of 84.306% dye for 23.36 g/L S2 biosorbent and 62.714% color for 19.72 g/L S2 biosorbent used.

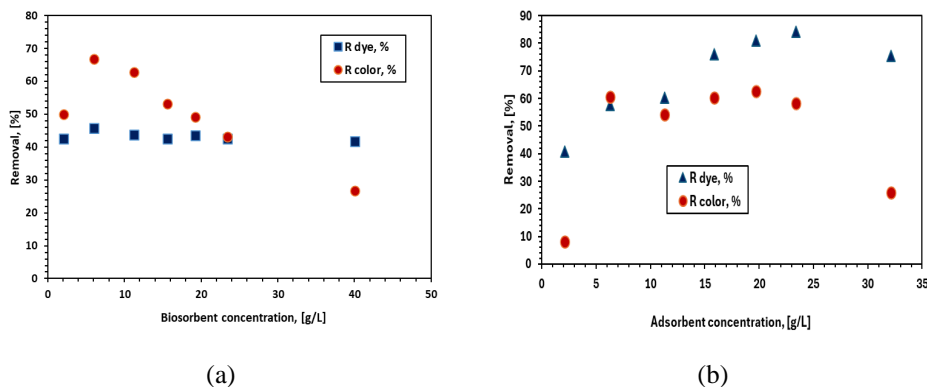


Fig. 5 – Influence of biosorbent concentration on dye removal and WW discoloration: (a) S1 biosorbent, (b) S2 biosorbent. Working conditions: $C_{(\text{dye})} = 50 \text{ mg/L}$; $t_{(\text{contact})} = 24 \text{ h}$; $T = \text{room temperature } (22^\circ\text{C})$; $\text{pH} = 3\text{-}4 \text{ (}3.44\text{-}3.98\text{)}$.

In general, for the RR-RB dye-containing WW treatment working with freshwater green algae-based biosorbents is recommendable to apply concentrations of biosorbent in range of 10-20 g/L for both dye and color removals, excepting the case of dye removal working with the S2 biosorbent.

3.4. Influence of temperature on dye removal and WW discoloration

The biosorption capacity and removals of RR-RB dye and color from the simulated textile WWs are commonly temperature-dependent, therefore series of biosorption experiments were performed at different temperatures, i.e. 5° , 22° and 50°C , to find the adequate biosorption operating conditions applied on simulated dye-containing WWs with the same characteristics. The results are presented in Fig. 6.

High value of temperature is beneficial in the case of S1 biosorbent application for removal of color as indicating the experimental results, i.e. 50°C for 97.86% color removal working with 8.32 g/L S1-biosorbent, and room temperature (22°C) for RR-RB dye removal (67.191%). In the case of S2 biosorbent application, the best removals, i.e. 85.31% dye and 62.17% color, were obtained at room temperature (22°C) working with 19.72 g/L S2 biosorbent.

Considering as selection criterium the WW treatment cost - efficiency, it can conclude that concentrations of S1-S2 biosorbents in range of 10-20 g/L are beneficial for obtaining values of RR-RB dye and color removals higher than 60% with respect to the established standards/limits for discharges into different aquatic receptors.

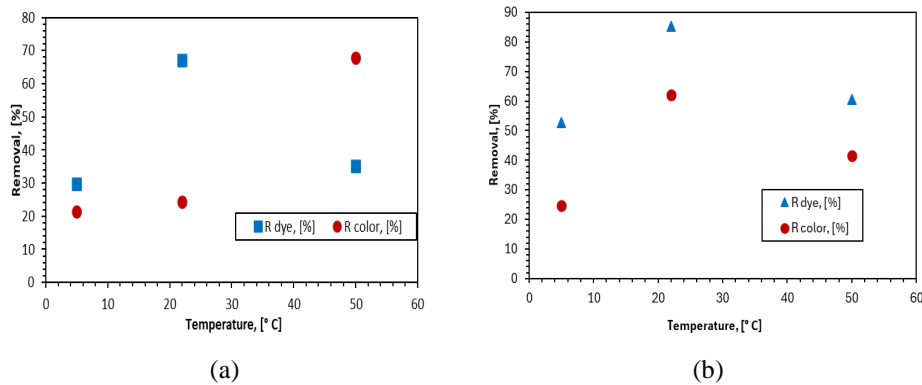


Fig. 6 – Influence of temperature on RR-RB dye and color removals. (a) S1 biosorbent; (b) S2 biosorbent. Working conditions: $C_{(\text{dye})} = 50 \text{ mg/L}$; $C_{(\text{biosorbent})} = 8.20\text{-}8.32$ (S1), or $19\text{-}20$ (S2) g/L; $t_{(\text{contact})} = 24 \text{ h}$; $\text{pH} = 3\text{-}4$.

3.5. Influence of biosorption contact time on dye removal and discoloration

The biosorption time is an important operating variable which can control the treatment step efficiency and permit the maintaining of imposed qualitative and quantitative limits for treated WWs. The results performed in the case of simulated RR-RB dye-containing WWs for both studied biosorbents based on green algal biomass (S1 / S2) are shown in Fig. 7.

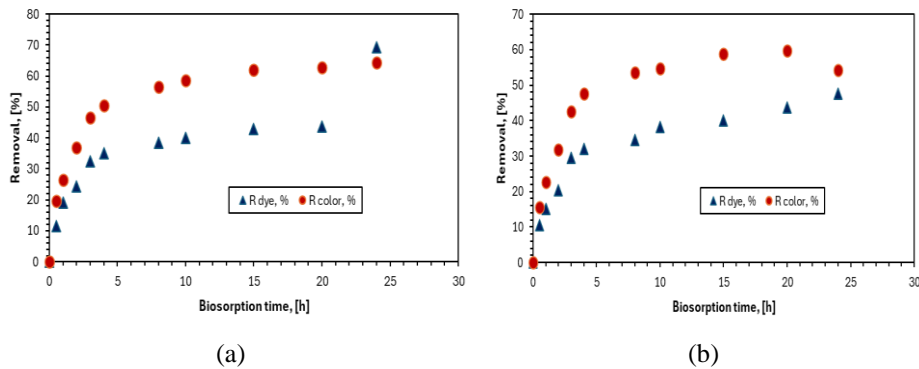


Fig. 7 – Influence of biosorption time on RR-RB dye and color removals: (a) S1 biosorbent; (b) S2 biosorbent. Working conditions: $C_{(\text{dye})} = 50 \text{ mg/L}$; $C_{(\text{biosorbent})} = 11.28 \text{ g/L}$; $T = \text{room temperature } (20^{\circ}\text{-}22^{\circ}\text{C})$; $\text{pH} = 3.44\text{-}3.93$.

After 24 h of static biosorption treatment, the best removals obtained for (50 mg/L)-RR-RB dye-containing WWs are 69.39% dye and 64.29% color working with the S1 biosorbent at room temperature and pH 3-4, and 47.65% dye and 54.29% color working with the S2 biosorbent in the same operating

conditions. As shown in Fig. 8 it seems that is necessary a minimum biosorption time of 8 h (until biosorption equilibrium establishing) and experimental data conclude on satisfactory biosorption efficiencies, i.e. 38.45% dye and 56.45% color for S1 biosorbent, or 34.45% dye and 53.45% color for the S2 biosorbent.

The biosorption time will be always correlated with the economic situation of textile dye-containing WW producer and imposed environmental requirements for pollution prevention, control and reduction.

4. Conclusions

1. The experimental results underline the viable and efficient alternative of using freshwater green algae biomass (*Spirogyra*) as biosorbent for retaining residual Remazol Rosso RB azo dye from aqueous solution, or simulated industrial effluent (textile WW), in association with its advantages of low cost, relatively large biosorption capacity and no secondary pollution produced.

2. All experiments were performed in batch laboratory scale setup systems, and the results conclude for maximum dye and color removals in range of 64-91% achieved with S1 biosorbent and 54-85% with S2 biosorbent at specific operating conditions, e.g. pH 3-4, with no more than 8-20 g/L biosorbent, after at least 8 h of biosorption and room temperature. Best results were performed working with only dried non-living green algae-based biomass (S1), not heated at 100°C (as S2) in a few specific situations. The highest dye removal (90.306%) was obtained working with the S1 biosorbent at specific dosage of 23.36 g/L and highest color removal (70.536%) for 6.28 g/L at 50°C for the same S1 biosorbent. Thus, it is recommendable to use biosorbent concentrations in range of 5-20 g/L, but not higher than that.

3. In severe conditions of large and frequent fluctuations in temperature, residual/remanent dye concentrations, or pH of treating RR-RB dye-containing WWs, both prepared biosorbents based on green algal biomass can be easily applied for an even wider range of polluting species, but with high color and RR-RB dye retention efficiencies (> 60-91%). The biosorption experimental studies will continue by using both prepared biosorbents in free and immobilized form (with sodium/calcium alginate, in form of granules and/or biofilm) for findings the corresponding biosorption isotherms, elucidation of the main thermodynamic and kinetic aspects of the dye biosorption mechanism, and further proposal of viable biosorption treatment models which can be used in real RR-RB dye-containing effluent treatments.

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BIOSORBȚIA COLORANTULUI TEXTIL PE BIOMASĂ MOARTĂ DE ALGE
VERZI DE APĂ DULCE DE SUPRAFAȚĂ: FACTORI DE INFLUENȚĂ ȘI
EFICIENȚĂ. UN STUDIU DE CAZ (I)

(Rezumat)

Acest studiu discută rezultatele experimentale (i.e. eficiența decolorării și reținerii colorantului Remazol Rosso RB) obținute prin aplicarea unei trepte de biosorbție în epurarea unei ape uzate textile simulate (AU) folosind materiale bazate pe alge verzi moarte uscate (alge de *Spirogyra*, de dimensiune < 2 mm) drept biosorbent în forma liberă (S1) și după încălzire la 100°C în cuptor timp de 6 ore (S2). Diferiți factori de influență, i.e. pH, doză de biosorbent, concentrația colorantului, temperatura, timpul de biosorbție, au fost studiați pentru găsirea celor mai bune condiții de operare în vederea obținerii celor mai mari grade de decolorare și reținere colorant. Rezultatele indică faptul că materialul pe bază de alge verzi moarte uscate este eficient ca biosorbent (i.e. reținerea colorantului și culorii în proporție de 64-91% folosind biosorbentul S1 și 54-85% folosind biosorbentul S2) și poate fi utilizat în epurarea apei uzate textile pentru scăderea încărcării organice și decolorare, în special în cazul variației frecvente a debitului și compoziției chimice a apei uzate, când se lucrează în condiții adecvate de operare.