

Removal of Heavy Metals and Colour from Industrial Wastewater by Biosorption - Marine Algae and Prosopis Juliflora

Samuel Paul Prasanna. T, Supriyasubrahmanian

Abstract— present day effluents containing overpowering metals are taken into consideration as a superb wellspring of water defilement. The defilement reasons real ordinary issues which can be being seemed via the general masses today. Contrasting treatment shapes are open and are absolutely analyzed for the remedy of the dirtied waters and wastewaters from affiliations. A supervisor most of the maximum supporting methodology for wastewater treatment is the biosorption technique. Biosorption is used as an different treatment method and are overriding the common frameworks. Prosopis juliflora (provoked carbon) and marine green development are used in the biosorption method of remedy of tannery transmitting water. Marine inexperienced improvement adsorb extensive diploma of metal debris in context at the closeness of various utilitarian social affairs at the telephone surface, in context on physico-compound correspondence. in this examination, biosorption of Cr(VI) and Pb(II) particles from watery outlines the use of Prosopis juliflora and Marine inexperienced development is seemed into as a phase of pH, starting metal iota center, biosorbent bit and make contact with time. At the right adsorption pH regards, the most mind blowing take-up reason for constraint concerning chromium is assessed as seventy one.106 mg g⁻¹ and for lead seventy seven.145 mg g⁻¹. night time out records is all round depicted by using the Langmuir and Freundlich adsorption family members. The closeness of realistic get-togethers is ensured using (FTIR) spectroscopy and the steel debris are destitution troubled some spot around AAS framework the use of unequivocal lights at explicit wavelength. The end result shows that Prosopis juliflora (started out carbon) and marine inexperienced headway as biosorption substances has splendid ability for the discharge of metal particles and shading from the wastewater.

KEYWORDS:AAS, Biosorption, Chromium, FTIR, Isotherms, Lead, Marine Algae, Prosopis juliflora, Tannery Effluent.

1. INTRODUCTION

Industrial wastes are often generated from different contemporary structures. Thusly, the whole and lethality of liberal metal waste released from contemporary practices influences with the mechanical strategies. A mind-blowing metallic is a full scale term for metals of excessive atomic mass, specially the ones which are unfavorable and can't be overseen with the aid of living organisms(Chervona et al(2012).) these consolidate lead, chromium and cadmium amongst others. Subordinate upon the unique situation, the time period can interlace walls lighter than carbon and might deny possibly the heaviest metals. Liberal metals can be widely referenced into the going with gatherings, for

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instance, those which can be important for sure biochemical methodologies, at any rate are unsafe when their obsession defeats positive edges and those which are the maximum risky amassing which cements lead, chromium, cadmium and mercury which serves no recognised normal motive of limit and are savage in any respect center interests. The normal unavoidable aftereffects of look for after steel lethality to living creatures consolidates mind issue, internet twists being made, volatile development causing impacts and the whole thing considered, disturbance of ordinary structures. typically these elements discover their manner into the earth via human mechanical principle, for example, mining, electroplating, battery make, calfskin tanning, and advent of printing tones and paints, among others. A high centralization of overpowering metals inside the earth is of mind blowing flourishing worry due to the fact that they're non-biodegradable and emerge as storing up in bleeding edge life in diverse structures, for example, common, inorganic or organometallic species (J.Nirmal Kumar et al(2012)). In context on the risky notion of search for after metals, it's far important to oust them from water explicitly and the earth whilst all is stated in performed.

2. MATERIALS, TECHNIQUE & RESULTS

Amassing of pattern

Tannery enterprise wastewater turned into accumulated from the wrapping areas of Nagalkeni, Pallavaram, Chennai, TN, India, and became confirmed in cooler to disturb similarly sullying. The wood of Prosopis juliflora changed into accumulated from Alathur city and changed into disconnected bodily. The wood changed into dried below light for multi week. inside the wake of drying, the timber become made into commenced charcoal by way of a couple of treatment shapes and changed into confirmed. The examinations exhibits that the adsorption maximum remote spans of the monetarily open installation carbon is quit to that of the brought on carbon composed from Prosopis juliflora(R.Sivakami et al (2015)).

Plan of Biosorbent (Macro algal biomass)

sorts of macroalgae viz., Sargassum wightii(brown inexperienced development) to be had abundantly within the shores of Gulf of Mannar, Tamil Nadu were accrued and washed with subtle water, color dried and a concise variety later range dried at 60oC medium-time period. The dried inexperienced headway had been then grounded into atom size of zero.5mm. The organized algal biomass had been



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secured in polythene packs for biosorption experiments(A.Davis et al(2003)).

Plan of artificial steel solutions

Potassium dichromate was used for the game plan of evolved chromium(VI) game-plan. A stock recreation-plan of chromium VI (Cr+6) was set up through dissolving potassium dichromate (AR grade) in 1L of zero.1N sodium hydroxide approach. From the prepared stock technique of 100 ppm/L, special centers, as an instance, 2, 4, 6, 8 and 10ppm were prepared using deionised water. similarly turned into prepared distinctive weakenings of lead plan the usage of lead nitrate (AR grade).

percent Biosorption studies

The tannery wastewater was experienced the began carbon of Prosopis juliflora, which have been eaten up ethanol for 48hrs and had been isolated thru the use of Whatman No.1 channel paper, the tannery wastewater shading was emptied to the maximum sudden near the dispatch of chromium and lead. The filtrate wastewater, resulting to shading departure, become used for biosorption studies(B.Volesky(1990)). The biosorption explores have been made the usage of a hundred ml volume of chromium and lead ruined tannery liquid technique in 500ml Erlenmeyer compartments. impact of parameters, for instance, pH (2,four,6,8 and 10), contact time (30,60,ninety,a hundred and twenty and 120min), metallic obsessions (2,four,6,8 and 10ppm) and macroalgal biomass (zero.five,1.zero,1.five,2.0,2.five and 3 g/100ml) on metal biosorption become researched by means of transferring one of the parameters expeditiously and keeping the extraordinary parameters strong. The biosorption technique became completed at the temperature of 27±20C. The fundamental steel iota obsession (Ci) inside the liquid recreation-plan became settled by means of APHA (APHA,23rdEdn. 2017) the usage of Atomic Absorption Spectrophotometer (AAS). The mixes had been combined all round asked in a rotational shaker [Buchi] by way of solving the fomentation price between a hundred to a hundred and twenty rpm for 30min. After 30min, the stable level became filtered off the use of Grade 1 Whatman No-1 channel paper. The closing overpowering steel obsession inside the filtrates (Cf) changed into assessed the usage of AAS.

Request of metallic debris over the span of hobby

Biosorption assessments had been achieved in duplicates and the effects have been found the center estimation of out for the examination. The rate biosorption of overpowering metals (lead and chromium particles) was settled as searches for after:

$$\text{Biosorption (\%)} = \frac{(C_i - C_f)}{C_i} \times 100 \quad (\text{Pb\&Cr})$$

wherein Ci is the simple steel molecule get-collectively of lead (mg/l) and chromium(mg/l) and Cf is the remaining steel particle obsession (mg/l)

Biosorption isotherms

Isotherms have been studied by means of transferring the primary centralization of the metallic particles at the precise situations for each metallic. evident biosorption fashions have been used for relationship of starter information.

SEM has high dreams and gives better fortifying for vigorously scattered materials. in the gift examination, the surface morphology of the control (pre-dealt with) and the biosorbed green progression became seen as the use of Scanning Electron Microscope (Hitachi s.54000).

three. outcomes AND dialogue

The lessen shaded macroalgae changed into used for the biosorption of lead (Pb) and chromium (Cr) from liquid technique and the conceded results of effect of every parameter are inspected beneath.

effect of pH

The impact of pH on the biosorption of chromium (Cr(VI)) and lead (Pb(II)) on to the macroalgal biomass became surveyed. It turned into visible that beyond what many could remember ability changed into growing with the extension of pH from 2 to 10. The pH is visible because the maximum essential parameter which apprehend an vital paintings inside the biosorption of metal debris from outlines. At lower pHs, the dynamic destinations on the biomass surface could be fused right into a standard sense via the protons in mild of its high consciousness interest. this will tie the route of motion of the metallic cations in the direction of the outside of the biomass. as the pH increases, with a lessening in the proton center, the biomass surface breezes up being drastically extra oppositely charged and overhauls the biosorption of the truly charged steel iota attaining maximum prominent biosorption within the pH level of 5-7 for S. wightii. As proven by our exposures, the maximum awesome take-up of chromium (VI) and lead(II) through the stupid shaded inexperienced development turned into at pH 5.09 and 6.24 independently as given in table 1. The extensively inclusive biosorption with developing pH regards may be credited to the closeness of acidic carboxyl and sulphonate clusters on the mobile dividers of the biomass and to metallic iota technological know-how in sport-plan.

Table. 1: Study of the effect of pH on the biosorption of metal ions

S.No	Metal Ions with Biosorption system	Biosorption max.at different pH values				
		2	3	4 to 5.5	5.5-7.0	7 to 10
1	Lead as Pb(II)	-	-	-	6.24	-
2	Chromium as Cr(VI)	-	-	5.09	-	-

3. INFLUENCE OF BIOSORBENT DOSAGE

The effect of the macroalgal biomass measurement at the biosorption of chromium (VI) and lead(II) from arrangement demonstrates a precarious increment inside the chromium (VI) and lead(II) take-up by utilizing the biomass of S. wightii after developing the measurement from 0.5g to 2g/100 ml. The biomass measurement of 2g/100ml had the most extreme evacuation of 92% and seventy six% for



chromium (VI) and lead (Pb(II)) individually from the watery arrangement as given in table 2. the extent take-up of chromium (VI) and lead (II) become situated to be relentlessly diminishing over the most solid biosorbent measurement. This effect will be because of the arrangement of totals of the biomass at better doses which thus diminishes the surface territory to be had for floor adsorption of metal ions(Tobin et al((1998)).

Table. 2: Study of the effect of Biosorbent dosage on metal biosorption

S.No	Biosorption system with metal ions	Maximum removal of metal ions using dosages from 0.5g to 2g/100 ml
1	Lead as Pb(II)	92 g/100ml(%)
2	Chromium as Cr(VI)	76 g/100ml(%)

Effect of Contact Time

touch time become determined to profoundly impact the biosorption process that is verified from the effect on the biosorption of chromium(VI) particles and lead(II) debris utilizing a really perfect biomass (2g/100ml) of *S. wightii*. The results established that the biosorption of chromium(VI) and lead(II) turned into short amid the important 30min and after that tested a slow increment with the accomplishment of stability at 90min. The take-up restrict did no longer demonstrate any development after the touch time of 90min as seemed table 3.Table.3: Study of the effect of contact time on metal biosorption

Concentration(g/100ml)	Lead as Pb(II) and Chromium as Cr(VI) uptake		
	30 -60 mins	60-90 mins	90-120 mins
Biomass (2g/100ml)	-	86% Pb(II)	No Change
	-	81%(Cr(VI))	No Change

4. INFLUENCE OF METAL ION CONCENTRATION

The perspective on the impact of metal molecule obsessions at the biosorption way shown that the biosorption of lead(II) and chromium(VI) changed into creating with the movement inside the possibility of lead(II) and chromium(VI) from 2 to ten ppm inside the closeness of the macroalgae. The most dispatch percent was 71.1% and seventy seven.1% uninhibitedly at 10 ppm get together of (Cr (VI)) and Pb(II) exclusively as given in table 4. The effects prescribe that the biosorption structure was critical paying little heed to for better preliminary metallic molecule center. this is in synchronization with the past report at the examination of the biosorption of overpowering metallic lead from liquid answer by systems for the non-withstanding biomass of *Sargassum* sp. Biosorption changed into saw to reduce with the progress inside the metal molecule obsession above 10ppm. The enlargement is a quick outcome of the closeness of huge wide combination of void limiting objectives at first inciting higher and snappier biosorption and at the later estimation the decrease is an eventual outcome of the supply of less extent of vivacious locales on the floor of the algal biomass.

Table.4: Study of the effect of metal ion concentrations on the biosorption of metal ions

Metal Ions concentration(mg/L)	Metal ion removal (%) Lead as Pb(II) and Chromium as Cr(VI)
2 to 10 mg/L	71.1g/100ml (%) of lead (Pb(II))
	77.1g/100ml (%) chromium (Cr(VI))

Adsorption Isotherms

The Langmuir and Freundlich isotherms delineate the adsorption wonders approximately the solid liquid interface. The records had been used for the showing of the adsorption gadget and moreover to understand the association between the adsorbent and the adsorbate(N.Das et al(2008)).

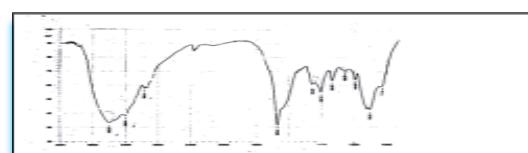
The consequences of the Langmuir model parameters for chromium and lead biosorption through macroalgae exhibited that the functionality of adsorption was least ($q_{max}=1.41\pm 0.18$ (Cr⁺⁶), 1.37 ± 0.11 (Pb⁺²)) with a high affiliation coefficient (2.69 ± 0.31 (Cr⁺⁶), 2.33 ± 0.13 (Pb⁺²)) as given in desk five. these derive that monolayer adsorption in addition as heterogeneous floor conditions may want to agree under the idea about situations. for this reason Langmuir isotherm may be used to exhibit the exploratory adsorption information for the picked marine macroalgae.

Table.5: Langmuir model parameters for chromium and lead adsorption of macroalgae

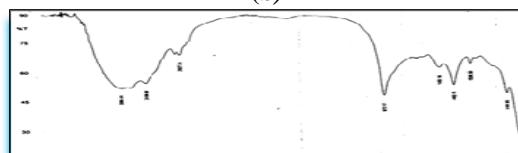
Macro algae	$q_{max}(\text{mmol g}^{-1})$	$b (\text{L mmol}^{-1})$	r^2
<i>Sargassum wightii</i>	1.41 ± 0.18 (Cr ⁺⁶) 1.37 ± 0.11 (Pb ⁺²)	2.69 ± 0.31 (Cr ⁺⁶) 2.33 ± 0.13 (Pb ⁺²) &(Pb ⁺²)	0.97(Cr ⁺⁶)

Characterization of Biosorbent (FTIR)-Fourier Transformation Infrared Spectroscopy
Fig 1: IR spectrum of the biosorbent before and after lead(II) (a,b) and chromium(VI) (c,d) biosorption.

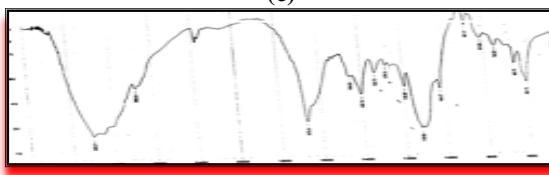
(A)



(b)



(c)



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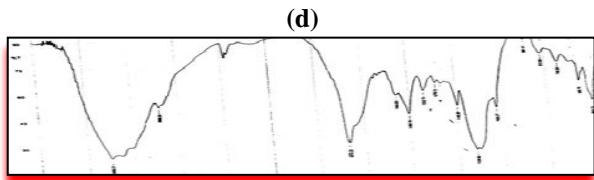


Table 6:FTIR values of Cr(VI) and Pb(II) of biosorption

Before Cr(VI) & Pb ions biosorption		After Cr(VI) & Pb ions biosorption		Difference
Wave number (cm⁻¹)	Annotations	Wave number (cm⁻¹)	Annotations	
3435	O–H group	3438	O–H group	3
2925	CH ₂ group	2923	C–H stretching vibration	-2
2524	S–H stretching vibration	2525	S–H stretching vibration	1
1807	Carbonyl group (C=O) stretching vibration	1802	C=C bond stretching vibration	-5
1624	C=O stretching vibration of the ketone	1624	C=O stretching vibration of the ketone	0
1471	Vibration of the CH ₂ group	1419	Carboxyl COO ⁻ units	-52
1417	Carbonyl group, C=O	1036	C–O and C–O–C stretching vibrations	-381
1082	PO ₂ ⁻ vibrations of phospholipids	876	C=O stretching vibration	-206
875	CO ₃ vibrations of calcite	719	C–H bend of alkene	-156
716	C–O–C bending vibration	546	Vibration of P=O in PO ₄ ³⁻	-170

Fourier Transform Infrared (FTIR) spectroscopy was applied for the exam of the pre-treated and the biosorbed algal biomass exams. The algal biomass assessments had been made into a pellet making use of KBr and the IR run changed into accrued utilising an Agilent spectrophotometer within the range four hundred-4000 cm⁻¹. The FTIR spectra of the models are portrayed out in Fig. 1(a to d) for the cleansed biomass (manipulate) and chromium (Cr) and lead (Pb) stacked biomass. The IR tops relate to the utilitarian events present ostensibly of the cellphone mass of the biomass and their affiliation with the metallic debris

(N.ok.Srivastava et al(2008)). it's far apparent from Fig.1a,1b,1c and 1d that the FTIR spectra of the chromium and lead stacked S.wightii biomass, validated an important diminishing

inside the zenith manipulate relating to hydroxy (- OH) and – NH growing social events (3400 to 3315cm⁻¹). The decreasing available between the social occasions for the stacked biomass after metal restricting is an immediate aftereffect of the fulfillment of higher symmetry in the cellphone divider mastermind in light of steel complexation. comparable form of correspondence was in like manner specified via the examinations on the route of motion of adsorption of liberal metals, as an instance, chromium and lead by *Sargassum* biomass. The exam of the IR spectra of the launched algal biomass and the metallic particles stacked biomass uncovered the proximity utilitarian social occasions, as an example, amino, carboxyl, hydroxyl and carbonyl parties apparently of the biomass cells and their relationship with the steel particles. The refinement inside the band structure can be credited to the nitrogen-hydrogen growing band. except, an important circulate is found in the wave variety from 2925 to 2923 cm⁻¹, diverging from the C-H developing band exhibiting the relationship of the C-H widening band inside the professional of the chromium onto the macroalgae. Dissipating of the carbonyl social event top at 1082cm⁻¹ earlier than the p.c. stacked biomass tests demonstrates the persuading facilitated exertion of the carbonyl party with chromium than with lead. For lead dealt with biomass test, the obligation of the other utilitarian social events related with real with the noteworthy steel is given in desk 6.

Scanning Electron Microscope Analysis (SEM)

The floor morphology of the control (depleted biomass) and the biosorbed inexperienced advancement have been watched using Scanning Electron Microscope (Hitachi s.54000). The SEM picture of the chromium and lead stacked dull shaded inexperienced advancement are seemed in Fig 2(a and b) and Fig 3(a and b) freely. Irregularities and microstructures saw reputedly of the cleansed *S.wightii* biomass take a look at may be an immediate aftereffect of the calcium and salt crystalloid assertion as further discovered in the SEM examination of grungy *Sargassum sp.* shown in Fig 4.

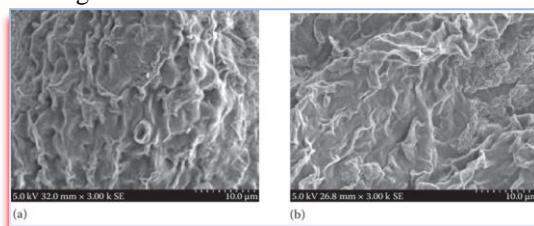


Fig 2:SEM image of Sargassumsp:

(a) before Cr (VI) sorption, (b) after Cr (VI) sorption.

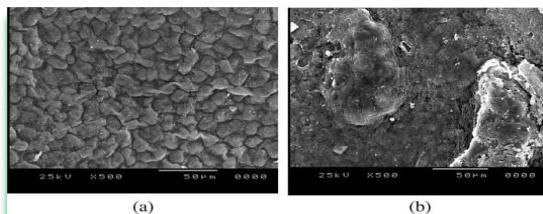


Fig 3:SEM image of Sargassum sp: (a) before Pb(II) sorption, (b) after Pb(II) sorption

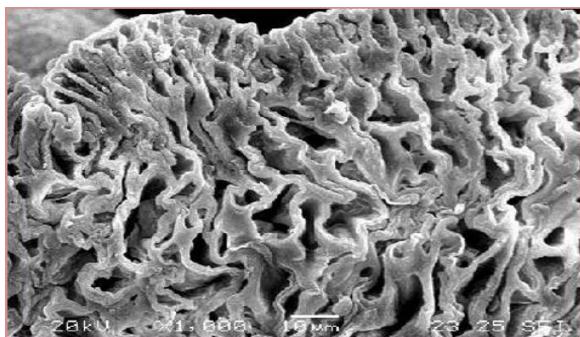


Fig 4: SEM image–Sargassum sps.

5. CONCLUSION

The biosorption and biomonitoring separate finished in this work gives colossal surenesses concerning the sensibility of reduce shaded green headway as a biosorbent and a bioindicator for the picked overpowering steel tainting. Adsorption parameters had been settled. The most fulfilling pH become seen to be five.8and 5.zero for chromium and lead, just and the contact cases required for the quantitative steel take-up had been 40min for chromium and 50min for lead.. Very far had been found to be 71.106 mg/g and seventy seven.145 mg/g for chromium, and lead, self-rulingly. The central metal obsessions which actuated most raised steel adsorption onto reduce tinted green improvement were some spot in the degree of 500 and 700 mg/l for the two metals considered. The shade departure percent wound up made plans to be ninety seven% through using the prompted charcoal got from *Prosopis juliflora* which went about as a tolerable diminishing master in the tannery business wastewater. since the straightforwardness of this plant in India is full-measure like dull conditioned green headway it might be used for seeing the wastewater as is particularly in your respect run.

From this classy signs, decrease tinted green improvement, *Prosopis juliflora* (as started carbon) ended up saw to be an extraordinary biosorbent which can be used for the fitting trade of overpowering metals and shading from tannery wastewater. The green headway fills in as a reasonable bioindicator by goals of its ability to make metals to a reasonable estimation. honestly, even as the metal suspected inside the water tests changed into immaterial for the metals considered, the green progression were much consistently lavish in liberal metal substance. due to the trading of liberal metals from sullied water with the guide of the biosorbents, targets of overpowering steel harms in any water body by procedures for direct examination of water tests won't be exact as it does now not reproduce the authentic bioavailable poison engineer in the water body. this is other than a prompt result of the real world, by far

most of the astounding metals can be removed from the water through the biota and the remaining parts occupant in the undefined water. Usage of a bioindicator like dull conditioned green improvement could fill the need in a transcendent way. besides, work may be passed on to find the amleness in markdown of thought of different overpowering metals present in the tannery wastewater. New present day structures can be searched for after to shoot the utilization of this methodology for answer for putting off the noteworthy metals to a broadly comprehensive total without dirtying the trademark bodies.

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