



A Comparative Study on the Degradation of Leather Industry Effluent by Marine Algae

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ABSTRACT

Industrial effluents are one of the important sources of harmful chemicals that are drained into land and water bodies without treatment leading to severe impact on environment. Marine algae are currently used for treating the industrial effluent effectively. They are mostly used as an adsorbent and also as a biofilters for treating industrial effluent. In this present study, different extracts of four marine algae such as *Ulva lactuca*, *Enteromorpha flexuosa*, *Grateluopia lithophila* and *Centroceras clavulatum* from Covelong, Tamil Nadu, India were used to treat the leather industry effluents collected from Nagalkeni village, Pallavaram, Chennai, Tamil Nadu, India. Among all, extracts of *Ulva lactuca* reduced more amounts of chemicals present in the effluent. Benzene extract of *Ulva lactuca* showed good reduction in TDS (85%), sulphate (82%) and nitrate (91%). Hardness (81%) and chloride (91%) content was reduced more by methanolic extract of *Ulva lactuca*. Chloroform extract of *Ulva lactuca* reduced more amount of chromium (91%) present in the effluent.

Keywords: Industrial Effluent, Marine algae, solvent extracts.

INTRODUCTION

Environmental pollution by industrial waste water is a major problem in the world due to increase of industrialization. The availability and quality of water determines the quality of life. Water quality is closely linked to water use and to the state of economic development.¹ Ground and surface waters are contaminated by several sources. In urban areas, the careless disposal of industrial effluents and other wastes may contribute greatly to the poor quality of water.² Most of the water bodies in the areas are the end points of effluents discharged from industries. The effect of industrial discharges depends also on their content of specific inorganic and organic substances.³ Most of the industrial effluent contains chromium and aromatic compounds that are discharged by the industrial processes such as wood preserving, metal finishing, petroleum refining, leather tanning and finishing, paint and ink formulation, pulp and paper industry, textile Industry, pharmaceutical industry and automobile parts manufacturing industry.⁴⁻⁸ Various chemical methods have been adopted for treating this harmful chemicals present in the effluent. Though it is a cheaper method, it generates hazardous side effects. Hence biological treatment method is used because of its ease of operation, eco friendly and less economical flexibility. Microbial degradation is one of the foremost methods for treating oily pollutants in waste water. Fuel eating bacteria has major role in degrading oil content in waste water.^{9,10} Use of biofilter for treating industrial effluent was discussed by various researchers.¹¹⁻¹³ Macro algae have numerous applications. Producing biodiesel from algae is one of its main applications.¹⁴ It was also used for treating waste water. *Ulva reticulata* and *Gracilaria crassa* were used as a biofilter for removing nutrients

from fish pond effluent.¹⁵ Ryther studied about Biological treatment of sewage by algae and bivalves.^{16, 17} Studies revealed that dealginated seaweed will adsorb metals from solution and bind them to the solid material.¹⁸⁻²⁰ The used of dried natural algal biomass for treating industrial effluents is found to be an effective method.²¹ Seaweed *Ulva lactuca* was used as an adsorbent for treating plate making industry effluent.²² Recent studies had dealt with effect of plant extract on domestic and industrial effluent.²³⁻²⁶ In this study, extracts of various seaweeds were analyzed for its effect on leather industry effluent.

MATERIALS AND METHODS

Collection of sample

Various Seaweeds such as *Ulva lactuca*, *Enteromorpha flexuosa*, *Grateluopia lithophila* and *Centroceras clavulatum* were collected from Covelong, Tamil Nadu, India. They were thoroughly washed and dried under sun light. Then they were powdered by mixer and stored. Leather industry effluent was collected from Nagalkeni village, Pallavaram, Chennai, Tamil Nadu, India and stored in refrigerator for avoiding further contamination in the waste water.

Preparation of plant extract

The powdered samples were soaked in different solvents such as methanol, ethanol, chloroform and benzene for 48 hrs and the extracts were filtered out using whatman No.1 filter paper (Table 1).

Treatment of effluent

Leather effluent was treated with various algal extracts and the reduction of various chemical constituents was investigated.

Table 1: Extracts of Seaweed

Seaweed	Solvent Extracts			
	Ethanol	Benzene	Chloroform	Methanol
<i>Ulva lactuca</i>	ULE	ULB	ULC	ULM
<i>Enteromorpha Flexuosa</i>	EFE	EFB	EFC	EFM
<i>Grateloupia lithophila</i>	GLE	GLB	GLC	GLM
<i>Centrocerus clavulatum</i>	CCE	CCB	CCC	CCM

Estimation of TDS

Effluent sample was filtered and the sediment leftover on the filter was scrapped off and dried in oven. Then the dry weight of the sediment was measured.

Determination of Hardness

Twenty five milliliter of sample was dissolved in 50ml of distilled water and 1 or 2 drops of EBT indicator was added to it. The solution was titrated with EDTA solution till the color changes from reddish to blue tinge.

Analysis of Sulphate concentration

About 100ml of sample was treated with 20ml of buffer solution A(30 g of $MgCl_2$ was dissolved in 5g of sodium acetate, 1g of KNO_3 and 20ml of CH_3COOH in 500ml distilled water). A spoonful of $BaCl_2$ was added to it. The turbidity was measured. Using standard graph, the concentration of sulphate was measured.

Determination of Nitrate level

An aliquot containing 50ml of sample was added to 1ml of HCl and OD was measured using calorimeter. The nitrate concentration was measured for the given sample using standard graph.

Determination of chromium content

Hexavalent chromium was measured spectrophotometrically by diphenyl carbizide method which is nearly specific for Cr(VI) Adding diphenyl carbizide solution to samples develops a pink color which can be measured with a UV-spectrophotometer at 540nm.

Estimation of chloride

Ten milliliter of effluent samples in a conical flask was taken and 1ml potassium chromate was added to get light yellow color. It was then titrated with standard silver nitrate solution till color change from yellow to brick red.

RESULTS AND DISCUSSION

Leather industry effluents are one of the major components which pollute land and water bodies. In this investigation, various solvent extracts of seaweed were used for treating this harmful leather effluent.

Total Dissolved Solid (TDS)

Calcium and magnesium salts are the main constituents of TDS. Maximum amount of TDS (85%) was removed by benzene extract of *U.lactuca* (Fig.1). It is comparatively more than methanolic extract of *Prosopis juliflora* (80%).²⁴

Hardness

Hardness is the measure of the capacity of water to react with soap. EPA classified hardness in to four categories such as soft (0-50 mg/l), moderately hard (50-150 mg/l), hard (150-300mg/l) and very hard (>300 mg/l). Methanolic extract of *U.lactuca* considerably reduced 81% of hardness (390 mg/l) (Fig.2) and the untreated effluent contains 2100mg/l of hardness.

Chloride

As per EPA 1986, the permissible limit of chloride for inland surface water is about 1000mg/l and for on land is about 600mg/l. In this work, nearly 89% of chloride content was reduced from tannery effluent by the methanolic extract of *U.lactuca*. (254.94 mg/l). (Fig.3)

Sulphate

Hydrogen sulphide increases the corrosive property of water and also interferes in the chlorination. Hence removal of sulphate content is very important. Untreated effluent contains more amount of sulphate (3400mg/l) which was very high as per EPA, 2002 standard (1500mg/l). Benzene extract of *U.lactuca* showed noticeable reduction in sulphate (82%). (Fig.4)

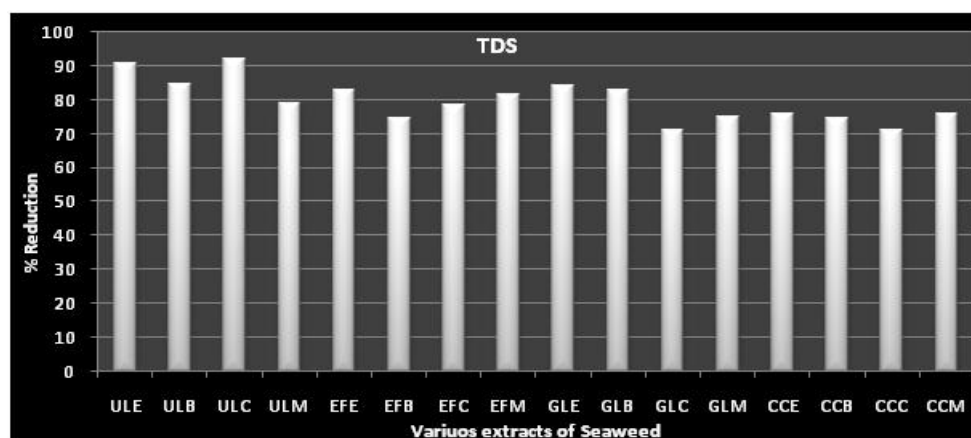


Figure 1: Effect of seaweed extract on TDS

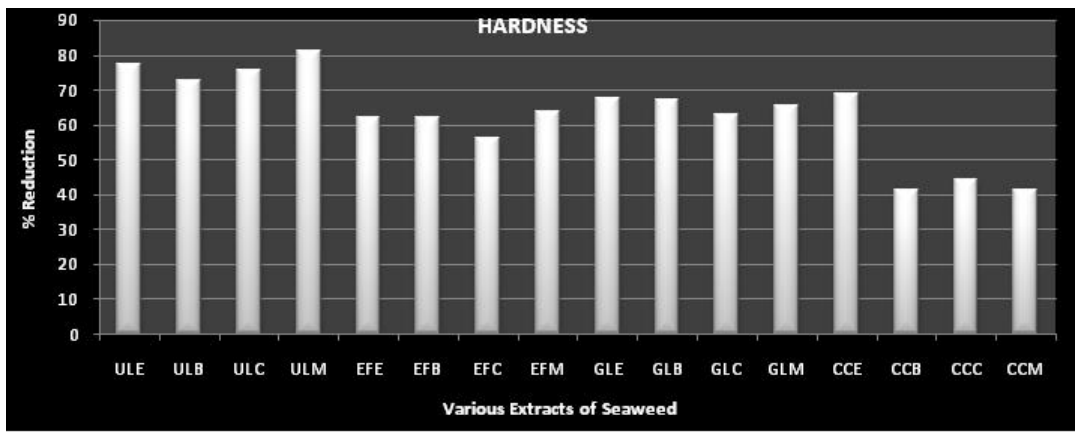


Figure 2: Effect of various extracts of algae on hardness

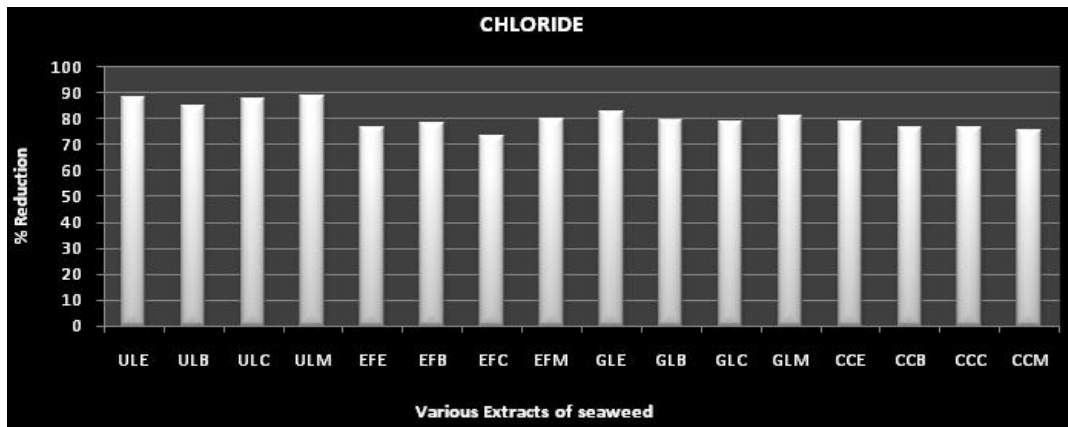


Figure 3: Effect of marine algal extract on chloride content

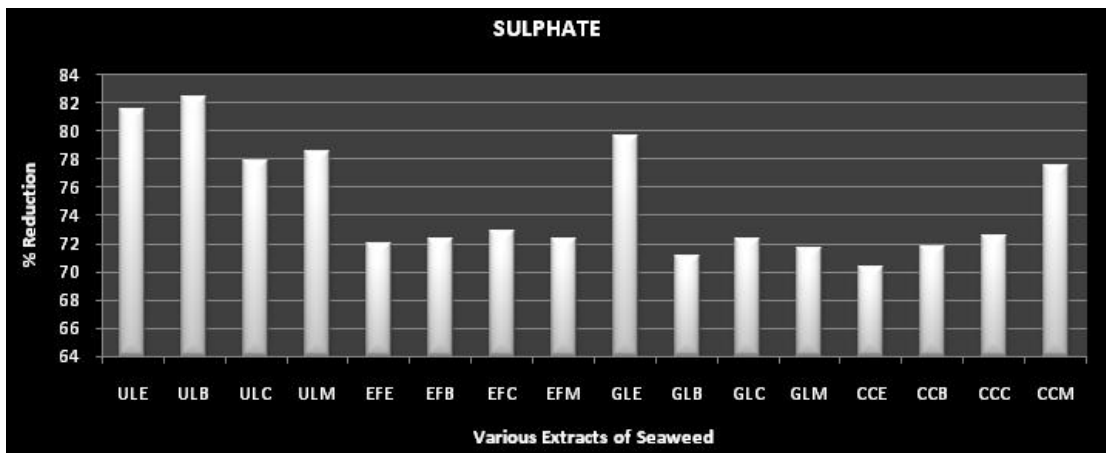


Figure 4: Effect of seaweed extracts on sulphate concentration in effluent

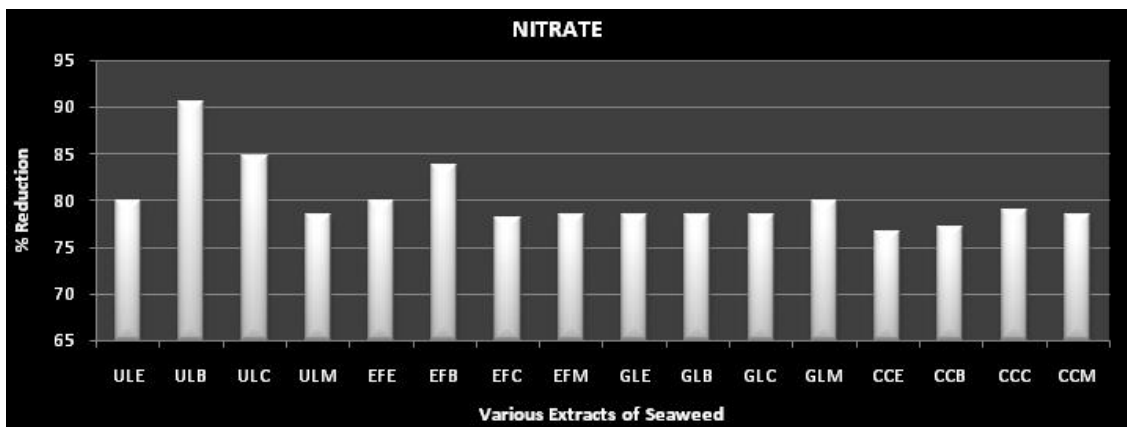


Figure 5: Effect of algal extracts on nitrate content

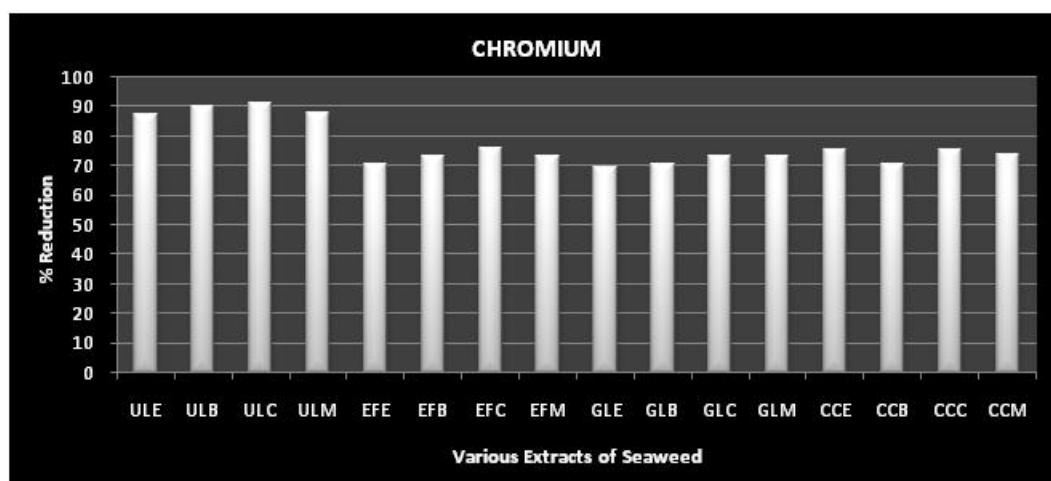


Figure 6: Effect of seaweed extracts on chromium in effluent sample

Nitrate

High nitrate level in drinking water causes blue baby syndrome. In this study, 91% of Nitrate content (Fig.5) was reduced by benzene extract of *U.lactuca* which was higher than the use of ethanolic extract of *P.juliflora* (80%).²⁴

Chromium

Hexa-valent chromium is highly toxic. Chromium was highly reduced by chloroform extract of *Ulva sp.* (91%)(Fig.6) Benzene extract of *U.lactuca* also reduced chromium (90%) present in effluent. It is comparatively higher reduction than the use of benzene extract of *Prosopis juliflora* (58%) for treating leather effluent.²⁴ It is also higher than the used black tea as an adsorbent (75%) (Kim et al., 2012).

CONCLUSION

Reduction of harmful chemicals by the extracts of various macro algae was investigated. Among all, extracts of *U.lactuca* showed significant reduction of chemicals present in the leather effluent. Further more studies may be carried out for the reduction of other chemical constituents present in tannery effluent.

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