6

SUMMMARY AND CONCLUSION

- The algal species selected for the study was identified as *Sargassum wightii*.
- The brown seaweed, *S. wightii* proved its potency for BG dye biosorption from aqueous solution. The effect of different parameters such as the adsorbent dosage, pH, initial dye concentration and temperature were studied.
- An optimization study showed that maximum biosorption occurred at lower biomass dosage (0.1g), 7 of pH at 35° C.
- BG dye adsorption decreased with an increase in the initial dye concentration and a maximum removal percentage obtained was 94%.
- The consequence of equilibrium adsorption was successfully described through the Langmuir isotherm for the biomass.
- Kinetic models were also examined and the pseudo-second- order was found to be the applicable kinetic model in the present study.
- Thermodynamic analysis shows that biosorption follows an exothermic path of the negative value of ΔH^o and spontaneous with positive value of ΔG^o.
- The physico-chemical analyses of the untreated and treated brilliant green dye showed a major difference. Physicochemical parameters of untreated BG dye values were exceeded the BIS permissible limits whereas treated dye values were within the BIS permissible limits.
- UV- Vis Spectroscopy indicated the intensity of absorption spectra was reduced considerably after absorption.
- FT-IR analysis confirmed the role of different surface functional groups for the sorption of BG dye.

- SEM photographs clearly indicated the porous and fibrous texture of the biosorbent with high heterogeneity that could contribute to the biosorption of the dye.

- EDX analysis showed variation in the elemental quantity and various elements were identified from biomass before and after the adsorption.

- Hydrochloric acid (0.1M) was found as the most powerful desorbing agent (82.92%) under optimized conditions of 7 of pH at 35 °C was mixed with 100 mL of the desorbing medium and it was agitated at 150 rpm at 30 ºC for 30min. Although HNO_3 (47.78) and CH_3COOH (49.42%) showed minimum rate in desorption compared to HCl, they too performed as powerful desorbing agents as well.

- NaOH is a strong base that has been widely used as a desorbing agent in desorption process but it was precipitated.

- Re- usage efficiency of the desorbed biomass was studied and the dye removal was reached 61% under optimimum conditions.

- The toxicity studies confirmed that the decolorized BG dye does not have any inhibitory effect which reveals the nontoxic nature of the treated dye.

- Phytotoxicity study reveals the treated BG dye could be valorized as an excellent nutrient rich source for agricultural practices. The germination percentage, root length, shoot length, vigour index, tolerance index, % of phytotoxicity, plant fresh weight, plant dry weight, No. of leaves, total leaf area, seed dry weight, no. of root nodules and number of fruit yield was significantly higher in control (T1) and *S. wightii* treated BG (T3) dye irrigated plants of black gram when compared to T2 (untreated BG dye).

- In this study, untreated dye which has substantial amount of the dye (colour) in it, exhibited significant toxic effect against major gram positive and gram negative bacteria. The clear zone of inhibition exhibited by the untreated dye around bacterial and fungal colonies reflects its extent of microbial toxicity and infers that

the untreated dye has anti-bacterial and anti-fungal activity. No inhibition zones were observed with *S. wightii* treated dye when compared with the untreated dye. Consequently, the treated dye does not exhibit microbial toxicity due to the complete absence of the dye in it.

- Cytotoxicity study on *Allium cepa* grown in untreated dye solution showed decrease in root growth and mitotic index, increase in the mitotic depression and chromosomal damage. Whereas *Allium cepa* bulbs grown in *S. wightii* treated dye showed betterment in root growth, increase in the mitotic index, decrease in mitotic depression and chromosomal damage. Results of the cytotoxicity study indicated the untreated dye solution exerts toxic effect on *Allium cepa* whereas *S. wightii* treated dye solution did not pose any toxic effect.

- The mortality percentage, haematological parameters (RBC, WBC, haematocrit and haemoglobin), biochemical (plasma protein and glucose) and enzymes (plasma GOT, GPT, LDH and GSH) in control and *S. wightii* treated BG dye was significantly each other which depicts that the less toxic nature of degradation product. In contrast, the high level was observed in fish exposed to untreated BG dye which infers the toxic nature of brilliant green dye. Extensive histopathological lesions in gill, liver and kidney tissues were observed in untreated BG dye compared to fishes grown in control and *S. wightii* treated BG dye might be due to the stress caused by toxic presence in dye.

- The study showed that pH, temperature, contact time and adsorbent dose play a major role in adsorption of textile effluent by *Sargassum wightii*.

- Percentage adsorption increased with increase in pH and maximum was obtained at pH 6 (65%). Above pH 7 the adsorption percentage was gradually decreased and recorded 45% at pH 10.

- An increase in temperature showed an initial increase in adsorption percentage and maximum adsorption was recorded at 35ºC (49%).

- The effect of contact time on colour removal was observed from 1-7 days and was rapid in the first 5 days and after 5th day the amount of dye removal was almost constant.

- The effect of bisorbent dose (0.1-0.6g) on the biosorption of dyes indicated maximum dye removal at 0.3g (69%) biosorbent dose. Adsorption efficiency decreased with further increase in the biosorbent dose.

- Physicochemical analyses revealed a major difference between treated and untreated textile effluent.

- The untreated textile effluent showed the presence of colour with objectionable odour, high electrical conductivity, high TSS, TDS values, alkaline pH, high BOD and COD, low DO, high amounts of chlorides and sulphates, nitrates and also showed the presence of heavy metals, oil and grease.

- After treatment the effluent became colourless and odourless and recorded a decrease in all the analyzed physical and chemical parameters.

- In comparison with BIS limits it was found that the parameters exceeding the prescribed permissible limit are TSS, TDS, pH, BOD, COD, chlorides, nitrates, lead, zinc, copper, oil and grease for raw effluent, whereas the treated effluent recorded all these parameters within the permissible limit.

The present study concluded that the utilization of brown marine macroalga could be a good alternative and could drive the current expensive methods for the removal of dyes from aqueous solution and effluent. Bioremediation integrates the intensity of pollution and environmental effects, forms a major research outcome. By responding to the bioavailable concentration of a pollutant, they measure its impact on the environment more accurately. This is vital in assessing the environmental clean-up. *S. wightii* treated dye could have integrated with decolourization and revealed that it does not lead to detoxification of the dye whereas untreated dye reflected its extent of toxicity on plants, microbes and fishes. Thus the reduction in toxic effect of *S. wightii* treated dye decreases the environment damage.