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Biodecolorization Of Reactive Dyes By Spirogyra sp. & Oscillatoria sp.

Dr.N.H.Brahmbhatt[1] , Dr.R.T.Jasrai[2]

[1]V.P & R.P.T.P Science College, V.V. Nagar, Anand,

Associate Professor

E mail: naina_bbhatt@yahoo.co.in

[2] R K Parikh Arts & Science College, Petlad

Associate Professor

E.mail: rtjasrai@yahoo.com

Abstract- In recent years the ability of microorganisms on decolorizing of textile wastewater has received much attention due to the environmental persistence and toxicity of these pollutants. In this paper biodegradation of Blue dye and Red dye, by Spirogyra species and Oscillatoria species were investigated. The results obtained from batch experiments revealed the ability of the algal species in removing the dye. The effects of operational parameters include different algal biomass & effect of pH on decolorization efficiency were examined. All assays were conducted in duplicates.

Keywords— Biodegradation; Bluedye; Decolorization; Oscillatoria sp.; Red dye; Spirogyra sp.;.

1 INTRODUCTION

Water is life but now a-days due to the advancement in industrialization, it is spoiling a lot. Many contaminants present in wastewater, such as acids, bases, toxic organic and inorganic dissolved solids, and colors. Among them, colors are considered the most undesirable and are mainly caused by dyes [1]. Presence of colour and its causative compounds has always been undesirable in water used for either industrial or domestic needs. Different colouring agents like dyes, inorganic pigments, tannins, lignins etc. usually impart colour. Amongst complex industrial wastewater with various types of colouring agents, dye wastes are predominant [2]. This wastewater not only toxic to the biological world, but it also has a dark colour, which blocks sun light. By these reasons, it causes many problems to the ecosystem [3]. The number of dyes presently used in textile industry is about 10,000. Among these dyes, Blue dyes and Yellow dyes constitute the largest and the most important class of commercial dyes. Both dyes are widely used in textile, plastic, leather, and paper industries as additives. The removal of both dyes in aquatic environment is important because some types of dyes are toxic to aquatic organisms .

The processes such as ozonation, photooxidation, electrocoagulation, adsorption, activated carbon, membrane filtration and flocculation are applied for color removal from textile effluents. Such methods are often very costly and although the dyes are removed, accumulation of concentrated sludge creates a disposal problem. There is a need to find alternative biodegradations that are effective in removing dyes from large volumes of effluents and are low in cost such as biological or combination systems [9][10].

In recent years a number of studies have focused on some microorganisms, which are able to biodegrade, and biosorb dyes in wastewaters. A wide variety of microorganisms capable of decolorizing a wide range of dyes include some bacteria: *Escherichia coli* ; *Pseudomonas luteola*; *Aeromonas hydrophila*; *Kurthia* sp.; fungi: *Aspergillus niger* ; yeasts: *Saccharomyces cerevisiae*, *Candida tropicalis*, *C. Lipolytica* ; algae: *Spirogyra* sp.; *Chlorella vulgaris*.[6][7][10][8][17]

Algae are microscopic, photosynthetic organisms, which typically inhabit aquatic environments, soil and other exposed locations. So, the present study aims to investigate the potential of the spirogyra sp. and oscillatoria sp. for decolorization of the solution containing a textile dye. The effect of operational parameters on biodegradation of Blue dye and Red dye was also studied.

2 Materials and Methods

2.1 Algal Biomass

The algae obtained from natural lake. According to its morphology and microscopic observations. It is identified as Spirogyra sp. and Oscillatoria sp. belonging to green algae and blue green (brown green).Fig,(10,11) shows the microscopic image of both algal sp.

2.2 Growth medium

BBM (Bold's basal medium) and BG 11 (Blue Green 11) used for Spirogyra sp. and Oscillatoria sp. Both species was grown in several 1-l glass jars containing medium (modified Bold basal medium AND BG 11 medium) in order to obtain stock algal culture to be used during the experiments.

2.3 Dye analysis

Dye analysis was performed at Green Circle, Inc, Research lab. At Baroda [Recognized By Ministry of Environment and Forests. New Delhi under EPA 1986 and GPCB approved Environmental Auditor – (Schedule - 2)].Table (1) shows the analysis report of both dye.

The Blue dye & Red dye used in this study. The absorbance was measured with a spectrophotometer at the maximum absorption wavelengths (λmax=619 nm). Decolorization was determined by absorbance reduction. The dye concentration in mg per liter was determined from absorbance calibration curve of standard solutions. The efficiency of color removal was expressed as the percentage ratio of the decolorized dye concentration to that of initial one (Eq. 1).

$$\text{Percentage of decolorization} = \frac{\text{Initial absorbance} - \text{Final absorbance}}{\text{Initial absorbance}} \times 100$$

....eq.1

2.4 Batch decolorization operation

The experiments were conducted in 250 ml Erlenmeyer flasks containing 100 ml of respective dye solution. The effect of different algal biomass as well as pH were studied to know the decolorization efficiency. The experiments were operated at static incubation.

3 Figures and Tables

Table 1 Dye analysis report

SR. NO	PARAMETER	UNIT	BLUE DYE	RED DYE
1	PHYSICAL APPEARANCE	-	BLUE COLORED TURBID LIQUID WITH TOO MUCH SUSPENDED PARTICLES AND ODORLESS	BROWNISH RED COLOR LIQUID WITH VERY FEW SUSPENDED PARTICLES AND COLORLESS
2	PH	-	7.68	7.23
3	COLOR	UNIT	7.6	20.6

4	TOTAL SUSPENDED SOLID	MG/L	460	56
5	TOTAL DISSOLVED SOLID	MG/L	3984	13036
6	BIOCHEMICAL OXYGEN DEMAND (3 DAYS AT 27 ^{O}C)	MG/L	206	723
7	CHEMICAL OXYGEN DEMAND	MG/L	960	2640
8	CHLORIDE AS CL^{2-}	MG/L	840	3480
9	SULPHATE AS SO_4^{2-}	MG/L	240	708
10	TOTAL CHROMIUM AS CR	MG/L	BDL	0.76
11	COPPER A CU	MG/L	0.84	0.56
12	IRON AS FE	MG/L	0.52	1.26
13	MANGANESE AS MN	MG/L	1.02	0.27
14	NICKEL AS NI	MG/L	0.26	1.60

BDL=Below Detectable Limit

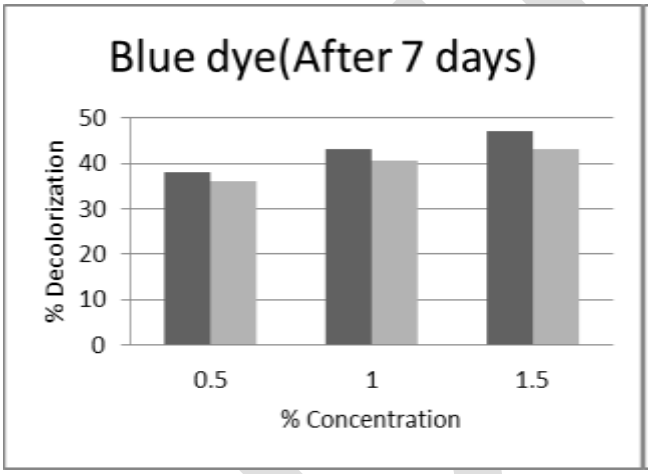

Figure 2

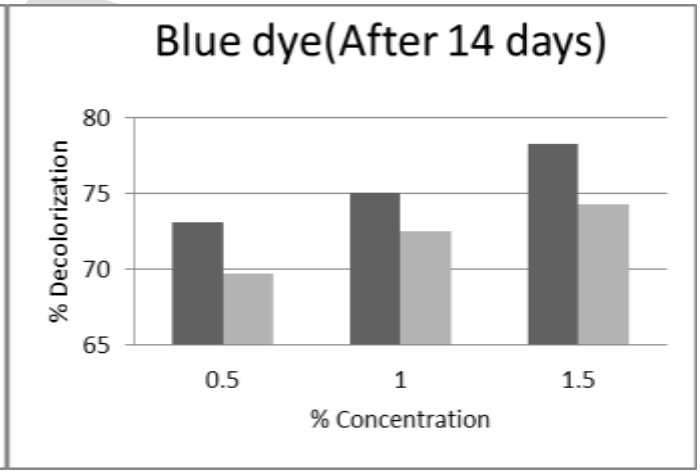

Figure 3

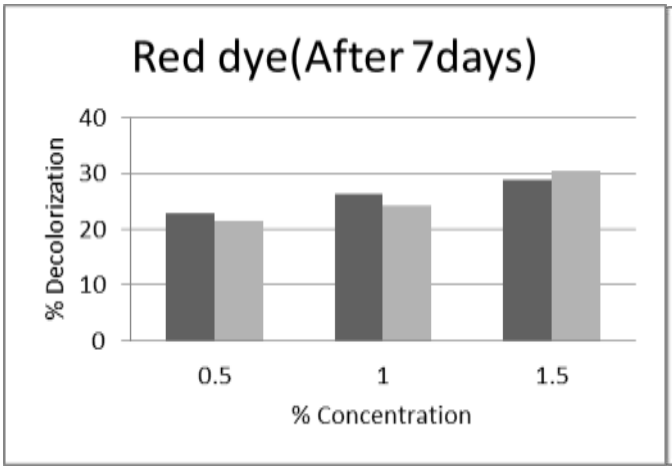

Figure 4

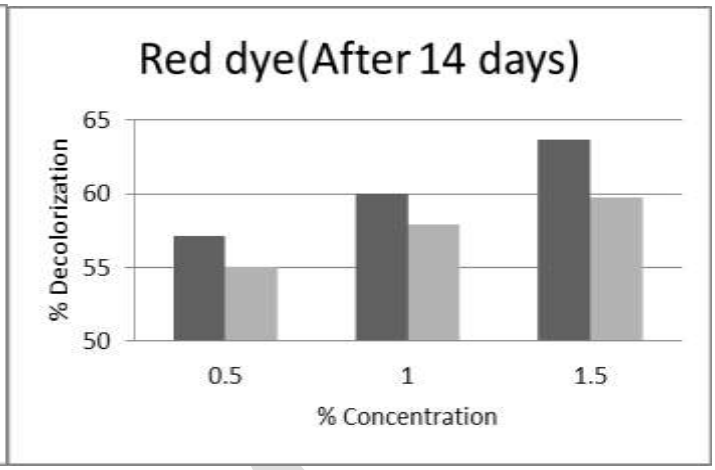

Figure 5

Above figure shows the effect of Diff. concentration of Algal biomass on Decolorization of dyes by Spirogyra sp. & Oscillatoria sp.

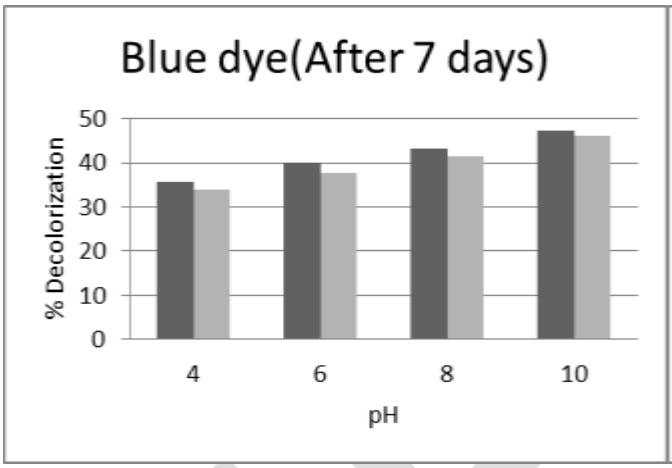

Figure 6

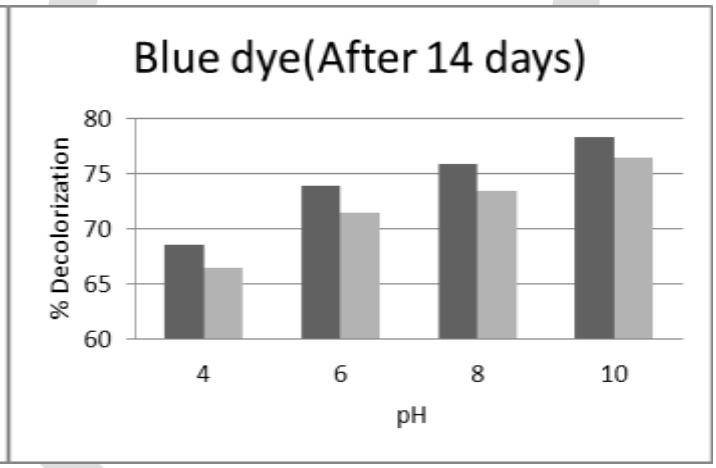

Figure 7

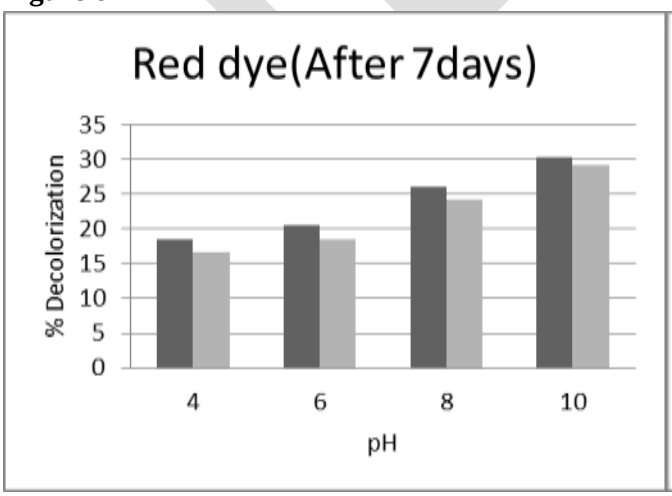

Figure 8

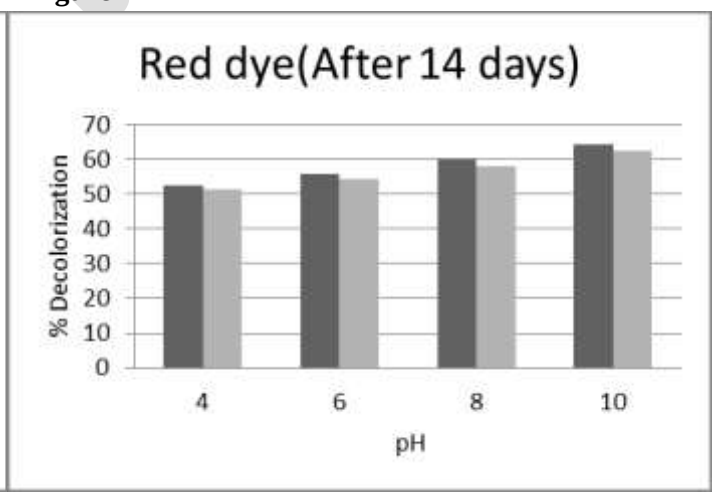

Figure 9

Above figure shows the effect of Diff. pH on Decolorization of dyes by Spirogyra sp.& Oscillatoria sp.

Figure 10

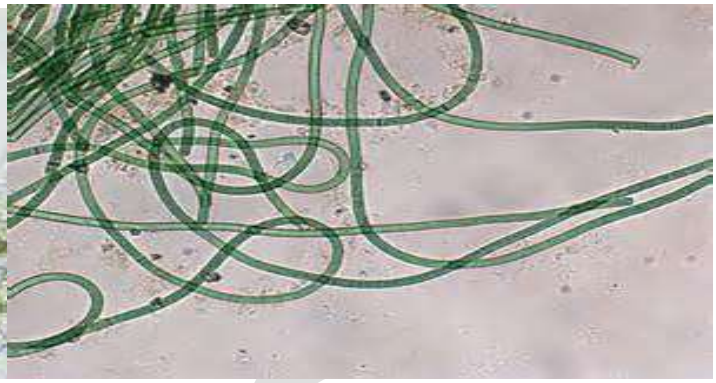

Figure 11

4 Results

Figures (2-5) shows % decolorization of Blue dye and Red dye by different algal biomass (0.5 %,1.0 % & 1.5 %). There was an increased in the decolorization rate with an increase time duration. The results obtained from present investigation revealed the ability of Spirogyra sp. and Oscillatoria sp. in biodegradation of both dyes. The 1.5 % algal concentration of Spirogyra and Oscillatoria sp. showed about78.28% and 74.30 % decolorization of blue dye in 14 days duration. Where as in case of red dye, 63.68 % and 59.73% decolorization were monitored by Spirogyra sp. & Oscillatoria sp. respectively for the same period

The pH of the solution significantly affects the adsorption of dyes by algal biomass. Figures (6-9) shows % decolorization of Blue dye and Red dye by adjusting the pH at 4,6,8 & 10 respectively. At pH 10, the more effective dye adsorption capacity of algae was observed. At pH 10, Spirogyra sp. and Oscillatoria sp. showed about 78.29% and 76.48 % decolorization of blue dye in 14 days duration. Where as in case of red dye, 64.21 % and 62.63 % decolorization were monitored by Spirogyra sp. & Oscillatoria sp. respectively for the same period

5 Conclusion

In this research study it has been found that the Spirogyra sp. and Oscillatoria sp. are an easily available aquatic algae and has sufficient biodegradation potential for removing blue dye and Red dye from its aqueous solution under optimized conditions of temperature 33-40°C. It has been also found that Spirogyra sp. has more potential to phytoremediate than Oscillatoria sp. Whereas with increasing pH Spirogyra sp. Shows better decolorization than Oscillatoria sp. Keeping in view of this research study, concludes that both species of algae can be used for removing blue and yellow dye from its aqueous solution. Knowledge from present work may be employed on large scale at actual contamination sites. Our future study aims to find out the mechanism of this biodegrdation of blue dye and yellow dye by Spirogyra sp.and Oscillatoria sp.

6 Acknowledgements

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