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UTILIZATION OF ALGAE IN PURIFICATION OF WASTEWATER

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Abstract-With the increase in the number of industries the generation of high strength wastewater has been noticed now days. There are so many researches going on the purification of wastewater. A newly developed wastewater treatment by using the different species of algae is gaining much importance. The present study is to investigate efficiency of algae in treatment of wastewater. The algae selected for the treatment of wastewater was chlorella Vulgaris species. The various characteristics of wastewater like Biological oxygen demand (BOD), Chemical oxygen demand (COD), turbidity, pH, Total dissolved solid (TDS) was checked initially and was also observed by using the chlorella Vulgaris species of algae. It was observed that the percentage reduction rate of different parameters of wastewater was: BOD-92.42%, COD-86.95%, TDS-75%, and Turbidity-70%. The result observed shows the potential of chlorella Vulgaris species of algae for treating the wastewater. The use of different species of algae for the treatment of wastewater is economical and is also found environmentally safe alternative for treating wastewater.
Keywords: Algae, Wastewater, BOD, COD, TDS, pH, Turbidity.

1. INTRODUCTION

Water is one of the major products of nature used mainly by human beings and it is not unnatural that any growing community generates enormous waste water or sewage [2]. As a clean environment is a prerequisite for a healthy living in any urban settlement, proper treatment and safe disposal of sewage is a prime attention [1]. Untreated waste water can cause pollution of surface and ground waters. Many new developments in the field of sewage treatment are eventually taking place [7]. These developments include improvements for more effective removal of pollutants and new treatment processes capable of removing pollutants not ordinarily removed by conventional methods. One such method with enormous potential is the use of biological catalyst process involving free cells [11].

Waste water treatment is gaining much more importance in recent years with the intension of reusing it. Purification of wastewater by using algae is one of the methods which is gaining more importance now a days. It is a cheap and easy method for the purification of wastewater [4].The algae species selected should have good purifying capacity of wastewater which can be used for treatment of wastewater. The different species of algae that are taken into for purifying the waste water are Brotryococcus Brounii sp., Ulva sp., Chlorella sp., Cladophora sp [3]. Amongst all of these species the Chlorella species is the most active bacteria that has the most purifying capacity for the treatment of wastewater.

2. MATERIALS AND METHODS

2.1 Selection of wastewater -

The wastewater which was used for the treatment was collected from Nag River (Nagpur Municipal Corporation) which was containing very high impurities. The composition of the inlet waste water is shown in Table 1. and the different parameters like Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), Turbidity, pH were conducted so that the level of impurities can be reduced to reuse the waste water.

Table 1: Range of Composition of Inlet Wastewater provided by NMC

Parameters	At inlet
BOD	300 mg/l
COD	600-900 mg/l
TDS	900-1500 mg/l
Turbidity	150 – 250 NTU
pH	6 - 8.5

2.2 Selection of Algae -

For the present study freshwater algae such as Chlorella Vulgaris was taken for the treatment of wastewater. Chlorella Vulgaris was collected from Shobhadevi Vidyalaya, Gondia. Algae of suitable amount was collected in cans and washed thoroughly with tap water and placed in the photo bioreactor by adding nutrients like phosphate, nitrate and ammonia for a time period of 21 days for the growth of the algae.

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2.3 Procedure -

The algal species is fed in the rectangular tank. The wastewater sample of about 2.5 liters was fed into the rectangular feed tank. The feed tank contains mat of grown algae. Each algae of initial dosage 20 g was fed to the reactor. Then the operating parameters were varied to find the optimum condition.

2.4 Optimization of number of days –

The wastewater was fed to the reactor containing 20 g of algae. No pH adjustment was made. Before adding wastewater in feed tank the initial parameters of wastewater are checked. The initial parameters of wastewater are compared with the parameters given by NMC. Then after 8 and 14 days samples were collected and analyzed for the various parameters like pH, TDS, Turbidity, BOD, and COD after addition of algae species.

pH: pH is measured by electromotive method. pH is determined by measurement force of a cell comprising an indicator electrode responsive to hydrogen ions such as glass electrode, contact between the test solution and the reference is usually achieved by means of a liquid functions which forms apart of reference electrode. It is measured by pH meter.

TDS: Ignite the clean evaporating dishes in the muffle furnace for 30 min at 550^0 c and then allow the dish to cool completely. Note down the empty weight of dish (W_1). Filter the measured portion of the mixed sample in a previously prepared and weighted evaporating dish. Transfer the dish to an oven maintained at either 103^0c to 105^0c and dries it for 24 hours. Allow the dish to cool completely and then weight the dish as soon as it has completely cooled (W_3). Weight of residue = (W_3-W_1) mg which gives the amount of total dissolved solids present in the sample.

Turbidity: Nephelometer method of turbidity measurement is based in a comparison of the intensity of light scattered by the sample under defined condition with the intensity of light scattered by a standard reference suspension under the same conditions. Higher the intensity of scattered light higher is the turbidity. Turbidity meter with a tungsten filament lamp as a light source for illuminating the sample and a photoelectric detector with a read out device is a system used for turbidity measurement by turbid meter. Meter is designed to prohibit stray light reaching to detector. Short warm period is necessary to make the instrument free from significant drift. Clear colorless glass tube is used for sample.

B.O.D: First samples are prepared in BOD bottles (300 ml) by adding the following chemicals-

- 2ml $MnSO_4$ + 2ml Alkali-iodide – azide + stopper immediately.
- Mix well + allow the ppt. to settle.
- Add 2ml concentrated H_2SO_4 + mix well till ppt. dissolve.
- Take 203 ml (correspond to 200ml) sample in a conical flask.
- Titrate against sodium thiosulphate (0.025N) till pale yellow colour appears and then add starch solution which gives blue colour. Then titrate again till the solution becomes colourless.

The dissolved oxygen content at the initial day and after five days are found out with the help of BOD incubator and the difference between the two gives the required BOD of the sample.

COD: Sample is prepared by adding 0.4gm $HgSO_4$, 5ml waste water sample, 15ml distilled water, 10ml of $K_2Cr_2O_7$ and the solution is stirred well to get properly mixed. Then 30 ml of COD acid is added drop wise. Reflux the solution at 25 to 30^0 c for 2 hours. Then cool at room temperature. Then add 90 ml of distilled water in it. Titrate the above mixture with 0.1 N ferrous ammonium sulphate solution using ferroine indicator (2 to 3 drops) till the colour change from bluish green to wine red. Then we perform a blank experiment with distilled water instead of the water sample and the difference between them gives the COD of sample.

3. RESULTS AND GRAPHS

Table 2: pH Values

Time in Days	Initial	After 8 days	After 14 days
pH	6.8	7.26	7.75

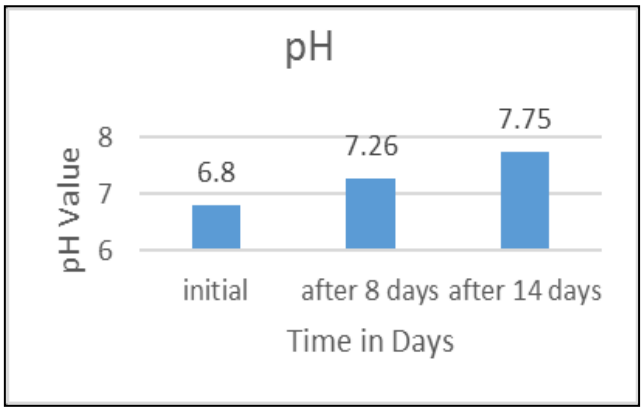

Fig 1: Comparison of pH Values

Table 3: Total Dissolved solid Values

Time in Days	Initial	After 8 days	After 14 days
TDS	1600	800	400

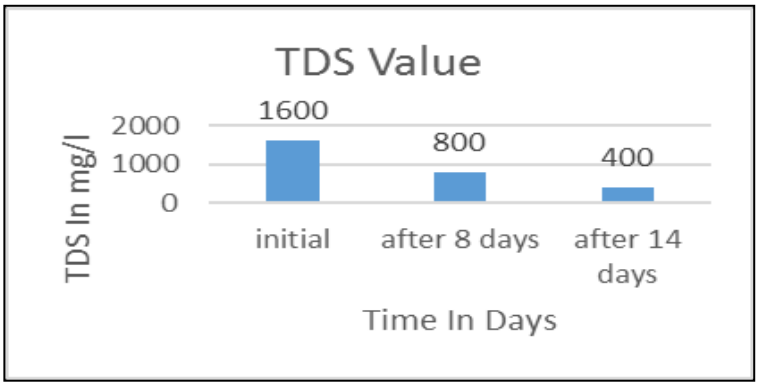

Fig 2: Comparison of Total Dissolved solid Values

Table 4: Turbidity Values

Time in Days	Initial	After 8 days	After 14 days
Turbidity	140	62	42

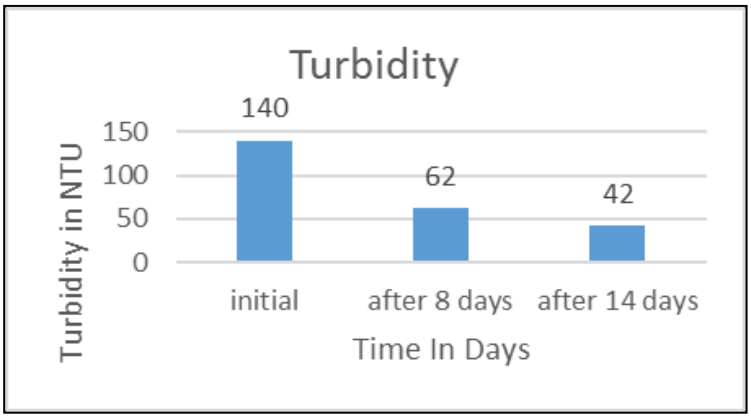

Fig 3: Comparison of Turbidity Values

Table 5: BOD Values

Time in Days	Initial	After 8 days	After 14 days
BOD	316.5	84	24

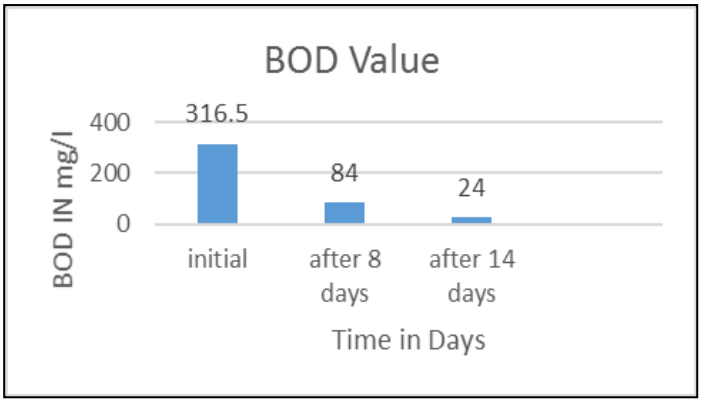

Fig 4: Comparison of BOD Values

Table 6: COD Values

Time in Days	Initial	After 8 days	After 14 days
COD	736	208	96

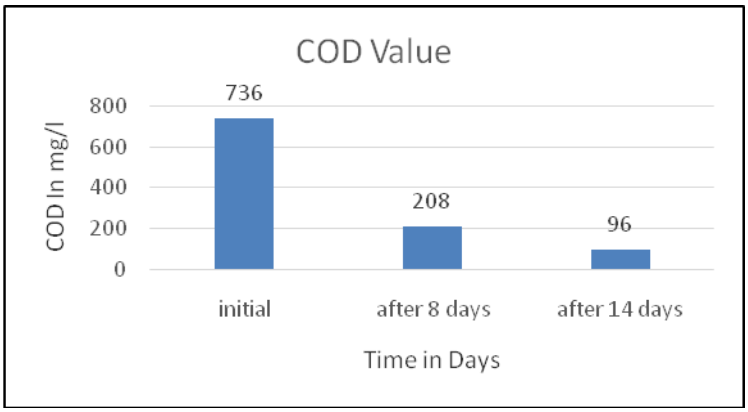

Fig 5: Comparison of COD Values

4. CONCLUSION

The test results shows that after treatment of wastewater with chlorella vulgaris a maximum of 92.42% (BOD), 86.95% (COD), 75% (TDS), 70% (Turbidity) removal and pH changes from acidic to alkaline. After 14 days of treatment the wastewater can be used for the purpose of irrigation. This could be one of the good treatment techniques for purification of wastewater as it is cheap and easier than other process.

Table 7: Comparison of Results different parameters of Waste water with CPHEEO Manual

PARAMETERS	Initials	After 8 Days	After 14 Days	For Irrigation Purpose as per CPHEEO	Reduction in % after 14 days
pH	6.8	7.26	7.75	6.5 - 8	-
TDS in mg/l	1600	800	400	< 450	75%
Turbidity in NTU	140	62	42	< 45	70%
BOD in mg/l	316.5	84	24	< 30	94.20%
COD in mg/l	736	208	96	< 100	86.95%

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