International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 08 | Aug 2021 www.irjet.net p-ISSN: 2395-0072

# Nitrate Removal from Wastewater using Different Algae

**Swathi Krishna [1], Varsha Ashokan[2]**

[1]*M Tech Student, Department of Civil Engineering, MDIT Engineering College, Kerala, India*
[2]*Assistant Professor, Department of Civil Engineering, MDIT Engineering College, Kerala, India*

---

**Abstract –** *This paper focused on the nitrate removal from wastewater using different algae. The algae used in this study is Green (Spirulina)and Red algae (Batrachospermum). The domestic waste water which is generating from households is to be treated before discharging into environment to prevent severe health problems. The waste water contains excess amount of nitrate and phosphate present in them. The excess nitrate in water also leads to river eutrophication, excess growth of plants. The dye industry is the major source of textile processing hence it contains huge amount of waste containing nitrate , phosphate, BOD, COD, TDS etc. This work is for the use of bio absorbent in different waste water to achieve the task by using spectrophotometer. The algae benefits in the removal of BOD, COD, TDS, ph, nitrate, phosphate.*

***Key Words***: **Nitrate, Green algae, Spectrophotometer, TKN, BOD, COD**

## 1.INTRODUCTION

This Population growth, industrialization and rapid Urbanization have led to excessive Nitrogen pollution to, often in the form of nitrate, presenting a water quality problem of growing concern. Excessive fertilizer use in urban and agricultural regions have caused serious problems of nitrate and phosphate pollution in surface water5s, ground waters and the marine environments. Although nitrate is one small component of the nitrogen cycle, the focus of this review is nitrate assimilation by algae. Ground water contaminated with nitrate above the United States Environmental Protection Agency (USEPA) and World Health Organization (WHO) maximum level is 10 mg/l must be treated before use as drinking water. Europe also set a maximum of 12mg/l in drinking water for the same concern. Methods for nitrate and nitrite removal in water resources are a controversial issue that has attracted a good deal of attention. Generally, there are two basic types of treatments for removing nitrate from waste water or water : Physicochemical methods include Reverse Osmosis (RO), Ion Excahnge (IE), Electro Dialysis (ED) and activated carbon adsorption in conjunction with ph adjustment. While IE and RO are well developed, both area energy intensive processes and are not highly efficient, producing bbrine waters that are frequently discharged into adjacent waterways. Recently researchers have developed new methods for nitrate removal, including metallic iron aided abiotic nitrate reduction (also known as zero valent iron or ZVI)Many have sought biological solutions to cost effective and sustainablre treatment processes that can be as effective as the conventional physico chemical processes. A variety of biological methods are available for the denitrification of surface and ground waters based on plant and microbial metabolic processes. The best described mechanisms are assimilation of nitrate by plants , algae and microbes and microbial respiratory denitrification where nitrate and its reduction products serve as alternate electron acceptors under anaerobic conditions resulting in the conversion of nitrate to $N_2$ Gas reduction. The chlorophyta or green algae consist of 7000 series, most of which occurs in freshwater and some in marine environments. Spirulina is a biomass of cyanobacteria that can be consumed by human and animals. Green algae benefit wastewater treatment by producing oxygen that allows aerobic bacteria to breakdown organic contaminants in the water and taking up excess nitrogen and phosphorus in the process. Red algae can be used in wastewater treatment for a range of purpose, some of which are used for removal of coliform bacteria, reduction of both chemical and biochemical oxygen demand, removal of nitrate and phosphate and also for the removal of heavy metals. Red algae are common and mainly represented by the genera Galaxaura, Jaina, and Amphiroa as well as by many species of the order Ceramiales and Crustose genera ( Peyssonnelia , Litophyllum and Mesophyllum Bactrachospermum is a red algae found in streeams and springs throughout the world.

### 1.1 Objectives

- The aim of the project is to study the effectiveness of both green and red algae in the removal of nitrate and other parameters present in domestic and dye industry waste water.
- To conduct further studies on the collected wastewaters with the most efficient algae and to plot the corresponding graphs.

### 1.2 Scope of the Study

Water treatment is an important process in which has high influence in industrial, domestic, and commercial purpose. It is important to reduce the daily intake of nitrogen content so as to avoid diseases. Bio-adsorbent have bright future and concerned by many researches because of their,

- Low price

- Environmental friendly
- Biodegradable
- Abundant source

## 2. MATERIALS AND METHODOLOGY

### I. COLLECTION OF DYE INDUSTRY AND DOMESTIC WASTE WATER

The dye effluent was collected from kanhirode weavers, Kannur which is a major pollution facing by the people. About 6L of waste water was collected in polyethylene cans from the dye industry. The domestic wastewater was collected from home itself, about 6L were collected.

### II. DETERMINATION OF VARIOUS PARAMETERS OF THE COLLECTED SAMPLES

The dye and domestic waste water was collected and the different water quality parameters were analyzed from the water laboratory.

- Ph
- BOD
- COD
- Nitrate
- Phosphate
- TDS

### III. COLLECTION OF GREEN, RED ALGAE

In this study I focused on the different types of algae that is red and green algae used in the entire treatment of both domestic and dye waste waters. The green, red algae is a locally available material. It is used as a bio-adsorbent in removing various parameters from wastewater. It is collected from the CMFRI west hill. 5 grams of algae is added to 1L for culture.

### IV. CULTURE OF COLLECTED ALGAE

Take sterilized cans and fill half to two-third of the bucket with distilled water. Add the Spirulina & Red Algae culture into the water in the can with a spoon. Also add urea fertilizer as a nutrient for the growth of algae. Place the bucket on a sunny spot inside, near a windowsill is perfect. Also attach a thermometer to monitor the temperature of the water in the cans.

### V. TREATMENT OF BOTH WASTEWATERS BY GREEN , RED ALGAE

Taken, cleaned polyethylene can and filled with 500ml distilled water and 500ml domestic waste water.5g of green, red algae of required quantity is added to the solution of distilled water and domestic waste water.It is kept or aeration process for 5, 10, 15 days. The sample is taken and filtered with Whattsman 45 filter paper and the parameters are analyzed after 5, 10, 15 days.The same treatment is done for the dye waste water.

### VI. DETERMINATION OF VARIOUS PARAMETERS AFTER TREATMENT

It is necessary to determine the parameter before and after treatment process. The domestic waste water and dye waste water is treated using both green and red algae after 5 days, 10 days and 15 days. The parameters like pH BOD, COD, TDS, nitrate and phosphate were determined in the water lab.

## 3. RESULTS AND DISCUSSION

The preliminary analysis were done on collected samples of domestic and dye industry waste water.

**Table -**1 Preliminary test result table.

| SI NO | Parameter | APHA Method | Unit | Domestic | Dye |
|---|---|---|---|---|---|
| 1 | pH | 4500 H+B | **mg/l** | 7.13 | 11.2 |
| 2 | TDS | 2540 C | mg/L | 103 | 10706 |
| 3 | COD | 5220 B | mg/L | 315 | 11380 |
| 4 | BOD | 5210 B | mg/L | 195 | <2 |
| 5 | Nitrate | 4500 $NO_2B$ | mg/L | 24.9 | 32 |
| 6 | Phosphate | 4500 P.C | mg/L | 0.28 | 1.38 |

Analysis done after 15 days of aeration with red algae and the obtained values are given in the table below.

**Table 2:** Analysis after 15 days of aeration with red algae.

| SI NO | Parameter | APHA Method | Unit | Domestic | Efficiency (Domestic) | Dye | Efficiency (Dye) |
|---|---|---|---|---|---|---|---|
| 1 | pH | 4500 H+B | - | 7.02 | 0 | 11.0 | 1.78 |
| 2 | TDS | 2540 C | mg/L | 79 | 23.30 | 94884 | 11.41 |
| 3 | COD | 5220 B | mg/L | 196 | 37.77 | 9811 | 13.66 |
| 4 | BOD | 5210 B | mg/L | 56 | 71.28 | <2.0 | - |
| 5 | Nitrate | 4500 $NO_2B$ | mg/L | 18.6 | 25.30 | 29.6 | 7.5 |
| 6 | Phosphate | 4500 P C | mg/L | <0.05 | - | 1.24 | 23.18 |

Analysis done after 15 days of aeration with green algae and the obtained values are given in the table below.

**Table 3:** Analysis after 15 days of aeration with green algae.

| SI NO | Parameter | APHA Method | Unit | Domestic | Efficiency (domestic) | Dye | Efficiency (Dye) |
|---|---|---|---|---|---|---|---|
| 1 | pH | 4500 H+B | - | 7.13 | 1.54 | 10.8 | 3.57 |
| 2 | TDS | 2540 C | mg/L | 52 | 49.51 | 9011 | 15.83 |
| 3 | COD | 5220 B | mg/L | 177 | 43.80 | 9825 | 13.78 |
| 4 | BOD | 5210 B | mg/L | 49 | 74.871 | <2.0 | - |
| 5 | Nitrate | 4500 $NO_2B$ | mg/L | 14.1 | 43.37 | 28.1 | 12.18 |
| 6 | Phosphate | 4500 P C | mg/L | <0.05 | - | 1.06 | 10.14 |

Green algae are more efficient when compared to red algae so increasing the concentration analysis was conducted for 5 days. The impact of both algae on dye wastewater is very less and hence further study was conducted on domestic wastewater.

**Table 4: Result** Analysis for domestic waste water.

| SI NO | Parameter | APHA Method | Unit | 10%↑ | 20%↑ | 30%↑ | 40%↑ | CPCB Disposal Guidelines |
|---|---|---|---|---|---|---|---|---|
| 1 | pH | 4500 H+B | - | 7.29 | 7.31 | 7.36 | 7.49 | 5.5 – 9.0 |
| 2 | TDS | 2540 C | mg/L | 71 | 63 | 59 | 55 | No Limit |
| 3 | COD | 5220 B | mg/L | 238 | 166 | 117 | 92.4 | 250 |
| 4 | BOD | 5210 B | mg/L | 65 | 47 | 32 | 26 | 30 |
| 5 | Nitrate | 4500 $NO_2B$ | mg/L | 16.7 | 12.3 | 11.2 | 9.92 | No Limit |
| 6 | Phosphate | 4500 P.C | mg/L | <0.05 | <0.05 | <0.05 | <0.05 | No Limit |

**Domestic wastewater with different concentration after 5 days of treatment with green algae**

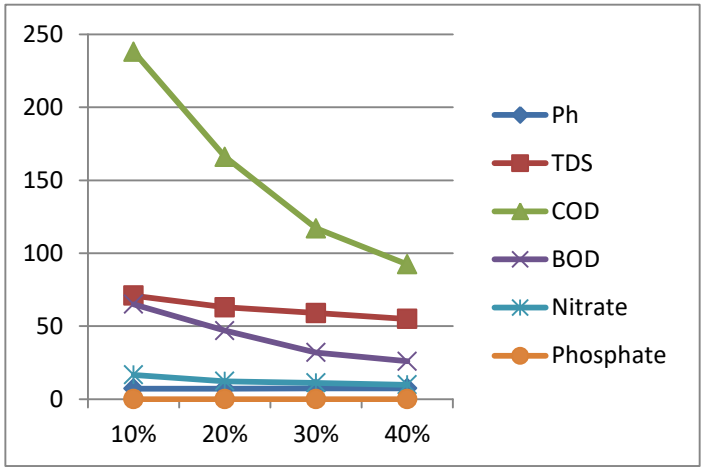


**Chart 1 :** Domestic water treatment with green algae.

## 4. CONCLUSIONS

From the above analysis it is inferred that green algae is found to be more efficient than red algae. The removal efficiency of green algae compared to red algae is also determined. Among the matrix selected, green algae was found to be more effective for domestic waste water treatment than the textile dye effluent, since the late has

very high chemical contamination then former .So in order to increase the effective removal , a study varying the concentrations of green algae was performed by a systematic increase in concentration. The study obtained matrix removal efficiency 0f 40% increase of the algae concentration. Also15 days treatment with Green algae was found to be more effective for treatment of domestic waste water

## REFERENCES

[1] Amiri & Mojtaba Ahmadi (2015), Treatment of wastewater in sewer by Spirogyra sp. green algae: effects of light and carbon sources. International Journal for Engineering and Technology, Volume 09

[2] Badiadka Narayana and Kenchaiah Sunil (2014), A Spectrophotometric Method for the Determination of Nitrite and Nitrate, Springer, Volume 10.

[3] Barragain j (2012),Spectrophotometer treatment of waste water. International Journal of Advance Research in Science and Engineering, Volume 08.

[4] D. Buono, M.L. Bartucca, T. Mimmo, S. Cesco, (2015), Nitrate removal from polluted water by using a vegetated floating system. International Research Journal of Engineeering and Technology, Volume 6, Issue 3.

[5] Davood Nourmohammadi, Mir-Bager Esmaeeli, Hossein Akbarian, and Mohammad Ghasemian (2013), Nitrogen Removal in a Full-Scale Domestic Wastewater Treatment Plant with Activated Sludge and Trickling Filter. International Journal of Advance Research in Science and Engineering, Volume 10.

[6] Duruibe, J.O., Ogwuegbu, M.O.C., and Egwurugwu, J.N. (2007), Heavy metal pollution and human biotoxic effects, International Research Journal of Engineeering and Technology, Volume 05.

[7] Federico Rossi 1, Oriana Motta 2, Simona Matrella 1, Antonio Proto 1 and Giovanni Vigliotta (2017), Nitrate Removal from Wastewater through Biological Denitrification with OGA 24 in a Batch Reactor, International Journal of Environmental Science and Technology, Volume 5, Issue 13.

[8] Mahboobeh Taziki1, Hossein Ahmadzadeh Marcia A, Murry and Stephen R. Lyon (2015), Nitrate and Nitrite Removal from Wastewater Using Algae, International Journal for Environmental Research, Volume 07.

[9] Sumiya U. and Anu N. (2016), Nitrate Removal from Synthetic Wastewater by using Bio-adsorbent. International Journal of Environmental Science and Technology, Volume 09.

[10] Ruiz j, alvarez p, arbib z, garrido c, barragain j, (2013), Effect of nitrogen and phosphorous concentration on their removal kinetic in treated urban wastewater by cholerlla vulgaris., International Research Journal of Engineeering and Technology, Volume 3.