Experimental Study On Removal Of Ammonia From Waste Water By Biologicaltreatment

[1]G.Saranpriya
PG student
Department of civil Engineering
P.S.R Engineering college
Sivakasi

[2]S.Shanmuga sundari
PG Student
Department of civil Engineering
P.S.R Engineering college
Sivakasi

[3]Mr.S.Vijaya Baskar
Assistant professor
Department of civil Engineering
P.S.R Engineering college
Sivakasi

Abstract - *Industrialization and Urbanization are the two main aspects for the development of our country that contributes to a higher degree of waste generation in the present scenario. Most of the industries are discharging waste water into the water bodies without any treatment that may contaminate the water bodies. It also affects the life of aquatic organisms, as the raw waste water contains higher amount of nitrogen and phosphorous. Enrichment of these nutrients in waste water leads to Eutrophication. As per disposal standards, the waste water should be treated to bring the values of Nitrogen and Phosphorous within the permissible limits before discharging into the water bodies so that eutrophication in the receiving water body could be controlled.*

Many conventional methods are available to control the algal growth. But there will be more sludge formation after those treatments. The sludge formed will again influence the algal growth. In case of biological treatment, the sludge formed can be treated for biomass production. Hence it is considered to be more effective in removing nutrients from waste water. This project aims at removing ammonia and color from dye waste water and ammonia from domestic waste water using Blue Green Algae. Hence the experimental study was carried out on the respective waste waters. From the test results, it was found that Blue Green Algae is effective in treating waste water without any harm to the environment.

I. INTRODUCTION

Waste water is defined from the standpoint of sources of generation as a combination of the liquid or water-carried wastes removed from institution, commercial and industrial establishments.Water that has beenaffected by anthropogenic influence which is defined as waste water.Municipal waste water is usually conveyed in a combined sewer or sanitary sewer, and treated at a waste water treatment plant. Waste water can originate from many sources such as homes and businesses (domestic waste water) and industries. Storm water, Surface water and Ground water can enter the waste water collection system and add to the volume of waste water. The source of a waste water will determine its characteristics and how it must be treated. Industrial waste water includes toxic chemicals, metals, very strong organic wastes, radioactive wastes, large amount of sediments, high temperature wastes or acidic or caustic wastes. Most modern waste water treatment facilities are designed to treat domestic waste water. Industrial waste waters that contain high strength wastes may have to be pretreated to make them safe to discharge to the collection system. If not, the process at the waste water treatment plant receiving the wastes could be disrupted. Among the various wastes, we have chosen Dye waste water and domestic waster in our project.Beyond many large scale dyeing Industries, there are many small and medium scale dyeing units. The fact is that, the large industries have been provided with proper treatment plants and the state government awarded them with lent free loans considering the betterment of the industries.

But the small and medium dyeing units are not provided with proper treatment plants and they discharge their waste water into the ground water sources as well as into the major rivers and small ponds. This is the very common and threatening problems in many areas particularly in the villages. The waste water which improperly discharges into the ponds acts as the main source of water for the animals and birds, for the purpose of Irrigation, and also the source of children' recreational activities causes many harmful diseases to all the living organisms. Along with its harmful health treat, it also creates a problem to aquatic life by blocking the sunlight and curtailing the photo-sensitive chemical reactions necessary to the aquatic life.

II. EUTROPHICATION PROCESS

The elements of nitrogen and phosphorus are essential to the growth of Protista and plants and as such are known as nutrients or bio stimulants. Trace quantities of other elements, iron content which is necessary for biological growth, but in most cases nitrogen and phosphorus are the major nutrients of importance.

Nitrogen is an important parameter in the process of protein synthesis, hence the total amount of nitrogen content will be required to evaluate the traceability of waste water by biological processes. Nitrogen content available in maximum amount as compare to permissible limit which indicate waste water as treated. The age of waste water is indicated by the relative amount of ammonia. In aerobic environment, bacteria readily change the form to ammonia.

Growth factors which are sunlight, carbondioxide, and nutrient fertilizers are of higher amount than that of its needed for photosynthesis which causes the excessive plant growth as called Eutrophication, that occurs naturally over centuries as lakes age and are filled in with sediments. However, to accelerate the human activities the rate and extent of eutrophication through both point-source discharges and non-point loadings of limiting nutrients, such as nitrogen and phosphorus, into aquatic ecosystems(cultural eutrophication), with dramatic consequences for drinking water sources, fisheries, and recreational water bodies. For example, aquaculture scientists and pond managers often intentionally eutrophic water bodies by adding fertilizers to enhance primary productivity and increase the density and biomass of recreationally and economically important fishes via bottom-up effects on higher trophic levels. However, during the 1960s and 1970s, scientists linked algal blooms to nutrient enrichment resulting from anthropogenic activities such as agriculture, industry, and sewage disposal. The known consequences of cultural eutrophication include blooms of blue-green algae tainted drinking water supplies, degradation of recreational opportunities, and hypoxia. The estimated cost of damage mediated by eutrophication in the U.S. alone is approximately $2.2 billion annually.

III. SIGNIFICANCE OF AMMONIA

Ammonia occurs as a breakdown product of nitrogenous material in natural
water. It is also found in domestic effluents and certain industrial waste waters. Ammonia causes harmful effect to the fish and other acquatic life. So that the ammonia level is controlled in water which is used as acquarium.Ammonia tests are routinely applied for the monitoring of natural water, sea water; and for pollution control on effluents and waste waters. Ammonia is a naturally occurring compound made up of nitrogen and hydrogen which exists in two basic forms in the environment. It is required by most organisms for protein synthesis, and is a waste product of animal, fish and microbial metabolism. The principal releases of ammonia to the environment from human activity come from a number of industries, municipal waste water effluents and agricultural activities. The major sources of ammonia released to the aquatic environment are municipal waste water treatment plants, which discharge a total of approximate tons/year.
Ammonia is also released in large quantities into the environment by many industries such as pulp and paper mills, mines, food processing and fertilizer production. The majority of these releases go to the atmosphere. Large agricultural releases of ammonia may result from two principal sources: fertilizer application, and intensive animal-rearing facilities. Both activities may result in significant release of ammonia to the air, whereas intensive livestock activities may result in waste water.

The largest quantifiable industrial releases come from ammonia produced in the manufacture of fertilizer, while municipalities are the largest non-industrial source due to their release of sewage effluents. Under some conditions, depending on water pH and temperature, ammonia can become highly toxic to fish and other animals living in the water. These substances are not found to be bioaccumulative, or to transfer up the food chain. Freshwater organisms are most at risk from releases of ammonia in the aquatic environment. Rainbow trout, freshwater scud, walleye, mountain whitefish and fingernail clams are some of the most sensitive species. Some of the observed effects include reduced reproductive capacity and reduced growth of young. Ammonia is considered to be entering the aquatic environment in a quantity or concentration or under conditions that have or may have an immediate or long-term harmful effect on the environment or its biological diversity. The conclusions of the scientific assessment of ammonia are based on an analysis of risks from releases of ammonia from municipal waste water treatment plants. The assessment report recommends that options to reduce exposure to ammonia from municipal waste water systems should be explored. The assessment suggests that releases of ammonia from several other sources, such as runoff from manure-fertilized fields and intensive livestock operations, may also be causing environmental harm. However, it was not possible to quantify the extent and magnitude of these releases. The report recommends additional research on whether options to reduce exposure to ammonia from such sources should be undertaken.

STANDARDS (IS 2490 – 1985):

CHARACTERISTICS	TOLERANCE LIMIT
pH	5.5-9
BOD	30mg/l
COD	250mg/l
Ammonia	50mg/l

IV. STUDY AREA

Srivilliputhur is a semi-urban town and a municipality in Virudhunagardistrict inthe Indian st ate of Tamil Nadu. As of 2011, the town had a population of 75,396.

Srivilliputtur is one of the old historical town, a 1000-year-old temple, more than 130-year-old Hindu School, 135-year-old Pennington Public Library are remarkable historical evidence for this culturally important town. Thiruppavai, one of the important constituent of devotional Tamil literature period was from this temple town.

The remarkable landmark of Srivilliputhur is 11-tiered tower structure dedicated to the Lord of Srivilliputhur, known as Vatapatrasayee. The tower of this temple rises 192 feet high and is the official symbol of the Government of Tamil Nadu. It is said to have been built by Periyalvar, believed to be the father-in-law of the Temple Deity, with a purse of gold that he won in debates held in the palace of Pandya King Vallabhadeva. Another wonder in Srivilliputtur is Chariot which runs on AdiPuram. Srivilliputhur is well known for its ancient heritage and devotional contributions.

Our sample taken locations are Keelapatti and Nallakutralapuram street at Srivilliputtur .Keelapatti is the place where dyeing is important work of the people.

V. MATERIALS USED

A. Biosorbent

In general, this untreated waste water is mixed with the Municipal waste water and then disposed into nearby ponds. But their standards are relatively higher than the standards of municipal treated waste water. As the water is highly colored and turbid, vegetation along the streams appears scorched despite the fact that water from these streams is the major resource in the area, it is used for cleaning, irrigation of vegetables, drunk by animals and birds and children used for recreation.

A Biosorbentis the natural materials that have the ability to accumulate heavy metals or color from waste water through physico-chemical pathways of uptake. The use of biosorbents is one of the most recent developments in environmental or bio resource technology. The advantage this technique not only include its low-cost, but also its high efficiency, the minimization of chemical or biological sludge. The successful adsorption process also depends on the constant and continuous supply of the materials.

Biomass which allows to passively concentrate and contaminants onto its cellular structures. It is one of as physiochemical process. Engineers and scientist hoping for such a biomass used environmental factors it should be more economical process for removing heavy metals in industrial waste water. Biosorbent used for this experiment as chlorella vulgaris.

B. Chlorella Vulgaris

"Chlorella vulgaris" is eukaryotic, unicellular green algae. "C. vulgaris" is estimated to have been on Earth for more than 2.5 billion years. During that time it has needed to evolve for survival, resulting in many of the useful functions we use today and in the future. Most of the important features deal with its ability to rapidly grow. Common practice normally involves growing populations in photobioreactors. These chambers are consistently shaken and used to control certain aspects of metabolism in "C. vulgaris". Variables such as media, carbonation, and light have been researched heavily to understand the best means of optimal growth. Several uses of "C. vulgaris" have been researched. First, due to its high mineral and protein levels, it is used in vitamins and has even thought to be a viable food when dehydrated. It has powerful effects in boosting human health. Secondly, many algae produce lipids through photosynthesis. This makes these organisms a viable source for biofuel. "C. vulgaris" is lipid content per biomass is approximately 42%. This is more than soybeans, sugarcane, and corn; making it a viable alternative for biodiesel. With current technology, it can match oil prices of $63.97 per barrel. This is not even mentioning the potential to make money back through waste water treatment. Waste water is treated even in textile production. Research shows that "C. vulgaris" reduced the color dye by 41.8%, Ammonium by 44%, Phosphate by 33%, and Carbon dioxide by 33-62%. "C. vulgaris" ability has also been considered for reducing emissions from power plant. This mostly deals with the ability for rapid growth and the variety of uses. Despite the range of benefits, a negative aspect is the cost to grow "C. vulgaris". Vast areas would need to be used to make much of an impact. CO_2 is a limiting resource for large quantities of C. vulgaris to grow rapidly, in exception to a coal burning power plant. Photobioreactors are often carbonated with brings an extremely high cost in energy to the equation.

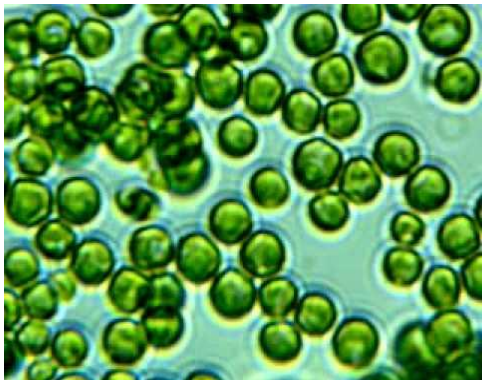


Fig1 :Chlorella Vulgaris

vulgaris is a small, spherical algae that has a size of 5-10µm. It contains 16 chromosones consisting of a range between 0.98 Mb to 4 Mb("Chlorella vulgaris" C-169). This range is rather large due to different geographic location and being a free-living alga. Full sequencing of the chloroplast was found to contain 150,613 bp. The total genome does not have large sections that repeat. This missing inverted repeat is found in most algae. A genomic section found in "Escherichia coli" that are responsible for cell division was found in "C. vulgaris", indicating that chloroplast division in "C. vulgaris" resembles the division taking place in bacteria. Red and brown algae contribute no homologous genomic sections in its chloroplast which means that "C. vulgaris" is surprising more similar to land vegetation. When looking at life history, plants are thought to be evolved from green algae. This correlates with gene segments in "C. vulgaris" that exist in many plants that have been sequenced to date. Currently, no Mitochondrial sequencing has been performed.

VI. TESTING OF SAMPLES

The samples collected are to be tested for the amount of dissolved elements present in it. It is tested for pH, BOD, COD and amount of ammonia.

A. pH TEST

The pH of solution is the negative common logarithm of the hydrogen ion activity.

pH = -log (H)+

In dilute solutions, the hydrogen ion activity is approximately equal to the hydrogen ion concentration.

Exposure to Extreme pH values results in irritation to eyes, skin, and mucous membranes. Eye irritation and exacerbation of skin disorders have been associated with pH values greater than 11. In addition, solutions of pH 10-12.5 have been reported to cause hair fibers to swell. In sensitive individuals, gastrointestinal irritation may also occur. Exposure to low pH values can also result in similar effects. Below pH 4, redness and irritation of the eyes have been reported, the severity of which increases with decreasing pH. Below pH 2.5, damage to the epithelium is irreversible and extensive (10). In addition, because pH can affect the degree of corrosion of metals as swell as disinfection efficiency, it may have an indirect effect on health.

Fig 2: pH Test

When ammonia is available as ammonium ion in waste water, it will be acidic. It will be alkaline, when it occurs in ammonia gas.The results were obtained for Std. solution, treated and untreated water.

pH value of std. solution = 5.99

B. BOD Test

Standard solution
BOD_5 of a given sample can easily be determined in the laboratory by direct pipetting method using the formula method using the following formula.
BOD_5 (mg/l) = (DO_I – DO_f) x volume of bottle
Volume of sample
DO_I, DO_f = DO in diluted samples before and after incubation.
Amount of BOD present in our Standard solution = 8.3mg/lit

C. COD Test

C.O.D is defined as the amount of oxygen, expressed in milligram per litre consumed under specific condition in the oxidation and oxidizable inorganic matter, corrected for the influence of chloride . It indicate the amount of oxygen required to oxidize the carbonaceous matter. C.O.D method is recommended as a supplement to C.O.D test, be the main advantage of C.O.D is that its determination takes 3 hours , compared to more than 5 days for the B.O.D determination, it is used to measure the extent of pollution of domestic and industrial waste.

Principle:
The organic matter of the sample is completely oxidized by reflection with known excess of potassium dichromate solution under acidic conditions. After digestion the remaining unreduced dichromate is back titrated with a standard FAS solution to determine the amount of potassium dichromate consumed and the oxidizable organic matter is calculated in terms of oxygen equivalent.

D. Determination of Ammonia

Ammonia occurs as a breakdown product of nitrogenous material in natural waters. It is also found in domestic effluents and certain industrial waste waters. Ammonia is harmful to fish and other forms of aquatic life and the ammonia level must be carefully controlled in water used for fish farms and aquariums. Ammonia tests are routinely applied for the monitoring of natural water, sea water; and for pollution control on effluents and waste waters.

VII. RESULTS AND DISCUSSION

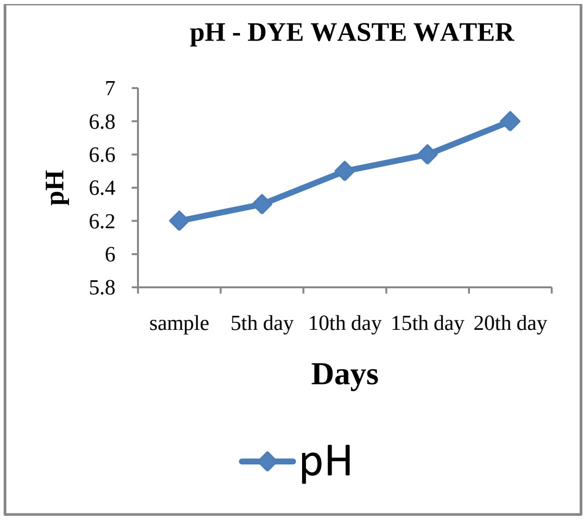
Dye Waste Water V_s Domestic Waste Water

Table :1 pH, BOD,COD, Ammonia –Dyewaste Water

DESCRIPTION	PH	BOD (mg/lit)	COD (mg/lit)	AMMONIA (mg/lit)
Sample	6.2	13.7	268	84.3
5th day	6.3	10.9	242.27	71.6
10th day	6.5	9.2	227.8	57.3
15th day	6.6	8.5	214.4	52.2
20th day	6.8	8	198	43

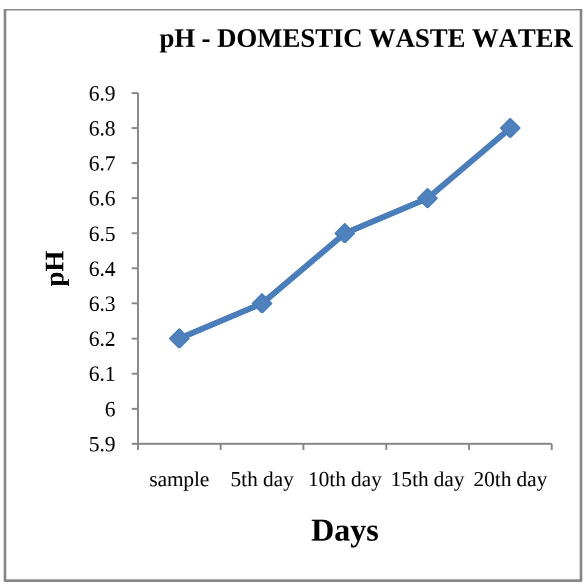
DESCRIPTION	pH	BOD (mg/l)	COD (mg/l)	AMMONIA (mg/l)
Sample	7.9	108.3	230	4.6
3rd day	8.1	86.4	200.4	2.9
5th day	8.1	79.8	189.7	0.89

Table : 2 pH, BOD,COD, Ammonia – Domestic Waste Water



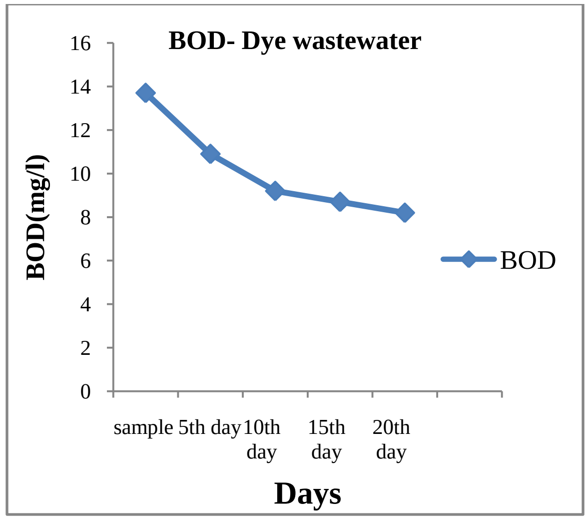
GRAPH 1

The values of pH was increased due to the treatment with algae. It was found that pH value was increased by 10% and the waste water approaches to neutral solution



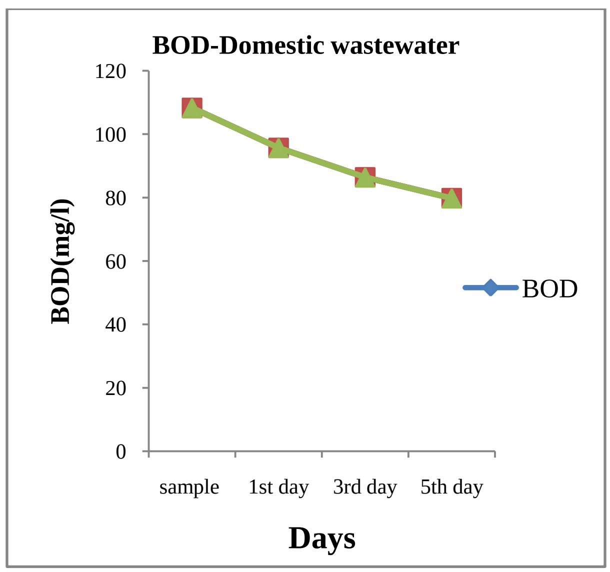
GRAPH 2

The values of pH was increased due to the treatment with algae. It was found that pH value was increased by 10% and the waste water approaches to neutral solution



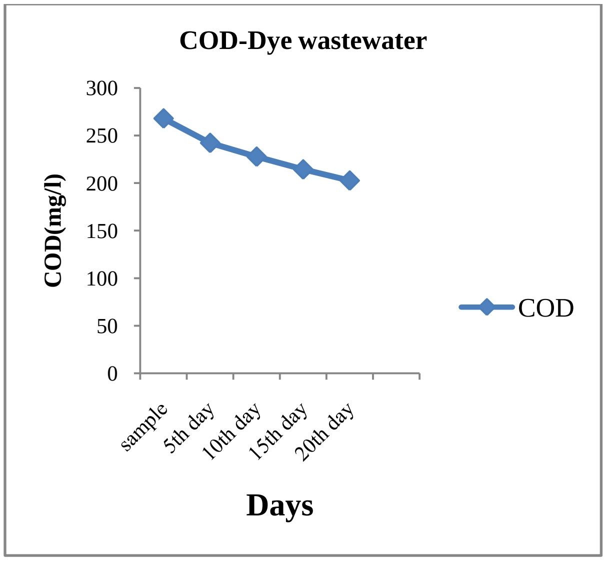
GRAPH 3

The BOD Values were decreased due to treatment with algae.It was found that the value was decreased by 41.6%



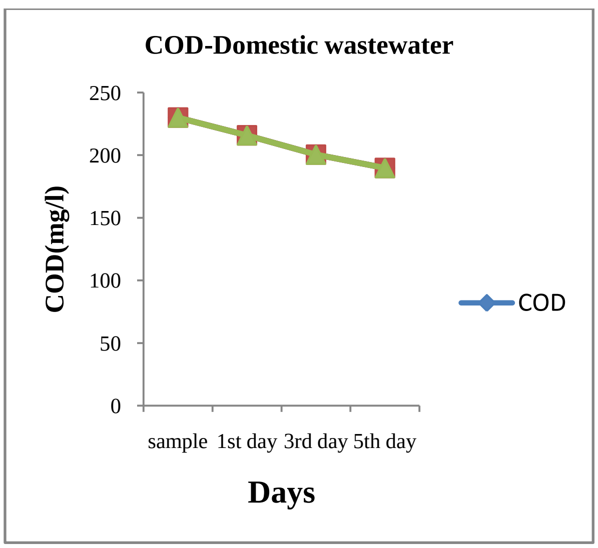
GRAPH 4

The BOD Values were decreased due to treatment with algae.It was found that the value was decreased by 26.3%.



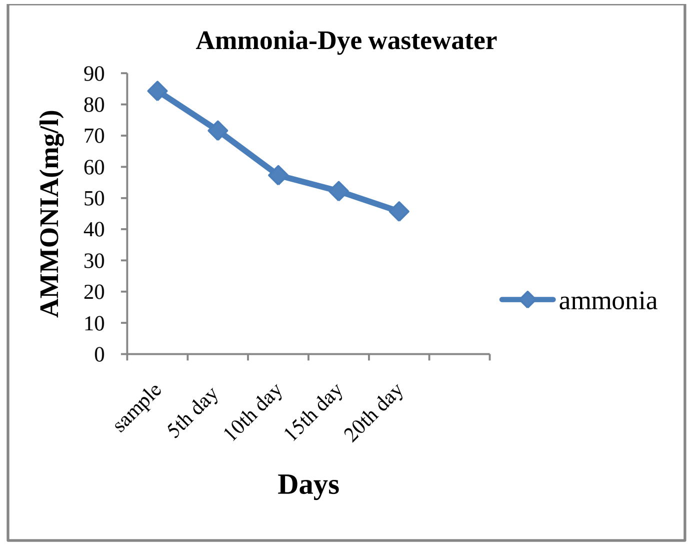
GRAPH 5

The COD Values were decreased due to treatment with algae.It was found that the value was decreased by 26.11%



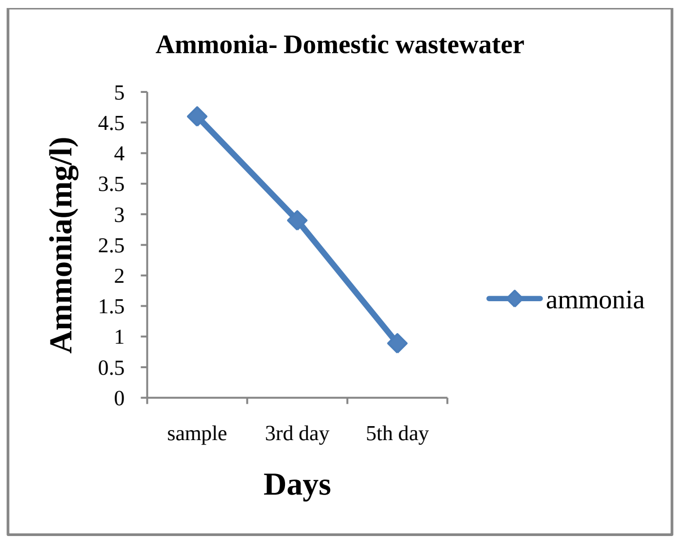
GRAPH 6

The COD Values were decreased due to treatment with algae.It was found that the value was decreased by 17.5



GRAPH 7

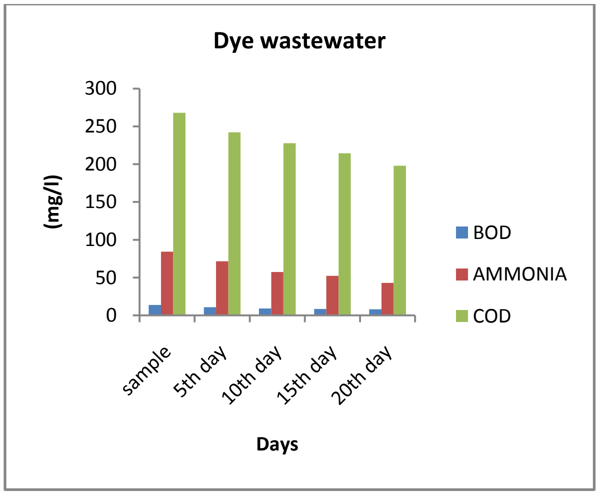
The Ammonia Values were decreased due to treatment with algae.It was found that the value was decreased by 5%



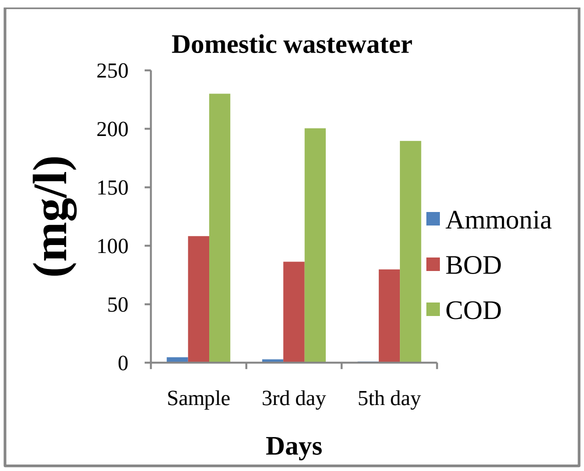
GRAPH 8

The Ammonia Values were decreased due to treatment with algae.It was found that the value was decreased by 80%.

VIII. COMPARISION CHART FOR TEST RESULT



GRAPH 9



GRAPH 10

CONCLUSION

Experimental study was carried out using algae Chlorella vulgaris to find pH, BOD, COD, ammonia level in domestic waste water and dye waste water. From the test results we have found that the pH level was increased when treated with Chlorella vulgaris. BOD, COD levels were also reduced. Ammonia level has reduced by 96% after treatment. This level was attained after 20 days of treatment of waste water with Chlorella vulgaris. Readings were taken after every 5 days to find variation in ammonia level. We found that the values of pH, BOD,COD, ammonia are within the permissible tolerance limit. IS code 2490 – 1985,IS code 4674 – 1973 are referred to find the tolerance limit of dye waste water and domestic waste water respectively.

REFERENCES

1. Acuner E, Dilek FB (2004) **Treatment of tectilon yellow 2G by Chlorella vulgaris**. ProcBiochem 39:623–631
2. Akhtar N, Saeed A, Iqbal M (2003) **Chlorella sorokiniana immobilized on the biomatrix of vegetable sponge of Luffa cylindrical**: a new system to remove cadmium from contaminated aqueous medium. BioresourTechnol 88:163–165
3. Aksu Z, Tezer S (2005)**Biosorption of reactive dyes on the green algae Chlorella vulgaris.**ProcBiochem 40:1347–1361
4. APHA (1998) **Standard methods for the examination of water and waste water.** American Public Health Association, American Water Works Association, Water Pollution Control Federation, United Book, Baltimore
5. Abadulla, E., Tzanov, T., Costa, S., Robra, K.H., Cavaco-Paulo, A.,et al, 2000. **Decolorization and detoxification of textile dyes with alaccase from Trameteshirsuta**. Appl. Environ. Microbiol. 66, 3357–3362.
6. Changyong Wu, Zhiqiang Chen, Xiuhong Liu, YongzhenPeng, **Nitrification– denitrification via nitrite in SBR using real-time control strategy when treatingdomestic waste water,** Biochemical Engineering Journal 36 (2007) 87–92.
7. Q. Feng, A. Yu, L. Chu, X.-H. Xing, **Performance study of the reduction ofexcess sludge and simultaneous removal of organic carbon and nitrogen by acombination of fluidized- and fixed-bed bioreactors with different structuredmacroporous carriers,** Biochemical Engineering Journal 39 (2008) 344–352.
   - M. Morita, H. Uemoto, A. Watanabe, **Nitrogen-removal bioreactor capableof simultaneous nitrification and denitrification for application to industrialwaste water treatment**, Biochemical Engineering Journal 41 (1) (2008) 59–66.
   - G. Tchobanoglous, L. Franklin, H. Burton, Stensel David**, Waste water Engineering:Treatment Disposal and Reuse**, fourth ed., Metcalf and Eddy, Inc.McGraw-Hill, New York, 2003.
   - F. Shigeo, **Theoretical analysis on nitrogen removal of the step-feed anoxic–oxicactivated sludge process and its application for the optimal operation**, WaterScience and Technology 34 (1996) 459–466.
   - L. Larrea, A. Larrea, E. Ayesa, J.C. Rodrigo, M.D. Lopez-Carrasco, J.A. Cortacans,**Development and verification of design and operation criteria for the stepfeed process with nitrogen removal,** Water Science and Technology 43 (2001)261–268.
   - G.B. Zhu, Y.Z. Peng, S. Wu, S. Wang**, Influence of C/N ratio on the biologicalnitrogen removal in step-feed process**, China Environmental Science 25 (2005)641–645 (in Chinese).
   - G.B. Zhu, **Performance and optimization of anoxic/oxic step feeding enhancedbiological nitrogen removal process**, Ph.D. thesis, Harbin Institute of Technology,2006.
   - S. Schlegel, **Operational results of waste water treatment plants with biologicalN and P elimination**,Water Science and Technology 25 (1992) 241–247.
   - R. Kayser, G. Stobbe, M.Werner, **Operational results of theWolfsburg waste watertreatmentplant,**Water Science and Technology 25 (1992) 203–209.
   - E. Gorgun, E. Artan, D. Orhon, S. Sozen**, Evaluation of nitrogen removal by stepfeeding in large treatment plants**, Water Science and Technology 34 (1996)253–260.
   - F. John, V. Diyamandoglu, L.A. Carrio, L. Robinson, **Full-scale evaluation ofbiological nitrogen removal in the step-feed activated sludge process**, WaterEnvironment Research 68 (1996) 132–142.

- G. Zhu, Y. Peng, S. Wang, S. Wu, B. Ma**, Effect of influent flow rate distributionon the performance of step-feed biological nitrogen removal process**, ChemicalEngineering Journal 131 (2007) 319–328.

G. Zhu et al. / Biochemical Engineering Journal 43 (2009) 280–287 287

- ShahulHameed, M., Saraswathy, V., Sekar, ASS., (2010) "**Chloride Penetration Study on Self-Compacting Green Concrete Using Crusher Rock Dust and Marble Sludge Powder as Fine Aggregate**" ICI Journal, 96-105.
- APHA, **Standard Methods for the Examination of Water and Waste water**, 19th ed., American Public Health Association/American Water works Association/ Water Environment Federation,Washington DC, USA, 1995.
- G.B. Zhu, Y.Z. Peng, **Theoretical evaluation on nitrogen removal of step-feedanoxic/oxic activated sludge process**, Journal of Harbin Institute of Technology13 (2006) 99–102.
- M. Henze, **Capabilities of biological nitrogen removal process fromwastewater,**Water Science and Technology 23 (1991) 669–679.
- M. Henze, C.P.L. Grady, W. Gujer, G.R. Marais, T. Matsuo, **A general modelfor single sludge waste water treatment system**, Water Research 21 (1987)545–556.