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RECLAMATION OF NATURAL WATER BODIES USING BIOLOGICAL METHOD

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Abstract -*This project deals with the Reclamation of natural water bodies in a biological way by using diffused aerators. Wastewater treatment is any process that separates and removes contaminants from industrial process waters, or effluent. The microorganisms do the actual breakdown and removal of nutrients and organic material in the wastewater. These systems include physical and chemical processes to remove solids and heavier materials. ICF Lake, is a rain-fed reservoir located at Villivakkam and Ayanavaram areas of Chennai, India. The lake measures 450 meters in length, 270 meters in width, and is 7 meters deep, the reservoir began to get polluted due to mixing with oil waste and later by linking storm water drain from the Villivakkam area, and drinking water supply was discontinued. Plastic can of 20 litre capacity with stopper were used for collecting samples. This experimental setup consists of a rectangular glass tank , aerators , settling tank , diffusers , pipe fittings and valves. The collected waste water from the lake is then filled in the fish tank of 30 litre capacity. Then the diffusers are placed in the tank and aerator is started. The bacteria is mixed with some fresh water of about 300ml and then the water containing bacteria is poured in to the aerated water. Each sample is collected between the aeration process in an interval of about 2 hours. After the process of aeration for about 8 hours, the valve is opened and the water is passed in to the settling tank through the pipe fittings and the settling process is made. The settled water from the settling tank is collected and the sludge remained in the settling tank is then taken separately and dried and weighed. Then water tests such as Turbidity, COB, BOD, phosphate content, nitrate content, total dissolved solids and pH. So that analysis of water samples are made and the water is then used for domestic and gardening purposes.*

Key Words: Aeration, bacteria, Wastewater treatment.

1. INTRODUCTION

Wastewater treatment is any process that separates and removes contaminants from industrial process waters, or effluent. Wastewater has gained importance worldwide, but there is an immense need to develop a low cost treatment system for recycling of waste water which can be used for other purposes. These contaminants include oils, dissolved heavy metals, suspended solids and organic compounds. Either the local municipality or the Federal Government regulates the specific contaminants. A series of limits are set to determine the suitability for discharge. These limits must be met for the water to be legally discharged. If these limits are not met, the water must be pre-treated before being discharged, to remove the majority of the regulated contaminants. Although we are technically providing pre-treatment systems, we refer to them as treatment systems. Despite large supplies of fresh water and the natural ability of surface waters to cleanse themselves over time, populations had become so concentrated by 1850 that outbreaks of life-threatening diseases became commonplace. These outbreaks were traced to pathogenic bacteria in the polluted water.

1.1 Sources of Waste water

Wastewater can be defined as the flow of used water discharged from homes, businesses, industries, commercial activities and institutions which is directed to treatment plants by a carefully designed and engineered network of pipes. This wastewater is further categorized and defined according to its sources of origin. The term "domestic wastewater" refers to flows discharged principally from residential sources generated by such activities as food preparation, laundry, cleaning and personal hygiene. Industrial/commercial wastewater is flow generated and discharged from manufacturing and commercial activities such as printing, food and beverage processing and production to name a few. Institutional wastewater characterizes wastewater generated by large institutions such as hospitals and educational facilities. Typically 200 to 500 litres of wastewater are generated for every person connected to the system each day. The amount of flow handled by a treatment plant varies with the time of day and with the season of the year. Two types of waste water are generated in house, they are grey water and black water

1.2 BIOLOGICAL TREATMENT

A wastewater treatment plant is a microbiological zoo that houses bacteria, protozoa, metazoa and other microlife. The microorganisms do the actual breakdown and

removal of nutrients and organic material in the wastewater. These systems include physical and chemical processes to remove solids and heavier materials. A bacteria is a single cell life of form - each individual cell is a separate, unique organism. Bacteria often grow into colonies that appear as jelly-like masses, but each cell remains as independent. Bacteria need nutrients such as carbon, nitrogen, phosphate and trace metals to survive. They break down organic compounds found in nature or man made to get energy for growth. Bacteria are categorized by the way that they obtain oxygen. In wastewater treatment, there are three types of bacteria used to treat the waste that comes into the treatment plant: aerobic, anaerobic and facultative. Aerobic bacteria are used in most new treatment plants in an aerated environment. This means that there is dissolved oxygen available for the respiration of the bacteria. Anaerobic bacteria are normally used in an anaerobic digester to reduce the volume of sludge to be disposed of and to produce methane gas. Facultative bacteria are able to change their mode of respiration from aerobic to anaerobic and back again. These bacteria are able to adapt to either condition, although they prefer the aerobic condition

1.3 OBJECTIVES

The main aim of the project is to carry out a the treatment of waste water using biological method. The bacteria which is used is to treat the lake water which became waste water because of surrounding areas domestic and sewage water. So these are the following specific objectives to be achieved:

- To determine the percentage removal of chemical oxygen demand (COD), suspended solids (SS) and turbidity of the effluent.
- To develop a cost – effective biological treatment system.
- To reduce the load of turbidity and bacteriological contaminants from water.
- To make the water treatment process easier and environmental friendly for household and industrial applications.

2. METHODOLOGY

2.1 STUDY AREA DETAILS

ICF Lake, is a rain-fed reservoir located at Villivakkam and Ayanavaram areas of Chennai, India, reaching its peak levels during the monsoon seasons. The lake measures 450 meters in length, 270 meters in width, and is 7 meters deep. Seven infiltration wells have been sunk on the lake bed. The pathway around the lake measures 3 kilometers. The registered area is about 24 acres. The domestic sewage inlet is from the surrounding areas. The lake had been used as a source of drinking water in the region since the 1930s, when the reservoir was constructed. The reservoir began to get polluted due to mixing with oil waste and later by linking stormwater drain from the Villivakkam area, and drinking water supply was discontinued. In 2017, the ICF conducted surveys and renovated the lake at a cost of ₹ 10 million by removing sludge using dredgers, introducing new fish varieties, and building walking track around the lake.

Fig 1 View of the lake

2.2 BACTERIA USED

The bacteria used here is a cultured bacteria named **'ENZOBAC'.** It is viewed through specialized microscope to see the structure of microbes.

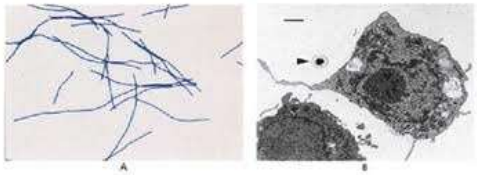

Fig 2 Bacteria structure

- 100 % natural vegetative bacteria
- Count: 1 x 10^{12} CFU per gram
- Pale brown coloured free flowing powder
- Stable at room temperature for 2 years
- Powders and solids are more stable and less susceptible to contamination. It takes a considerable amount of moisture to activate the product.

Vegetative Bacteria (ENZOBAC) characteristics:

Rapid growth & reproduction of these bacteria must have proper environment & should have the following characteristics:

1. A water medium containing food (organic waste).
2. Aeration or Dissolved oxygen (for the aerobic types that require it) in sufficient quantities.
3. pH between 6.5 to 8.5 not too acid nor too alkaline
4. Temperature between 30°C and 60°C.

Benefits of using ENZOBAC:

- Microbes are vegetative naturally occurring.
- Grow and reproduce quickly and readily in the environmental conditions found in the waste disposal systems.
- Degrades wide range of organic waste without causing odors or noxious gas.
- Enhances BOD/COD removal
- Reduces TDS & sludge build-up.

3. RESULTS AND DISCUSSION

3.1 COLLECTION OF WASTE WATER SAMPLE

Plastic can of 20 litre capacity with stopper were used for collecting samples. Plastic can is washed with clean water before collecting the samples in the location. The can is preserved at normal temperature. The bottle is filled leaving no air space, and then the bottle is sealed to prevent any leakage. The following precautions should be considered while, collecting waste water samples.

Fig 3 Waste water sample

3.2 EXPERIMENTAL SETUP

This experimental setup consists of a rectangular glass tank, aerators, settling tank, diffusers, pipe fittings and valves. First a hole is pierced in the side of the tank. Then a valve and pipe fittings are connected to that hole using araldite which prevents the leakage of water. The pipe is fitted to the settling tank. Settling tank is made of a 20 litre plastic water can and a tap is fixed in it so that we can collect water after settlement. Then the aerator is fixed to circuit and two pipes joining aerators with diffusers at its end is fitted. The collected waste water from the lake is then filled in the fish tank of 30 litre capacity. Then the diffusers are placed in the tank and aerator is started.

Fig 4 Experimental setup

3.3 AERATION OF WATER

Aeration in an activated sludge process is based on pumping air into a tank, which promotes the microbial growth in the wastewater. The microbes feed on the organic material, forming flocks which can easily settle out. After settling in a separate settling tank, bacteria forming the "**activated sludge**" flocks are continually recirculated back to the aeration basin to increase the rate of decomposition. Wastewater aeration is the process of adding air into wastewater to allow aerobic bio-degradation of the pollutant components. . Bio-degradation of organic matter in the absence of oxygen is a very slow biological process.In this process,the aeration is made for about 8 hours and more depending upon the quantity of water available.

Fig 5 Diffused aerator

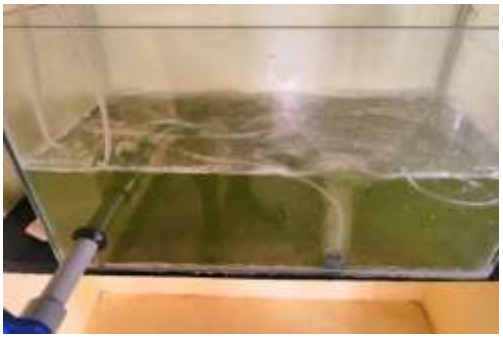

Fig 6 Aeration process

3.4 MIXING OF BACTERIA

The bacteria is taken in a correct proportion as 4g per litre of water. So we have taken 100 mg of bacterial powder for 25 litres of water. First the bacteria is mixed with some fresh water of about 300ml and then the water containing bacteria is poured in to the aerated water. Flocculation occurs after some interval of time. Then the process is continued for about 8 hours, and this completes one cycle of treatment. Then second cycle of treatment is also done for about 8 hours. Waste water samples are collected for 2 hours interval during treatment.

Fig 7 Bacterial powder

3.5 COLLECTION OF TREATED WATER SAMPLES

Plastic can of 400ml litre capacity with stopper were used for collecting samples. Plastic can is washed with clean water before collecting the samples in the location. The can is the preserved in normal temperature. The bottle where filled leaving no air space, and then the bottle is scaled to prevent any leakage. Each sample is collected between the aeration process in an interval of about 2 hours. Samples are taken special care while collecting it.

3.6 SETTLING PROCESS

After the process of aeration for about 8 hours, the valve is opened and the water is passed in to the settling tank through the pipe fittings. Then the setting tank is filled with the waste water and the settling process is made. In this process of settling, the sediments are settled. It is done in approximately 1 hour and 30 minutes. After settling the water above the sediments is collected seperately.

Fig 8 Settling tank

3.7 SLUDGE

After the process of settling for about 1 and half hours the sludge is settled under the settling tank. The settled water from the settling tank is collected and the sludge remained in the settling tank is then taken separately and dried and weighed. Therefore the amount of sludge content in the water is found.

Fig 9 Sludge

3.8 ANALYSIS OF SAMPLES

3.8.1 pH OF THE SAMPLES

pH is defined as the negative logarithm of hydrogen ion concentration of logarithm of reciprocal of hydrogen ion concentration. Practically every phase of water supply and waste water treatment, for example acid base neutralization, water softening, coagulation, disinfection and corrosion control is pH dependent.

SAMPLE	TIME	pH
1	0 hours	6.8
2	4 hours	6.6
3	8 hours	6.7
4	12 hours	6.7
5	16 hours + settling	6.4

Table-1 ph Of The Samples

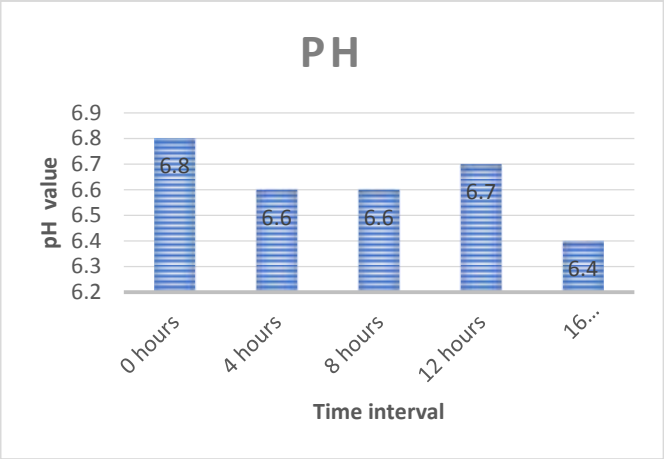

Fig 10 Graph for pH

3.8.2 TURBIDITY OF THE SAMPLES

Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air. The measurement of turbidity is a key test of water quality.

Sample	Time	Turbidity
1	0 hours	28 NTU
2	4 hours	20 NTU
3	8 hours	22 NTU
4	12 hours	18 NTU
5	16 hours + settling	10 NTU

Table-2 Turbidity of the Samples

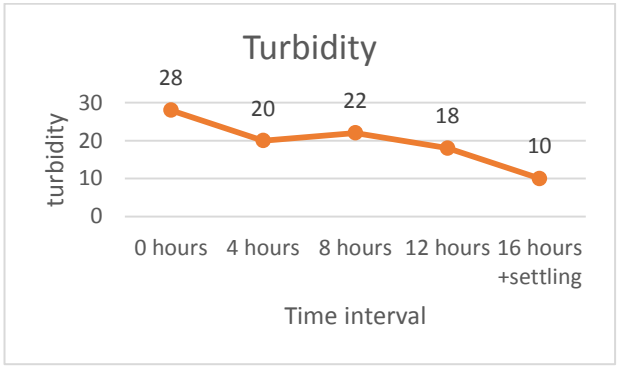

Fig 11 Variation in turbidity

3.8.3 NITRATE CONTENT

Nitrate in drinking water is measured either in terms of the amount of nitrogen present or in terms of both nitrogen and oxygen. The federal standard for nitrate in drinking water is 10 milligrams per litre (10 mg/l) nitrate. Excess nitrogen in water can harm people. Too much nitrogen, as nitrate, in drinking water can be harmful to young infants or young livestock. Excessive nitrate can result in restriction of oxygen transport in the bloodstream.

Table-3 Nitrate Content

SAMPLE	TIME	Nitrate
1	0 hours	20.68 mg/l
2	4 hours	18.40 mg/l
3	8 hours	15.80 mg/l
4	12 hours	12.24 mg/l
5	16 hours + settling	9.54 mg/l

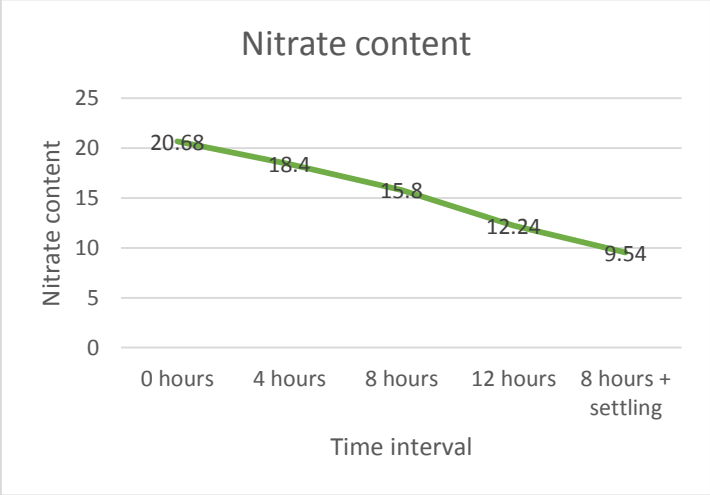

Fig 12 Variation in Nitrate content

3.8.4 PHOSPHATE CONTENT

Phosphate is an essential element for plant life, but when there is too much of it in water, it can speed up eutrophication of rivers and lakes. A sign of this is excess algae in the lake. That is, if all phosphorus is used, plant growth will cease, no matter how much nitrogen is available. The natural background levels of total phosphorus are generally less than 0.03 mg/L. The natural levels of phosphate usually range from 0.005 to 0.05 mg/L.

Table-4 Phosphate Content

SAMPLE	TIME	phosphate
1	0 hours	2.5 mg/l
2	4 hours	2.3 mg/l
3	8 hours	2.0 mg/l
4	12 hours	1.5 mg/l
5	16 hours + settling	1 mg/l

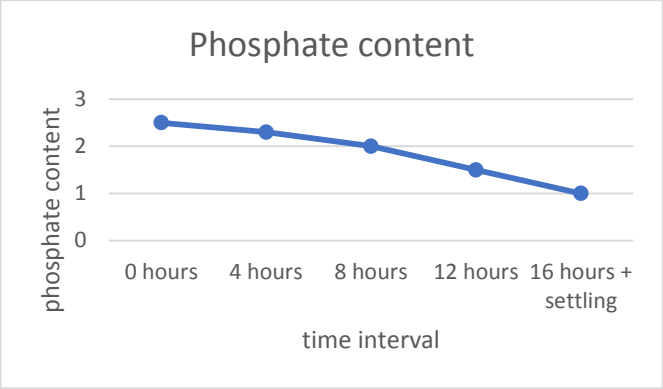

Fig 13 Variation in Phosphate content

3.8.5 CHEMICAL OXYGEN DEMAND

The Chemical Oxygen Demand (COD) represents the amount of oxygen in milligrams required to oxidize all the organic pollutants present in water, to carbon dioxide and water. This test was done using spectrophotometer.

Table 5 COD value

SAMPLE	TIME	COD
1	0 hours	282
2	4 hours	240
3	8 hours	198
4	12 hours	146
5	16 hours + settling	72

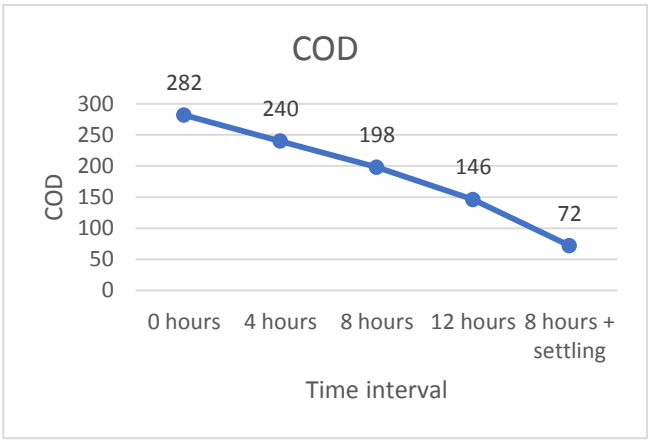

Fig 14 Variation in COD values

4. CONCLUSION

Sufficiently treating our wastewater is not only important to the environment its important to human well being.so by this method using this bacteria ENZOBAC the water is treated in a good way with low cost and has decreased the contents of chemicals in the water and also made BOD and COD removal. This helps in developing a cost – effective biological treatment system and to reduce the load of turbidity and bacteriological contaminants from water. This make the water treatment process easier and environmental friendly for household and industrial applications.

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