

# RESTORATION OF MOOKANARI LAKE BY USING BIO-OZOLYTE TREATMENT SALEM CORPORATION IN TAMILNADU, INDIA

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**Abstract** - In the dyeing industries there is growing interest for the process water. The purified waste water in the dyeing industry is required to satisfy strict quality standard before reuse become possible, advanced purification technique must be available which are efficient and reliable waste water, which are recycling means an addition cost in manufacturing as product. The existing technologies like Oxidation Ponds, Anaerobic Treatment, Coagulation, and Aerated Lagoons demand large area, which is difficult to get in the urban area. Other superior technologies like ASP, Trickling Filter needs high electrical and mechanical equipment in turn resulting in high Maintenance cost. So it's necessary to come out with an economically sound and Eco-friendly technology, for the effective waste water treatment. It is learnt from studies that Bio-Ozolyte system has high efficiency in removal of BOD, COD, colour and odour without high expenditures and also its non-toxic to the environmental. This system is clubbed with biological method (Eco-Bio Blocks). The samples are taken from Mookaneri (CETP) Common Effluent Treatment Plant and these samples are treated with Bio-Ozolyte treatment methodology to get effective results. The Raw effluent was treated using Eco-Bio Blocks, Ozone and finally Activated carbon filtered. By comparing the physio-chemical parameter of raw effluent and treated water, a highly remarkable efficiency was found out.

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**Keywords** - Bio-Ozolyte, Eco-Bio Blocks, Ozonation, BOD, COD.

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## I. INTRODUCTION

Water is one of the most important elements on earth. Every living being needs water for its survival. Without water, plants, animals, microbes- everything will perish. Population growth- coupled with industrialization and urbanization has resulted in an increasing demand for the water thus leading to water crisis and serious consequences on the environment. It is fast becoming a scare commodity in most part of the world. Water resource comprising of surface water, ground water and marine and coastal water, support all living things including human being. Though water is available in the universe in huge quantity in the order of  $1400 \times 10^6 \text{ Km}^3$ , only 3% of the water in the universe is fresh water. Among the fresh waters, only about 5% of them or 0.15% of the total world waters are readily available for beneficial use. The total water resources available in India are  $1850 \text{ Km}^3$ , which is roughly 4% of the world's fresh water resources. Despite the seeming abundance of water on earth, as much as 42% (2.9 billion) of the world's population live in water- scare areas.

### A. Water usages in Industries

The requirement of fresh water for industrial use will increase from 30 BCM (Billion Cubic Meters) to 120 BCM by 2025 AD. A rapid industrialization has lead

to the industrial effluents and sewage, resulting in water pollution which lead to the industries is mainly comprised of hazardous chemicals and heavy metal.

### B. Impacts of Dyeing Industries on Water Bodies

While talking about the impact of industries on water bodies, in Salem, dyeing industries plays major role in polluting the surface water, groundwater and the soil. There are about 850 bleaching and dyeing industries located in and around Salem. The cluster of industries located in Salem releases  $7, 50,000\text{m}^3$  of effluent per day. This is ultimately discharged in to the river Noyyal basin after semi treatment or without treatment.

But due to the recent strict enforcement of rules and stringent action initiated by Tamilnadu pollution Control Board, almost all the industries have constructed either Effluent Treatment Plant or joined Common Effluent Treatment Plant. Even though the industrial owners constructed the plant they do not run them effectively due to the various reasons. Hence, the parameters from such industrial units are still higher than the water quality parameters prescribed by TNPCB for irrigation purposes.

### C. Water Demands

Water is an essential commodity in various sectors of the society. A domestic utility of water includes

washing, cleaning, cooking, bathing, etc. Whereas in industries, water acts as one of the raw material for most of the manufacturing processes. The other major utility of water is irrigation. Nothing comes out without water. Certain crops demand large quantity of water for its yield. Hence, it is clear that all the major segments of the society directly or indirectly depend upon water for its functioning and growth. As a result of population explosion and Industrialization, the water demands are keep on increasing day by day. This ultimately led to the depletion of the existing water bodies and this in turn made water scarcity in the environment.

#### D. Environmental Issues

India has made rapid strides in Industrialization and it is one of the ten most industrialized nations of the world. Nevertheless inadequate care in pollution control coupled with unplanned expansion has lead to serious environmental damages. The Central Pollution Control Board has identified seventeen categories of industries (small, medium, large scale) as significantly polluting. Small-scale industries, the special amenities and protection provided to them being a special feature of the Indian economy, they play a very important contributory role in the environmental pollution. Indian small scale industries are deficient in pollution control mechanisms and hence the following are the pollution encountered due to such industrial growths:

- Aesthetically unpleasant.
- Unfit for drinking and other human use leading to human health implication from its use under duress.
- Unfit for irrigation.
- Unfit for livestock.
- Surface water pollution.
- Eutrophication and aquatic weeds.

#### E. Water Balance

The environment issues clearly indicates that a water balance should be attained to meet the demand of the society and also mainly to maintain the Eco-Balance of the environment. Water balance can be achieved by allocating sufficient amount of water quantities to three sectors like Domestic, Industrial, and Irrigation with a view consideration of the future growth. But due to monsoon failure and industrialization, the water bodies are depleted and polluted. Hence they will not be able to help us in achieving the water balance. A better solution is to regenerate the existing polluted water bodies and to reuse the effluent/sewage by treating them with appropriate technologies.

#### F. Bio-Ozolyte

Bio-Ozolyte System can replace the conventional and advanced treatment technologies, to treat the effluent or wastewater. This method can be implemented for

wastewater treatment because of its following beneficial:

- Capital cost will be reduced
- Less power consumption
- Maintenance cost is less
- Less/no sludge generation
- Treated water can be used for agriculture
- No skilled labour is required
- The system is simple and flexible

#### G. Ozonisation

Ozonation is the disinfection of water by adding ozone which is powerful oxidizer of inorganic and organic impurities. Their advantages over chlorine are that is effective against cryptosporidium leaves, no tastes or odours, and unlike chlorine, apparently does not treat with natural organics to form compounds hazardous to humans. Ozonation widely used in Europe, subsequent particularly for drinking water. (Henry and Heinks1997) In North American, except for these cities of Montreal and Los Angles, disinfection with ozone is limited to a few smaller plants. Ozone in 1960- was passed in sewers carrying industrial waste water generated. But was dropped because of its high cost. In 1977, further modified ozone generator was found out and it helped in complete settling and gave better quality of water to meet the standards. This produced 28g/hr and hence was economical (IOA/PAG Conference, 1977).

“Disinfection is the destruction. Inactivation or removal of those micro-organisms likes to cause subsequent infection of people. Waste water disinfection refers to the use of a process designed specifically to reduce the numbers of viable, infectious microbial organisms in an effluent,” Due to its high oxidation potential, ozone is the most effective commercially available disinfectant in killing bacteria and inactivating viruses and protozoa. (Wright, 1997)

Ozone plays an important role as a disinfectant and oxidant in potable water treatment practice and is increasingly being used as a pre-oxidant before coagulation. The purpose of this study is to obtain insight into the mechanisms that are operative in pre-ozonized coagulation. Effects of pre-ozonation on organic matter removal during coagulation with IPF-PACI were investigated by using PDA (photometric disperse analysis), apparent molecular weight distribution and chemical fractionation. Fractionation results showed that the organic products of pre-ozonation exhibited lower molecular weight and more hydrophilicity, which impaired the removal of DOC in the following coagulation process. (Hai-long et al., 2006)

In 2006, Petro stopping centres, LP in Kingman Arizona implemented ozone disinfection instead of chlorine in order to reduce costly chemical fees and found that a one year return on investment, along with a vast array of other benefits was achieved. Besides disinfection to meet regulatory mandates

such as reduction of BOD (Biological Oxygen Demand), TSS (Total Suspended Solids), and precipitation of certain metals. To a lesser degree, ozone contributes to reduction of these contaminants as well. Additionally, ozone is extremely effective in removal of colour and odours. Inactivation of microorganisms as measured by weekly e-coli testing consistently achieved 1 log to 2 log (90%-99%) reduction providing disinfection well within the daily maximum and monthly average discharge limits of 576 CFU e-coli /100mg/l and 235 CFU e-coli/100mg/l respectively. Ozone as a disinfectant is a very versatile solution offering the highest efficiency to the treatment of waste water effluents. It is environmental friendly and ozone is an effective solution to the high costs associated with wastewater disinfection. (Max Shepard et al., 2007)

#### H. Aeration Process for Wastewater

In wastewater treatment processes, aeration introduces air into a liquid, providing an aerobic environment for microbial degradation of organic matter. The purpose of aeration is two-fold: 1.To supply the required oxygen to the metabolizing microorganisms and 2. Provide mixing so that the microorganisms come into intimate contact with the dissolved and suspended organic matter. The two most common aeration system are subsurface and mechanical. In a subsurface system, air is introduced by diffusers or other devices submerged in the wastewater. A mechanical system agitates the wastewater by various means (e.g., propellers, blades, or brushes) to introduce air from the atmosphere. Fine pore diffusion is a subsurface form of aeration in which air is introduced in the form of very small bubbles. Since the energy crisis in the early 1970s, there has been increased interest in fine pore diffusion of air of air as a competitive system due to its high oxygen transfer efficiency (OTE). Smaller bubbles result in more bubble surface area per unit volume and greater OTE. The advantage of various fine pore diffusers are as follows : ( 1) Exhibit high OTEs. (2) Exhibit high aeration efficiencies (mass oxygen transferred per unit power per unit time). (3) Can satisfy high oxygen demands. (4) are easily adaptable to existing basins for plant upgrades. (5) Result in lower volatile organic compound emissions than nonporous diffusers or mechanical aeration devices. The performance of diffused aeration system under normal operating condition is directly related to the parameter like fouling, wastewater characteristics, and process type and flow regime. Aeration will improve the treatment efficiency and degradation of microbes in the presence of oxygen and also enables proper mixing. (United States Environmental Protection Agency-EPA-1999). Aeration was chiefly used to remove the organic matters initially; later it was found that it helps in removal of Iron and Volatile Organic compound also.

#### I. Activated Carbon Filtration

Activated carbon treatment is primarily based on a naturally occurring phenomenon called Adsorption, in which the molecules of a liquid or gas are trapped either by an external or internal surface of the solid. The phenomenon is somewhat similar to iron filings being held by magnet. Activated carbon has a very high internal surface area and thus it is an ideal material for adsorption (Calgon Carbon Corporation).

#### J. EBB and Ozone-Combined Treatment Technology

The Combined treatment technology showed higher treatment efficiency and higher reduction in the concentration of the various basic parameters. It was also found that the treatment process was so economical when compared to other treatment process. In continuation with this work, the Bio-ozone treatment technology is clubbed with named as "BIO-OZOLYTE SYSTEM".

## II. STUDY AREAS AND SAMPLE LOCATION

#### A. Study Area details

Mookaneri is located in Salem district. It is located in the latitude 11°40'15" and longitude 78°01'10". The registered ayacut is 454 acres. The combined catchment area is 1.19 sq. miles. The total water spread area is 0.06s sq.km. Capacity of the tank is 21.189 M.cft. Mookaneri Lake is divided into two by a railway track running in between. The domestic sewage inlet is from the surrounding areas.



Fig.1- India, Tamilnadu, Salem and Mookaneri lake view



Fig.2- Mookaneri Lake overview

### III. MATERIALS AND METHODS

Bio-Ozolyte system is an emerging indigenous technology in the area of waste water treatment technologies like biological treatment along with aeration process followed by, ozonisation, and carbon filtration. From literature studies it has been found that these technologies can be worked out in their different combinations for obtaining better treatment efficiencies. This system is generally a primary, secondary and tertiary treatment system. The combination of advance technologies like Eco- Bio Block, Ozone and Anolyte along with the conventional technologies like Carbon filtration and Aeration, will improve the quality of treated waste water and also will be Eco-Friendly and Cost-effective. This technology will help for attaining better prospective use in the area of both industrial and municipal waste water treatment.

#### A. ECO-Bio Blocks

Eco Bio Blocks is a natural way of cleaning the waste waters. Obtained through natural means. Japanese introduce this technology and it is widely being in the field of aqua culture and aquariums. Eco Bio Blocks does not harm to the human system as well as the environment. It is highly effective, less intrusive comes in different sizes and forms. Eco Bio Blocks fits into the existing system seamlessly. Eco Bio Blocks exploits the nature's power of cleansing water naturally. Especially in aquariums rearing fishes, Eco Bio Blocks adds further to the aesthetics, while ridding the water of the odour.

Central pollution control board tested the performance efficiency of EBB in treating sewage water and found to be encouraging treatment methods. It is technically and economically viable for waste water drains, lakes, ponds etc. in India. Since EBB is an online treatment technology, additional large land space is may required as in the case of conventional methods and it saves the trouble of land acquisition processes. It also observed that there is a reduction in odour after treatment. It may be noted that EBB does not require energy, manpower and maintenance to perform the waste water treatment process. There is no operational cost practically, whereas other conventional treatment systems involve huge operational cost viz. energy, manpower, chemicals etc. (Vijayan Gurumurthy Iyer and Nikose.E.Mastorakis 2007)



Fig. 3 – Eco Bio Block

#### B. ECO Bio Blocks Composition

Eco Bio Block is non-toxic. It is obtained from natural resources. Eco Bio Block is made by mixing effective microbes with cement and porous stones. It is obtained from volcanic resource called volcanic ashes. They are highly porous in nature. In India porous rock-soil materials blasted from various kinds of Himalayan rocks and other geological structures are the common sources of Eco Bio Block material. It is made by mixing effective microbe (bacillus) with cement and porous stones. It does not contain any organic and inorganic chemicals. The microbes in Eco Bio Block are aerobic and survive in temperature of 10-110 being most efficient between temperatures of 25-60. They live both in air and water. The microbes live in pH 3 to pH 11. The microbes are demand in blocks and get activated immersed in water.

#### C. Effective Usage of Eco Bio Blocks

Eco Bio Block will not be effective if buried under mud due to lake of oxygen. Place Eco Bio Block, where it is open to atmosphere and not buried completely. Because, Eco Bio Block is an aerobic bacteria and will be more effective in places with oxygen (water falls) or with added oxygen (aerators or fountains). If fishes are present, there is sufficient oxygen for Eco Bio Blocks Bacteria. Sometimes, there is enough oxygen at the surface of water, but not at the bottom of the pond. If it is not possible to measure the dissolved oxygen at the bottom of the pond or any water body means, then place them near the surface of the water body.

Sometimes after about two years, with plants will start growing on the surface of Eco Bio Block. This does not indicate a bad situation. Plants will help Eco Bio Block cleanse the water. They do not contain any chemical and are purely organic and no sludge is generated after this treatment. The microbe present in the block gets activated after the retention period of fifteen days. After their activation they act on the organic matters and any other constituents in the waste water and clean up the water. The effluent sample has a considerable reduction in TDS, BOD and COD. The used Eco Bio Blocks can be reused until nearly five years of its usage. The worn out blocks can be identified from its appearance itself.

The amount of water can be treated by the blocks can be calculated by multiplying the volume of Eco Bio Blocks with thousand. Eco Bio Blocks is widely being used for treating waste water of drains, canals, rivers, etc in Japan and Malaysia. Central Pollution Control Board, a statutory apex body lender of the Ministry of Environment and Forests, Govt. of India tested the performance efficiency of Eco Bio Blocks in treating the sewage water and found encouraging results.

#### D. Working Concept Of Eco Bio Block

The microbes when immersed in the waste water will get activated after certain retention period. The bacteria will start their multiplication process in the presence of atmospheric oxygen or externally added

aerators. The replication of these bacteria in the wastewater will continue until the aeration or oxygen supply is present. This large mass of bacteria will start acting upon the waste water and the stabilization will be carried out. During this process, the bacteria will consume the organic solids present in the waste water. As a result of the metabolic reaction, complex organic molecules will be converted to some intermediate compounds and finally into simpler and products. This ends the stabilization process. The initial colour of raw waste water will be brownish to black colour. If the waste water colour turns yellowish, it is identical that the stabilization is completed. The bio block can be removed by washing the blocks and the blocks can be re-used.

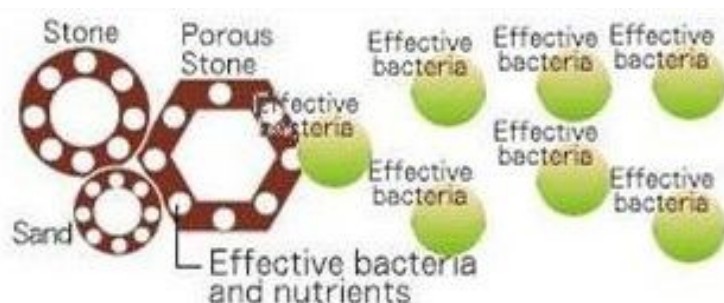


Fig. 4 – Working Mechanism of Eco Bio Block

#### E. Application of Eco Bio Block

- Treatment of polluted rivers, lakes, ponds, drains, etc.
- Water and waste water treatment plants.
- Sewage treatment plants.
- Sanitation, Deodourisation and waste water treatment of Livestock farms.
- Sanitation, Deodourisation and waste water treatment of Aqua culture (Tiger pralines, fishes, oysters, etc.).
- Garbage bin treatment.
- Treatment of grease trap saucer together with special oil treatment microbe.
- Household drains and septic tanks.



Fig. 5 – Sample is treated with Ozone



Fig. 5 – Aeration treated and Ozonised treated sample

## RESULTS AND DISCUSSION

The raw as well as the treated samples collected from Mookaneri (CETP) were tested for physio – chemical parameters, to find out the characteristics of the wastewaters. The physio- chemical parameters of the raw effluent was analysed. This test was carried out to the bio-block treated sample and ozonized treated samples. The results showed that the parameter as per the norms shown in the tables.

S.NO	Parameters	Raw water	Treated water Aeration+EBB+ Ozonized	Standard Parameters
1	pH	7.20	8.29	5.5 to 9.0
2	Colour	Less than 10.0 Hazen unit	Less than 2 Hazen unit	-
3	Turbidity	1.3	0.8	-
4	TDS	1100	970	2000 mg/l
5	TSS	96	8	Less than 600 mg/l
6	COD	1648	16	-
7	BOD	399	4	Less than 350 mg/l
8	Sulphate	9.09	167	-
9	Nitrogen	21.6	76	-
10	Phosphorous	20.6	1.93	-
11	Ecoli	10	9	10

TABLE I  
PHYSIO- CHEMICAL PARAMETERS OF THE RAW EFFLUENT, BIO-BLOCK TREATED AND OZONIZED TREATED  
SAMPLES

**In Aeration + EBB process the parameters like colour, Total Dissolved Solids, Total Suspended Solids, pH, BOD, COD are reduced in minimum range. But in Ozonised process the parameters are reduced in maximum range.**

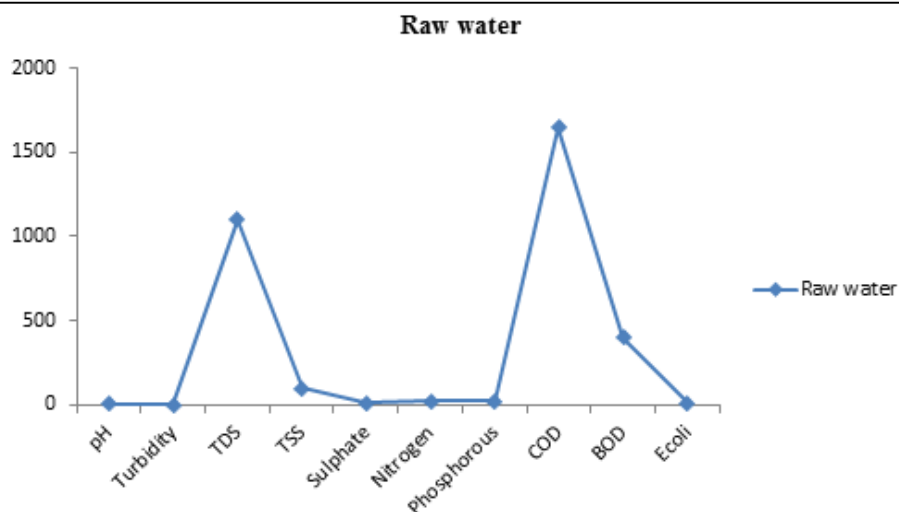


Fig. 6–Physio- Chemical parameters of the raw effluent

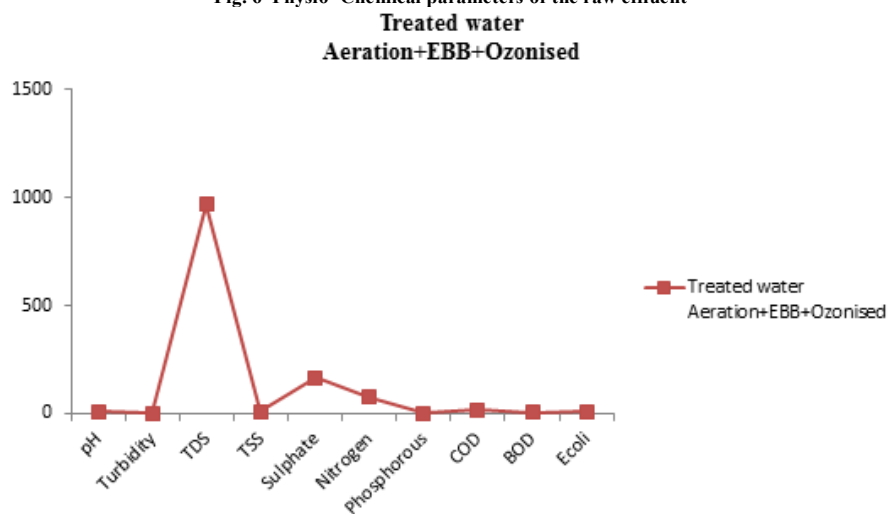


Fig. 7–Physio- Chemical parameters of Bio-block treated sample and Ozonized treated samples.

## CONCLUSIONS

Based on the lab scale studies subjected to the Bio-Ozolyte system, its performance has been evaluated in treatment of dyeing waste and the following conclusions are arrived:

- The combination of Eco Bio Block, Ozone, has proved to give best results for treating industrial textile dyeing wastewater.
- It is capable of drastically reducing various Physio-Chemical parameters like TDS, TSS, Sulphate, pH, etc.
- The BOD and COD reduction is highly remarkable, leading to better treatment efficiency.
- The BOD removal was higher than COD removal percentage.
- This system is so flexible and eco-friendly.
- The efficiency of treated water is much similar and also in some cases much better than other physical and chemical treatments.

- The colour of the treated water is much better when compared to other treatments.
- The Bio-Ozolyte System is suitable for Hostel, Slaughter House, Industrial wastewaters and Municipality.
- As the treated samples of Physio-chemical parameters are within the standard limits, so it can be used for irrigation purpose and re-dyeing process.

## SUGGESTIONS FOR FUTURE WORK

- With regard to the present investigation and if so any investigation to be carried out in the future, the following are suggested to be carried out:
- Performance of Bio-Ozolyte system can be evaluated by varying the Ozone.
- More number of trials shall be carried out to assess the sustainability of the treatment.

- Bio-Ozolyte technology is attaining its scope in the Domestic Sewage treatment due to its flexibility, cost of effectiveness and easy maintenance.
- Possibilities of fisheries and recreational facilities.
- More advantage than other conventional process in regard with capital cost, maintenance, space requirement, power consumptions etc.

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