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Waste Water Management Using Bio-Ozolyte System

T. Senthil Vadivel and S. Anitha Rathinam
Department of Civil Engineering, KPR Institute of Engineering & Technology,
Coimbatore – 641 407, Tamil Nadu, India.
Email: tsnsenthu@rediffmail.com, anitha.civil6@gmail.com
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Abstract - **Water pollution is the major problem in today's scenario. The sources of water in all areas are polluted by domestic and industrial wastes, results in boring more well points and decreases the ground water sources too. The climatic change lead into failure of monsoon and made the water demand in water bodies. Henceforth recycle and reuse of waste water become essential. Conventional and modern treatment methods are suitable for waste water treatment but constraints such as essentiality of additional treatment, large area requirement, more electrical energy consumption, high maintenance and operating cost prevails us to think about bio-ozolyte system which is called as zero pollutant technique. In this study, Eco Bio Blocks (EBB), ozone and anolyte along with carbon filtration technologies are clubbed together and found effective in treating domestic, industrial as well as bio-medical natured waste too. EBB serves in reducing the basic water parameters but the microorganisms generated can be removed with the help of anolyte, ozone and heavy metals present in water using carbon filtration. Different combinations of the above mentioned technologies have been worked out for three different set of samples and the high efficient combination was identified.**

Keywords: **Eco Bio Blocks, Ozone, Anolyte, Carbon Filtration, Bio-Ozolyte**

I. INTRODUCTION

Water is an integral part of the environment. It is everything either life saving or death trap .Water is a critical element of life without which sustainability is not possible. The importance of water is inevitable be overstated when it comes to life on earth. Over 70% of the Earth is covered with water, and without water there is no life. There are many life forms that can live with very little water, but nothing living on earth exists without water. Water makes up 50 to 90 percent of the weight of living things. Natural water cycle is responsible for the flow of water from surface sources to sub surface sources. Surface sources get water during rainfall and the rest percolates to form the sub- surface water sources. Surface waters were used widely and sub-surface water sources were kept as reserve in earlier days. In present status, the sub –surface sources are also being depleted in addition to the surface sources. This is a major impact of industrialisation, population growth and climatic change. It is estimated that 69% of worldwide water use is for irrigation, with 15-35% of irrigation withdrawals being unsustainable. It is estimated that 22% of worldwide water use is industrial. It is estimated that 8% of worldwide water use is for household purposes [31]. Climate change emphasized monsoon failures and this led to the scarcity of water. Adding to this, water pollution is a major sin that cannot brought under control. The industries let out the waste water with or without primary treatment alone and this pollutes the existing water sources also. Integrated water resources management is now essential to meet the demands of the technical society as well as to safeguard the environment. Waste water treatment can help us to bring down the water pollution and afforestation works out the climate change. The conventional treatment technologies available for waste water treatment are as follows: activated sludge, aerated lagoons, trickling filters, rotating biological contactors, packed bed reactors, anerobic sludge blanket, expanded bed, etc.

The demerits of the conventional methods are as follows:

a. Cost of capital and operation is high.
b. Sludge disposal is essential.
c. Alternative solution is important for shock loads and metals.
d. Clogging is possible in beds.
e. Insects breeding issues.
f. Effluent in reduced chemical form requires further treatment.
g. If the process is anaerobic hence it required long duration.
h. Requires sufficient amount of granular seed sludge for faster start-up.

Cost is the major reason for not implementing either conventional or advanced treatment techniques. Along with this sludge disposal is also a major problem to be considered. Some advanced techniques have been analyzed for waste water treatment.

a. EBC technological projects have an effective working life of ten seven years in running water and have been successfully tested in various construction projects for the purification of industrial wastewater and polluted water bodies. These remove total dissolved solids (TDS), chemical oxygen demand (COD) suspended particulate matter (TSS), organic pollutants, colour and odour, biochemical oxygen demand and chemical oxygen demand, nitrogen and phosphorus and bad odour from water and kill mosquito larvae [29].

b. Ozone has been an effective primary disinfectant which leads to further reduction of iron, TSS, COD, BOD, and Phenols and offers the highest efficiency to the treatment of wastewater effluents [14].

c. Anolyte eliminated the spore forming bacteria. Where anolyte made contact with a surface, disinfection was at an acceptable level, with most surfaces being sterilized [23].

The problems can be solved by the Bio-ozolyte system which is an zero pollutant technique. Eco Bio Blocks (EBB), ozone and anolyte along with carbon filtration technologies are clubbed together and found effective in treating domestic, industrial as well as bio-medical natured waste too. EBB serves in reducing the basic water parameters but the microorganisms generated can be removed with the help of anolyte, ozone and heavy metals using carbon filtration .Different combinations of the above mentioned technologies have been worked out for three different set of samples and the high efficient combination was identified.

II. Materials And Properties

A. Eco Bio Block (EBB)

EBB is made up of with volcanic rocks, zeolite cement infused with bacteria available in forms of blocks. It's a Japanese technology of cleaning water by natural source. These blocks are available in various sizes, shapes and the methods of manufacturing is very similar to bricks. Microbes powder, liquids and blocks are powerful products infused with specific natural microorganisms. These microbes are dormant in the powder, liquids as well as blocks and get activated when immersed in water. Since microbes are necessary to degrade the pollution load in the sewage treatment plant, the EBB plays an important role in generating microbes continuously when immersed in water, so as further seeding is not essential. It is efficient in reducing TSS, COD, BOD, heavy metals in the waste water. E. coli and total bacteria can also be removed to a certain extent. Colour and odour will be partially destroyed. It does not generate sludge and hence a single block can be efficiently used for 5 years for water treatment.

Fig. 1 Eco Bio Block

B. Ozone

Ozone is a well known disinfectant as well as oxidant. Ozone deactivates micro organisms through cellular lysis process and this occurs less than 2 seconds. Whereas, chlorine takes nearly 15 to 20 minutes to destroy the micro organisms. Ozone is generated through corona discharge and here the oxygen molecule into two atoms. This system is dielectric and in the corona (electric field) contains unstable oxygen atoms have excess electronic and combine with other oxygen molecule to their lower energy state. This combination forms the ozone. This method of ozone generator is cheaper comparatively and such ozone generators are available at different capacities of ozone generation (5g/hr – 36g/hr). The ozone generator employed has a capacity to generate 10g/hr.

Fig. 2 Schematic Diagram of an Ozone Generator

C. *Anolyte*

The anolyte is a Russian technology, which is being used for waste water treatment and reused for consumption . Anolyte is a colourless transparent biocidical liquid with a slight chlorine smell.It is produced by the electro chemical activation of raw water in a specially designed envirolyte reactor system. A saline solution is activated by passing through a cylindrical electrolytic cell. Anode and cathode are separated by semipermeable membrane.This results in production of streams of anolyte and catholyte. Anolyte is the positively charged oxidizing agent containing HOCL, O, O_2 & O_3. OCl ions and hydrogen peroxide micro bubbles displays unrivalled disinfectant properties and under controlled conditions, its proven to give a multi log reduction against selected microbes. Anolyte has a pH range of 2-9. This technology is safe for humans but it is lethal against bacteria, fungi, spores, viruses, algae, bio film and moulds. Its eco –friendly and only 0.5 -1 % of total water to be treated will be required. The anolyte also gives a drastic reduction in micro-biological concentration, BOD, COD, TSS & heavy metals also.

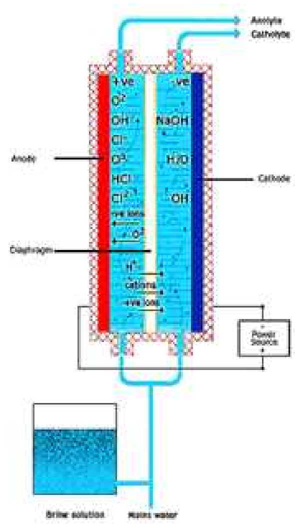

Fig. 3. Schematic Diagram of a Envirolyte Reactor System

III. METHODOLOGY

A. Sampling Areas

Three sampling areas have been selected with an aim of finding out the suitability of this combined technology to different types of waste waters. Accordingly, three sampling regions namely Sanganur canal, Rajavaikkal and Valankulam tank were choosen and their performance were studied.

1. Sanganur Canal

The Sanganur canal originates from the Western Ghats of Kuridimalai hills. It enters Coimbatore city limit at Coimbatore – Mettupalayam road and flows for about 10km within the city out falling into Singanallur tank. Sanganur canal water at Vellalore was once being utilized for irrigation, but now it was polluted completely. It acts as the major open drainage system which has intricate linkage with storm water supply, domestic sewage disposal. Major source of pollution in this canal is due to discharge of domestic sewage. The sample has been collected in Ramanathapuram area, after which it joins Singanallur Tank.

2. Rajavaikkal

The Rajavaikkal originates near Perur, Telungupalayam and it drains into Ukkadam Periakulam and finally joins the Singanallur tank . The source of water is from a Noyyal river and also the rainfall in that area. During monsoon season and distributes water to the nearby fields for irrigation purposes and it was the one of the canal in Coimbatore with high water carriage and hence it was named so. But, in recent days due to increase in population in Perur region and development of small scale industries, the canal was encroached by the people along the banks followed by dumping of solid wastes and this led to change in the course of the canal. The industrial effluent is the major part of the flowing water in Rajavaikkal, which are mainly discharged from the dyeing industries and plating industrial wastes around this region.

3.Valankulam Tank

Valankulam Tank is located adjacent to Trichy road of Coimbatore corporation. This tank gets water from Selva Chinthamani tank and Kumarasamy tank and from rain in this region. Valankulam tank is used for ground water recharging, protecting flood, nurtures birds and aquatic organisms. But in recent years the tank is subjected to eutrophication and its mostly covered by water hyacinth. This is mainly due to discharge of bio-medical waste from government hospital of Coimbatore and domestic sewage from nearby residential areas mainly from south Coimbatore.

B. *Treatment Process Involved*

A pilot plant study has been done with lab scale. Initially, the physio-chemical parameters, heavy metals concentration and biological parameters were found in the raw waste water samples. Five litres of the water samples have been taken. A single EBB was immersed with an addition of diffused bubble in the samples for aeration. The retention period will be given a minimum of five days. The decomposition of the micro organisms will be ended and it will be indicated by a colour change. If the pollution load is higher the retention period also will be higher and vice versa. After the decomposition of waste water by EBB, the waste water samples were tested for the physio - chemical parameters, heavy metals concentration and biological parameters. From this EBB treated samples, one litre of the water has given ozone injection of about 5gm for certain constant time period. This ozonized samples were filtered using a slow sand filter with two layer of sand and one layer of activated carbon. Then the physio-chemical parameters, heavy metals concentration and biological parameters were found for this set of samples. The next combination includes, ozone injection to a litre of EBB treated water for about same 5gm and this is followed by addition of anolyte in the ratio of 1:10 (if the pollution load is higher the ratio can be revised). Similarly, the physio-chemical parameters, heavy metals concentration and biological parameters have been found.

IV. Results And Discussion

Raw Sample Treated Sample

Fig. 4 Sanganur Sample Before and After Various Treatment Combinations.

1. *Water Parameters*

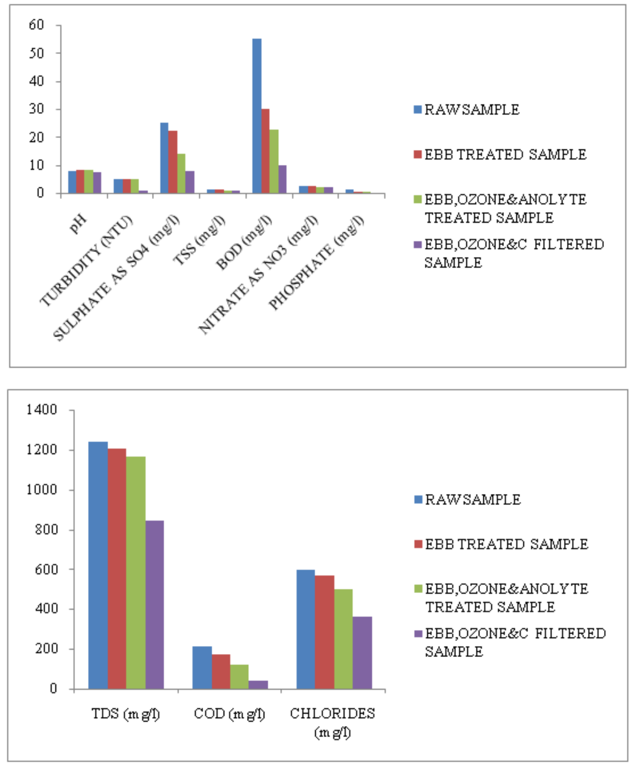

Fig . 4Variation of Physio-Chemical Parameters Of Sanganur Canal .

2. *Heavy Metals Concentration*

Table I Heavymetals Concentration Of Sanganur Canal

Heavy Metals	Raw Sample	EBB Treated Sample	EBB Treated, Ozonised and Carbon Filtered Sample	EBB Treated, Ozonised and Anolyte Added Sample
Mercury as Hg	BDL	BDL	BDL	BDL
Lead as Pb	BDL	BDL	BDL	BDL
Arsenic as As	0.12 mg/l	BDL	BDL	BDL
Zinc as Zn	BDL	BDL	BDL	BDL
Iron as Fe	0.34 mg/l	0.22 mg/l	BDL	0.1 mg/l
Copper as Cu	0.0012 mg/l	BDL	BDL	BDL

Note: BDL – Below Determined Level (< 0.0001 mg/l)

3. *Microbiological Characteristics*

Table II Microbiological Parameters Of Sanganur Canal

Parameters	Raw Sample	EBB Treated Sample	EBB Treated, Ozonised and Carbon Filtered Sample	EBB Treated, Ozonised and Anolyte Added Sample
E. Coli	$6x10^3$ cfu/ml	$2x10^3$ cfu/ml	0	0
Total Bacterial Count	$16x10^3$ cfu/ml	$11x10^3$ cfu/ml	0	0

B. *Rajavaikkal Sample*

Raw Sample Treated Sample

Fig. 5 Rajavaikkal Sample Before and After Various Treatment Combinations

1. *Water Parameters*

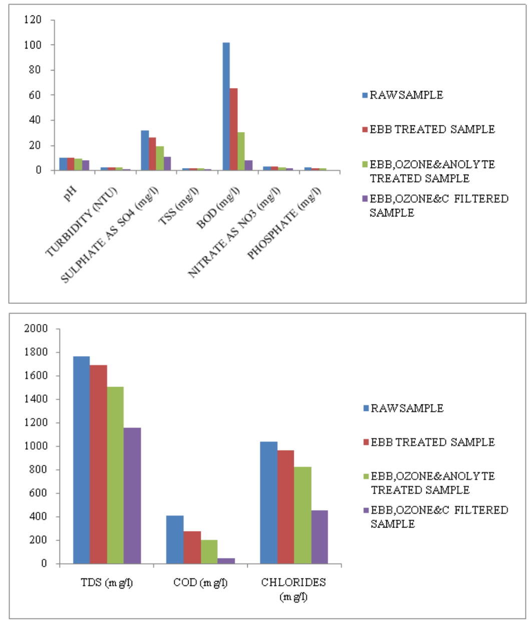

Fig. 6 Variation Of Physio-Chemical Parameters Of Rajavaikkal

2. *Heavy Metals Concentration*

TABLE III HEAVY METALS CONCENTRATION OF RAJAVAIKKAL

Heavy Metals	**Raw Sample**	**EBB Treated Sample**	**EBB Treated,Ozonised and Carbon Filtered Sample**	**EBB Treated, Ozonised and Anolyte Added Sample**
Mercury as Hg	BDL	BDL	BDL	BDL
Lead as Pb	BDL	BDL	BDL	BDL
Arsenic as As	0.11 mg/l	BDL	BDL	BDL
Zinc as Zn	0.011 mg/l	BDL	BDL	BDL
Iron as Fe	0.41 mg/l	0.26 mg/l	BDL	0.2 mg/l
Copper as Cu	0.0013 mg/l	BDL	BDL	BDL

3. *Microbiological Characteristics*

TABLE IV MICROBIOLOGICAL PARAMETERS OF VALANKULAM TANK

Parameters	**Raw Sample**	**EBB Treated Sample**	**EBB Treated,Ozonised and Carbon Filtered Sample**	**EBB Treated, Ozonised and Anolyte Added Sample**
E. Coli	$5x10^3$ cfu/ml	0	0	0
Total Bacterial Count	$26x10^3$ cfu/ml	$6x10^3$ cfu/ml	0	$1x10^3$ cfu/ml

C. *Valankulam Sample*

Raw Sample

Treated Sample

Fig. 7 Valankulam Sample Before and After Various Treatment Combinations

1. *Water Parameters*

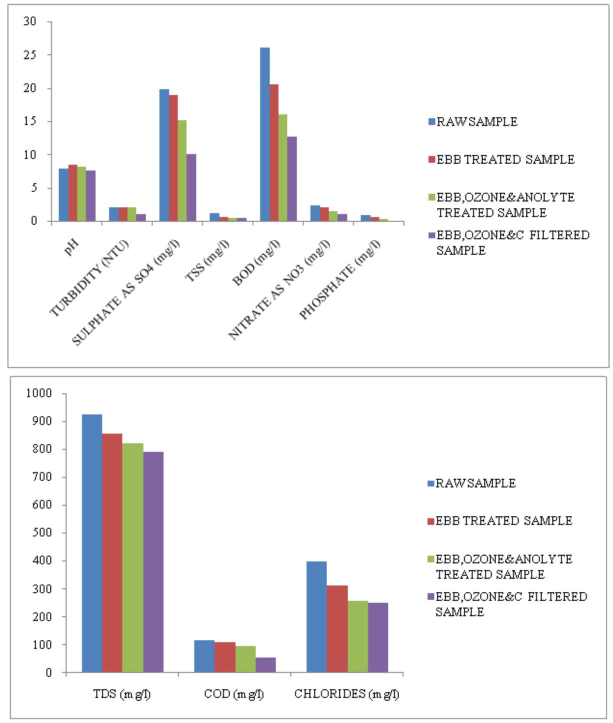

Fig. 8 Variation Of Physio-Chemical Parameters Of Valankulam

2. *Heavy Metals Concentration*

TABLE V HEAVY METALS CONCENTRATION OF VALANKULAM TANK

Heavy Metals	Raw Sample	EBB Treated Sample	EBB Treated,Ozonised and Carbon Filtered Sample	EBB Treated, Ozonised and Anolyte Added Sample
Mercury as Hg	BDL	BDL	BDL	BDL
Lead as Pb	BDL	BDL	BDL	BDL
Arsenic as As	0.10 mg/l	BDL	BDL	BDL
Zinc as Zn	BDL	BDL	BDL	BDL
Iron as Fe	0.27 mg/l	0.14 mg/l	BDL	0.1 mg/l
Copper as Cu	0.0018 mg/l	BDL	BDL	BDL

3. *Microbiological Characteristics*

TABLE VI MICROBIOLOGICAL PARAMETERS OF VALANKULAM TANK

Parameters	Raw Sample	EBB Treated Sample	EBB Treated,Ozonised and Carbon Filtered Sample	EBB Treated, Ozonised and Anolyte Added Sample
E. Coli	$5x10^3$ cfu/ml	0	0	0
Total Bacterial Count	$26x10^3$ cfu/ml	$6x10^3$ cfu/ml	0	$1x10^3$ cfu/ml

TABLE VII COMPARITIVE REMOVAL EFFICIENCY OF TREATMENT COMBINATIONS FOR SANGANUR

PARAMETERS	EBB TREATED SAMPLE	EBB + OZONE + ANOLYTE	EBB + OZONE + C FILTRATION
BOD	45	59	82
COD	19	44	81
TDS	3	6	32
TSS	6	45	60
Sulphates as SO_4	12	44	68
Chlorides	4	16	39

TABLE VIII COMPARITIVE REMOVAL EFFICIENCY OF TREATMENT COMBINATIONS FOR RAJAVAIKKA

PARAMETERS	EBB TREATED SAMPLE	EBB + OZONE + ANOLYTE	EBB + OZONE + C FILTRATION
BOD	36	71	92
COD	32	50	89
TDS	4	15	35
TSS	3	8	39
Sulphates as SO_4	16	39	66
Chlorides	7	20	56

TABLE IX COMPARITIVE REMOVAL EFFICIENCY OF TREATMENT COMBINATIONS FOR VALANKULAM TANK

PARAMETERS	EBB TREATED SAMPLE	EBB + OZONE + ANOLYTE	EBB + OZONE + C FILTRATION
BOD	23	38	51
COD	5	17	51
TDS	7	11	14
TSS	50	58	62
Sulphates as SO_4	5	23	49
Chlorides	21	31	37

It is evident from the removal efficiency that EBB alone treats the waste water partially, when it is clubbed with ozone and anolyte the treatment efficiency is comparatively better. But then the combination of EBB, ozone and carbon filtration has given better result with complete removal of microorganisms, better reduction in heavy metals concentration and colour, odour, BOD, COD, Sulphates. TSS, TDS and Chlorides are removed but only to an certain extent. It should be noted this methodology has suited domestic waste water and industrial waste water efficiently, whereas for bio-medical waste mixed waste water the treatment efficiency is comparatively lesser. This can be overcome by increasing the number of blocks and increasing the ozone dosage.

V. CONCLUSION

It is derived from the above study that EBB is capable of decomposing the waste water aerobically. Ozone helps in odour removal, reduction in heavymetal concentration and disinfection. Anolyte mainly serves as a disinfectant. EBB, ozone and carbon filtration has proven to reduce the needed waste water parameters effectively. This green technology can be employed as a Sustainable approach for the demanding waste water treatment.

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