Wastewater Treatment Using Eco Bio-Construction Material Technology

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Abstract: - Reclaimed wastewater can be considered as additional water resources and its planned reuse for lower grade purposes (other than drinking) will result in large saving of potable water supplies. Polluted water has to be cleaned up immediately by a suitable natural ecological system. In this paper, research inputs on water supply and wastewater treatment systems by using eco bio-construction (EBC) material technology have been presented. EBC constructed households, industries and farms are efficient for natural cleaning of discharged effluents according to environmental standards for the design period of ten years. EBC materials are 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 EBC material. It is the main ingredient in EBC material technology. EBC materials cleanup water through coexistence with microorganisms called aerobic microbiological process. This natural clean up systems using aerobic microbiological process are effective and efficient for wastewater treatment. Aerobic bacteria are a kind of grass bacillus taken from sea bottom and mountains. They are safe microorganisms with a determined DNA sequence. In porous biomaterials, mixture of this effective aerobic bacteria and feed are sprayed and get sealed. Such aerobic bacteria propagate and function as cleanup mechanisms by fermentation. During the cleaning process, aerobic bacteria come into contact with water. Fermentation process occurs in porous media and bacteria start propagation and go out of media. The bacteria degrade organic matter and convert into carbon dioxide and water and thus cleans up sewage water. Since, feed (that is food) for the bacteria are already enclosed, its effectiveness and efficiency is constantly achieved. EBC materials are made up of paste mixture containing volcanic porous stones or ashes , strong alkaline cement, appropriate quantity of water and effective bacteria sealed in a live and propagation state. Volcanic stones are rich in minerals and their fine porous structure is optimal for habitation of microorganisms. EBC material concrete technology made from a kind of fermented-soybeans bacillus which can be simulated from the sources of aerobic bacteria grow in mulch made from leaves in nature. These bacteria are viable in air and water. It degrades e.coli and anaerobic putrefactive bacteria thus sanitizing the environment. EBC microbes kill mosquito larva, which is of medical importance. By getting rid of mosquito larva, it can be used for controlling communicable diseases. This paper has provided overview of this technology applied in water supply and wastewater treatment projects. Such projects investigated are namely domestic sewerage treatment systems, storm sewerage systems, combined sewerage systems, industrial sewerage systems, water channels, constructed wetlands and public sewers, river channels, industrial wastewater sewers, constructed wetlands, wastewater treatment systems, sewage farms, pearl and fish farms and other ocean constructions. EBC material technology has also been applied to water purification systems. Wastewater quality has been achieved in such a way that aquatic vegetation can grow and fish can inhabitant in it. The EBC material structures works on the principle of “natural way of cleaning water” by absorbing pollutants and removing bad odor.

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, color and odor, biochemical oxygen demand and chemical oxygen demand, nitrogen and phosphorus and bad odor from water and kill mosquito larvae. EBC management practices have been investigated in open drains. It is has been reported that there is a drastic reduction in the content of total suspended solids (TSS) and chemical oxygen demand (COD). Treatment of sewage using this construction material can prevent pollution. It is a one-time investment. It can cut off 40-45 % power consumption and 55-60% cost of maintenance (COM) compared to other conventional wastewater treatments plants. There were EBC material structures laid down for about 500 meters in open drain. Samples have been collected and their results are very much a satisfactory. Such results are (i) killing of larval mosquitoes to considerable extent, (ii) 70% rate of reduction of Total suspended solids, nitrates and phosphates (iii) total detention time (iv) removal of color and foul smell to an extent of 90%. EBC materials structures could be used in house sewers. The results of performance tests undertaken in various wastewater supply and sanitation projects are provided in this research paper. This eco-friendly technology has been evaluated for its performance with a particular reference to techno-commercial, economical and environmental aspects. The construction method is cost effective, durable and efficient. It is recommended that EBC material technology can be used in water supply and wastewater treatment construction projects and thus the reclaimed wastewater can be used as additional water resources for sustainable water development.

Key-Words: - aerobic, biomaterials, construction, performance, pollution, wastewater

1 Introduction

Despite the seeming abundance of water on earth, as much as 42% (2.9 billion) of the world's population live in water-scarce areas. There will be 3.2 billion people in 54 water-stressed countries out of which 4.8 billion people will not be able to get their daily 50 liters – the minimum requirements of water for drinking, washing and cooking. Hence, reclaimed wastewater can be considered as additional water resources and its planned reuse for lower grade purposes (other than drinking) will result in large saving of potable water supplies. Wastewater becomes a reliable water source just available on the surface as a product from any treatment plant. Wastewater from municipal sewage treatment plant undergoes high level of treatment before getting into the environment. But it is costly and not quality [2]. An alternative method here is that polluted water may be cleaned up immediately by a suitable natural ecological system.

Water related diseases such as cholera, dysentery and typhoid are the common health effects. This can be prevented by various methods such as protection of water sources, effective water treatment and distribution systems, well-maintained sewers, comprehensive wastewater treatment facilities and pollution control measures. There is a great need to implement eco-friendly water and wastewater treatment systems using eco bio-construction (EBC) material technology for the treatment of sewage water similar to the role model presented in this pilot project [3].

2 Problem Formulation

The aim of the project is to design and develop EBC technology for the construction of structures for wastewater treatment, storm water sewers, sewage treatment sewers and industrial waste treatment sewers. The objective of this project is to assess and evaluate the performance of EBC management systems [2]. A pilot plant on this bio-remediation technology using EBC materials for treatment of sewage water and eradication of mosquitoes was investigated. This paper provides research overview of EBC material technology applied in water supply and wastewater treatment projects. Such projects are namely domestic sewerage treatment systems, storm sewerage systems, combined sewerage systems, industrial sewerage systems, water channels, constructed wetlands and public sewers, river channels, industrial wastewater sewers, constructed wetlands, wastewater treatment systems, sewage farms, pearl and fish farms and other ocean constructions. EBC material technology has been applied to water purification systems [4].

EBC materials can applied in ready mixing conditions to solve bad odors and sanitation problems

namely, (1) treatment of polluted rivers, lakes, ponds and drains (2) livestock farms, that is cows, pigs and chicken, (3) waste treatment for Aquaculture, that is tiger prawns and fishes, (4) waste and water treatment plant and sewage treatment plant, (5) domestic household pets, that is dogs and cats, (6) Highly effective reduction of foul odor from pets' waste, (7) Treatment of water in aquariums. (8) Garbage bin. (9) Treatment of grease trap saucer together with special oil treatment microbes, house hold drains and septic tanks. 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, color and odor, biochemical oxygen demand and chemical oxygen demand, nitrogen and phosphorus and bad odor from water and kill mosquito larvae.

3 Problem Solution

3.1 Materials and Methods

EBC materials are obtained from volcanic resource called volcanic ashes [3]. 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 EBC material. It is the main ingredient in EBC material technology. It is made by mixing effective microbe (bacillus) with cement and the porous stones. It does not contain any organic and inorganic chemicals. Sewers made of EBC constructed materials react microbiologically.

1.The microbes in EBM are aerobic and survive in temperatures of 10 - 110 °C being most efficient between temperatures of 25 - 60 °C. They live both in air and water.

2.The microbes live in pH 3 to pH 11.

This works on the principle of natural way of cleaning water by absorbing pollutants and removing bad odors. Many water pollution problems are due to the absence of dissolved oxygen (DO) in water. Aquatic ecosystem requires the presence of sufficient oxygen in the water. Organic pollutants are food for microorganisms. During their stabilization, oxygen is consumed. Excessive amounts of organic matter discharged to a watercourse will cause depletion of the dissolved oxygen level. This may kill most forms of aquatic life. Wastewater control measures are thus aimed at ensuring satisfactory dissolved oxygen concentrations in the receiving water, removing excessive amounts of suspended matter and preventing the discharge of toxic materials. Reclaimed wastewaters can be considered as additional water resources and its planned reuse for lower grade purposes (other than drinking) will result in large saving of potable water supplies. EBC material technology is a natural method of cleaning the wastewater [1]-[3]. It is a water quality purification mechanism. Plain cement concrete (PCC) made with this material technology is used for construction of water supply and sewerage projects. Microbe's flow into the water brings nutrition and purifies water since porous stones have got excellent living conditions for microbes [1].

As per the experiments conducted in many real time projects, some of the results and applications of EBC materials are presented below: -

EBC materials are made of mixing effective microbe with alkaline cement and the volcanic ashes and porous stones with clean water [3]. This biochemical product used in this project is eco bio-construction materials used in the construction of water treatment plants and sewers. It is a material manufactured through stringent process of mixing the precise amount of cement, sand, stone, environmentally friendly microorganisms with special nourishment and volcanic stone [figure 2]. It is infused microorganisms into cement blocks, which treat polluted water by maintaining the natural balance and eliminating unnatural and unfriendly microorganisms present in the polluted water continuously.

A pilot project on using the EBC materials for treatment of sewage water and eradication of mosquitoes was investigated. These materials were mixed with cement and "useful bacteria" (bacillus) and constructed in open sewers and pits; the constructed structures started reacting [5]. Figure 1 shows testing of construction samples. This works on the principle of "natural way of cleaning water" by absorbing pollutants and removing bad odor. EBC sites have been investigated in open drains [3].

Fig.1 . Aeration process of eco bio construction materials

Fig. 2. Constructed structures started microbiologically reacting

3.2 Results and Discussions

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 [5]. These remove total dissolved solids (TDS), chemical oxygen demand (COD) suspended particulate matter (TSS), organic pollutants, color and odor, biochemical oxygen demand and chemical oxygen demand, nitrogen and phosphorus and kill mosquito larvae [Table 1] [3].

3.2.1. Eco-Bio Construction Materials Conducted in Environmental Laboratory

Table 1 . Wastewater Quality Parameters

Substance/Characteristics	Before Adoption of EBC Material Technology	After Adoption of EBC Material Technology
pH hydrogen ion activity	7.3	7.6
Turbidity, mg/l	35	26
Total suspended solids, mg/l	3969	559
Total dissolved solids, mg/l	2522	429
Total nitrogen, mg/l	58.8	18.2
Total phosphorus, mg/l	44	11.2
Dissolved oxygen, mg/l	2.5	3.5
Biochemical oxygen demand, mg/l	95	20
Chemical oxygen demand	102	13

Fig. 3. Before Implementation of Eco-Bio Construction Material Technology

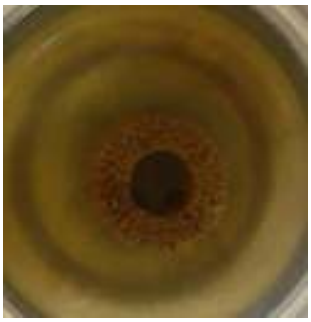

Fig. 4. After Implementation of Eco Bio Construction Material Technology

Table 2 . Eco-Bio Construction Material Structure Performance

Environmental Parameters	Before EBC	After EBC
1. pH	7.5	7.5
2. Turbidity, mg/l	385	300
3. Total suspended solids, mg/l	1800	1600
4. Chemical oxygen demand	90.4	40.7
5. Total nitrogen, mg/l	40.1	35.8
6. Total phosphorus, mg/l	50.9	40.8
7. Dissolved oxygen, mg/l	5.8	7.1
8. Biochemical oxygen demand, mg/l	20.3	11.4
Environmental Parameters	**Before EBC**	**After EBC**
1. pH	7.3	7.6
2. Turbidity, mg/l	35	26
3. Total suspended solids, mg/l	34.5	18
4. Chemical oxygen demand	90	40
5. Total nitrogen, mg/l	58.8	18.2
6. Total phosphorus, mg/l	16	9.2
7. Dissolve oxygen, mg/l	0	3.2
8. Biochemical oxygen demand, mg/l	40	25

3.2.2 Given Below EBC Materials Used In Various Construction Projects [1]

1.Sand, clay and Portland cement blends
2.Dredged sediments from lakes, rivers, harbors, channels and waterways
3.Coal ash, bottom ash from power plants
4. Storm water-drainage silts, sediments
5. Settling ponds sludge at factory sites
6.Flue gas derived gypsum from scrubber stacks
7.Wastewater filtrate cake and carbonates
8.Paper mill sludge
9.Colloidal particles and solids
10.Bag house-filtrate residues
11.Foundry sands
12. Conditioned bio solids

3.2.3 Field Trials

It is mentioned that there is 70 % reduction in the content of total suspended solids (TSS) and chemical oxygen demand (COD). Treatment of sewage using EBC material technology prevented water pollution [Table 2]. It is a one-time investment and can cut off 40-45 % power consumption and 55-60% cost of maintenance (COM) compared to other conventional wastewater treatments plants [Table 1]. There are EBC construction sites laid down for about 500 meters open drain [1]. Samples have been collected. Satisfactory results have been obtained. Such results are (i) killing of larval mosquitoes, (ii) 80% reduction rate of total suspended solids (TSS), nitrates, phosphates and (iii) removal of color and foul smell/ odor to an extent of 90%. This was possible due to the presence of bacillus bacteria that could survive in water with low pH values. EBC material structures can be used in house sewers [5].

1. EBC increase the dissolved oxygen in water to 5.4 and decreased BOD, COD and turbidity.
2. Bacteria upon contact with water, starts exponentially reproducing in water. This process can be lost for a design period of ten years before the construction needs replacement for a mean time between failure (MTBF). [7].
3. The microbes in EBM are aerobic and survive in temperatures of 10 - 110 °C being most efficient between temperatures of 25 - 60 °C . They live both in air and water.
4. The microbes live in pH 3 to pH 11.

It has been reported the following overview results of EBC technology [6]-[7].

1. EBC projects eradicate e-coli and other coli forms in less than 48 hours. It can be used in greenhouses.
2. Increases in dissolved oxygen levels of water treated by the EBB helps in faster growth of all vegetables.
3. EBC treated water was found to keep flowers fresher, healthier and much longer than using untreated water.
4. Longer shelf life for cut flowers is a tremendous benefit for the horticultural industry.
5. It controls mosquito populations in the water hazards and ponds.
6. It controls bacterial growth responsible for causing foul or bad odors emanating from the water.
7. It controls the growth of bad algae and prevents algae blooms.
8. It treats recycled water is a very effective way of maintaining an environmentally friendly course.
9. It is a non toxic environmentally safer method of treating course waterways without the use of chemicals, power
or Specialized equipments.
10) The EBC has no maintenance or operating costs associated to it.
11. EBC treatment in swimming Pools.
The main complaint some people have with swimming pools is the high concentration of Chlorine used and required to keep the water safe as shown in table 3. EBC will considerably reduce the use of Chlorine.

Table 3 . Eco-Bio Construction Materials Technology in Swimming Pool Sector

Chlorine	Eco-Bio Construction Materials Technology
1. Irritation to eyes	1. No irritation of eyes
2. Irritation to skin	2. No irritation to skins
3. Pungent smell	3. Odor less
4. Chlorine is a chemical	4. Composed of natural media and alkaline cement with active bacteria
5. Frequent additions	5. Once per year or two
6. Regular monitoring	6. No maintenance
7. Expensive	7. Cost effective
8. Bleaches clothing	8.No affect
9. Toxic	9. Eco-friendly and non toxic

12. Animal Husbandry: - Ground water contamination can be prevented in rural areas caused by run off from cattle, poultry and swine farms [6]. EBC will greatly reduce undesirable bacteria such as E. coli from propagating in run off, streams and rivers in an eco-friendly manner.
13. Cooling Towers: - One of the biggest problems related to cooling tower operation and maintenance is controlling the growth of bacteria and algae. Treating water with EBC technology will control the growth of algae.

3.2.3 Field Trials and Research Work In Progress

1. Design and development of eco bio-constructions structures for the construction of wastewater treatment system, such as sewers, water channels and industrial sewers are under progress [3].
2. Laboratory tests on wastewater and water analysis and sampling in progress on EBC treatment technology [5]-[6].
3. Field tests are being conducted [2]-[4].
4. Health survey in progress [3].

4 Conclusion and Recommendation

Reclaimed wastewater can be considered as additional water resources and its planned reuse for lower grade purposes (other than drinking) will result in large saving of potable water supplies. Polluted water has to be cleaned up immediately by a suitable natural ecological system. In this research paper, water supply and wastewater treatment by using eco bio-construction (EBC) material technology has been presented. EBC constructed households; industries and farms are efficient for natural cleaning of discharged effluents according to environmental standards for a design period of ten years. EBC materials are 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 EBC material. It is the main ingredient in EBC material technology. EBC materials cleanup water through coexistence with microorganisms called aerobic microbiological process. . This natural clean up systems using aerobic microbiological process are effective and efficient for wastewater treatment. Aerobic bacteria are a kind of grass bacillus taken from sea bottom and mountains. They are safe microorganisms with a determined DNA sequence. In porous biomaterials, mixture of this effective aerobic bacteria and feed are sprayed and get sealed. Such aerobic bacteria propagate and function as cleanup mechanisms by fermentation. During the cleaning process, aerobic bacteria come into contact with water. Fermentation process occurs in porous media and bacteria start propagation and go out of media. The bacteria degrade organic matter and convert into carbon dioxide and water and thus cleans up sewage water. Since, feed (that is food) for the bacteria are already enclosed, its effectiveness and efficiency is constantly achieved. EBC materials are made up of a paste mixture which the ingredients containing volcanic porous stones, strong alkaline cement, appropriate quantity of water and effective bacteria sealed in a live and propagation state. Volcanic stones are rich in minerals and their fine porous structure is optimal for habitation of microorganisms. EBC material concrete technology made from a kind of fermented-soybeans bacillus which can be simulated from the sources of aerobic bacteria grow in mulch made from leaves in nature. These bacteria are viable in air and water. It degrades

e.coli and anaerobic putrefactive bacteria thus sanitizing the environment. EBC microbes kill mosquito larva which is of medical importance. By getting rid of mosquito larva, it can be used for controlling communicable diseases. This paper has provided overview of this technology applied in water supply and wastewater treatment projects. Such projects investigated are namely domestic sewerage treatment systems, storm sewerage systems, combined sewerage systems, industrial sewerage systems, water channels, constructed wetlands and public sewers , river channels, industrial wastewater sewers, constructed wetlands, wastewater treatment systems, sewage farms, pearl and fish farms and other ocean constructions. EBC material technology has also been applied to water purification systems.

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.

EBC material structures works on the principle of "natural way of cleaning water" by absorbing pollutants and removing bad odour. EBC management practices have been investigated in open drains. It is has been reported that there is a drastic reduction in the content of total suspended solids (TSS) and chemical oxygen demand (COD). Treatment of sewage using this construction material can prevent pollution. It is an one-time investment. It can cut off 40-45 % power consumption and 55-60% cost of maintenance (COM) compared to other conventional wastewater treatments plants. There are EBC material structures were laid down for about 500 meters in open drain. Samples have been collected and their results are very much a satisfactory. Such results are (i) killing of larval mosquitoes to an extend to of 80%, , (ii) 70% rate of reduction of total suspended solids, nitrates, phosphates, (iii) detention period of twelve days time (iv) removal of color and foul smells to the extent of 90%. This was possible due to the presence of bacillus bacteria that could survive in water with low pH conditions. EBC materials structures can be used in house sewers. Water and wastewater quality have been achieved so that aquatic vegetation and fish can survive.

A pilot project under investigation which has total weight of about 5,000 grams of EBC materials for about 500 meters was used in construction of underground drainage, sewage structure systems. This was put in sewage pits and public sewers . There is a drastic reduction in the content of total suspended solids and chemical oxygen demand. Treatment of sewage using eco-bio construction material technology could prevent pollution. The initial cost is more and is a one time investment. This cut huge bills and maintenance cost compared to treatment plants. Samples collected and the results show that killing of larval mosquitoes while it takes some days to reduce total suspended solids and nitrates, phosphates and to remove color and foul smell.. Bacillus bacteria survive in low pH conditions, which reduce considerable pollution.
Thus, eco-bio construction materials structures;

1. Reduce organic matter into carbon dioxide and water,
2. Reduce harmful microbes such as E.coli,
3. Decrease the Biological Oxygen Demand (BOD)
4. Decrease the Chemical Oxygen Demand (COD),
5. Increase Dissolved Oxygen (DO),
6. Reduce ammonia, nitrites and suspended solids
7. Decrease turbidity (increase water clarity),
8. Prevent algal growth
9. Kill mosquito Larvae
10. Reduce bad odor from polluted water and effluent.
11. Enable to recover water to a pure state so that aquatic life can be survived .

It is recommended that EBC material technology may be commercialized for effective and efficient treatment of water supply and sewerage systems. EBC material technology is an eco-friendly technology to improve and enhance water and water water quality. The results of performance tests undertaken in various wastewater supply and sanitation projects are provided. This eco-friendly technology has been evaluated for its performance with a particular reference to techno-commercial,

economical and environmental aspects. This construction method practices are cost effective, durable and efficient. It is recommended that EBC material technology can be used in water supply and wastewater treatment construction projects and thus the reclaimed wastewater can be used as additional water resources for sustainable water development.

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