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A Review on Treatment of Sewage Using Soil Bio Technology

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ABSTRACT- Soil biotechnology (SBT) is a green engineering approach for wastewater treatment and recycling. In the present study institutional waste water characterization has been performed followed by the design of Soil Biotechnology plant. Water is a very versatile resource and hence it is used for numerous domestic as well as industrial purposes. As water is a free resource and 70% of earth's surface is covered in water, Man has used it rapidly subsequently contaminating it with domestic as well as industrial wastes. Now, as we understand the importance of water and how we are contaminating it, we know that there is a need to reuse the water again and again so as to ease the pressure on the fresh water available on earth's surface. To reuse the contaminated water, it has to be treated so that the harmful impurities can be separated and removed. Depending upon the quality of waste water, volume of water to be treated and the use of the treated water, number of processes have been developed and implemented. One of such process is known as Soil Bio Technology which is a green technology wherein there is a minimum use of power for treatment without compromising the quality of treated water. The waste water is first passed through tube settlers and then through Tanks known as Bio-Reactors which are filled with Aggregates, Brick Bats and Bio Media (earthworms). Waste water flows through this layers which acts as filters by gravity and is treated through a natural and harmless process. This process has number of benefits over the conventional processes but also has its own limitations. Soil biotechnology (SBT) is a modern technology to treat the wastewater effectively, less costly, eco-friendly which uses the granular media like soil, gravels and sand, biological media like earthworms, bacteria and plants. This technology is useful where there is no sewer transportation is available. In this paper analysis of the domestic wastewater and treated water is being done by IS: 3025 methods and the parameters are pH, TDS, TSS, BOD, COD and Ammonical, Nitrogen.

KEYWORDS: Soil Biotechnology (SBT), Sewage, Earthworms, BOD, COD, TDS, TSS

I. INTRODUCTION

1.1 OVERVIEW

Biotechnology Definition: It is the use of living system and organization to make technological application that uses biological system.

Environmental biotechnology can simply be described as "The optimal use of nature, in the form of plants, animals, bacteria, fungi and algae, to produce renewable energy, food and nutrients in a synergistic integrated cycle of profit making processes where the waste of each process becomes the feedstock for another process".

Generally, the wastewater discharged from domestic premises like residences, institutions, and commercial establishments is termed as "Sewage / Community wastewater". It comprises of 99.9% water and 0.1% solids and is organic because it consists of carbon compounds like human waste, paper, vegetable matter etc. Besides community wastewater / sewage, there is industrial wastewater in the region.

Earth has got only 2.5% of fresh water out of which only 0.01% can be accessed by humans as the rest is frozen as glaciers and ice bergs. India is blessed to have 10 major river systems namely Indus, Ganga, Yamuna, Brahmaputra, Tapi, Godavari, Narmada, Krishna, Kaveri and Mahanadi. Out of it, a major issue of concern is with river Yamuna which has a stretch of 1367 km before it merges with river Ganga in Allahabad. The river extends in the states of Uttar Pradesh, Himachal Pradesh, Haryana, Rajasthan, Madhya Pradesh and the entire union territory of Delhi. Only 2% of Yamuna flows through Delhi but on the contrary the capital contributes its 70% pollution load. Although the rivers

have a mechanism to self-purify but the rate at which a river can purify is much less than the rate at which it being polluted and the way it is being polluted is also a matter of concern.

Hence water recycling has now become a compulsory vertical to run a civilization efficiently. SBT is a wastewater treatment process, which is based on a bio-conversion process where fundamental reactions of nature, namely respiration, photosynthesis and mineral weathering take place in a media housing micro & macro organisms which bring about the desired purification. SBT is an oxygen supplying biological engine and so the process can treat all types of water – domestic, municipal and industrial.

Soil Biotechnology (SBT) used as an option for decentralized wastewater treatment. The current sanitation scenario of urban India is one of severe lack of collection, treatment and disposal systems for domestic sewage. In order to tackle this problem and protect water resources from contamination, while also augmenting usable water resources, there is an urgent requirement to identify appropriate technologies for wastewater treatment. Decentralized technologies are increasingly attractive because of several advantages, especially in the Indian context.



Today, lot of natural water streams are being polluted due the direct disposal of waste water. Industrial development has been exponential but with the cost of water and overall environmental pollution. Urban Town Planning includes the facilities of waste water treatment but in rural areas, the waste water is just disposed off into the nearby available water source. In these areas, Soil Bio Technology can be used successfully as it is cost effective and has very minimum maintenance issues. It has been successfully implemented in different areas where the volume of waste water to be treated is within 2-3 MLD. Soil Bio Technology (STB) is a bio conversion process where fundamental reactions of nature namely respiration, photosynthesis, mineral weathering take place in a media housing micro and macro organisms which bring about the desired purification. Due to its natural process, use of electrically operated equipment is very minimal. This reduces both the maintenance and energy costs. The objective is to analyze this Technology, evaluate the suitability and effectiveness of treating effluents by SBT and compare the results with conventional methods of treating waste water with STP.

1.2 Need of Green Technologies

As the operation of a conventional waste water treatment plant is a very costly affair and require regular maintenance, gradually the quality of treatment deteriorates and the efficiency of the whole plant is jeopardized.

Hence there is a need to study the Green technologies of waste water treatment to reduce operation and maintenance of STP. These Green Technologies should be low-cost method and should also have good degree of treatment as compared to conventional treatment. One of such Green technology is Soil Bio Technology but it has its own limitations.

1.3 NEED & SIGNIFICANCE

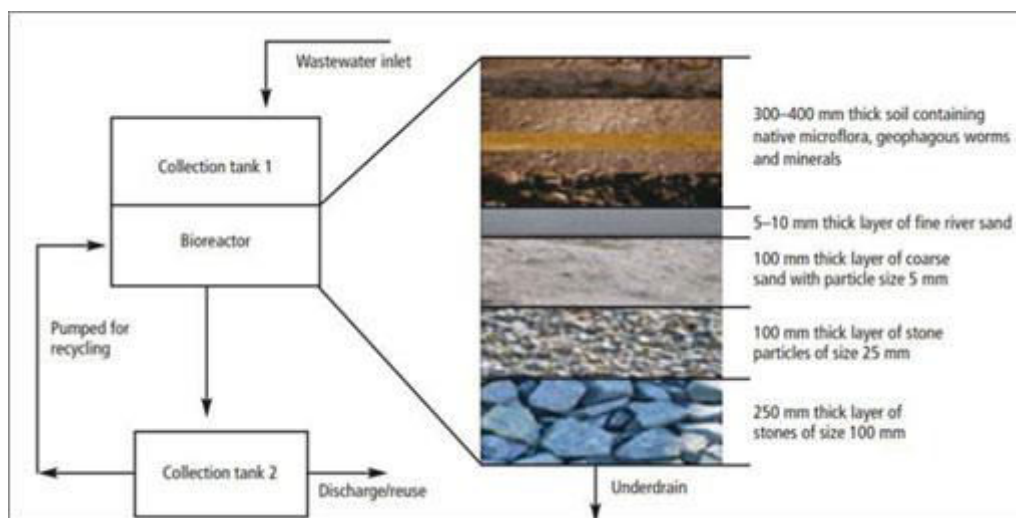
1. Keeping the Environment in perspective, there is a need of a green i.e. natural process for treating waste water with low installation cost as compared to large conventional waste water treatment plants.
2. Civil construction is very basic and simple and involves minimum mechanical and electrical equipment.
3. Operation and maintenance cost is very low.
4. As the process uses minimal external energy, breakdown is very rare and the setup is aesthetically good.
5. The Biomeida i.e. earthworms grow naturally and offer a simple and economic method of wastewater treatment.
6. The treated water can be used for domestic purposes like gardening, curing, washing.
7. It enhances the landscape and gives the site a green appeal.

II. PROPOSED METHODOLOGY

The general methodology adapted is summarized below. The samples are collected from various points in college campus i.e from hostels, canteen, mess, college and Architecture College etc. It is important to review the characteristics of waste water to design any kind of treatment facility. The treatment process their duration, efficiency all other factors are depends on the characteristics of an equivalent. After the calculation of observations of various tests performed the results are analyzed with MPCB (Maharashtra pollution Control Board) and CPCB (Central Pollution control Boards) boards. Based on the test results the treatment process is set and therefore the treatment units are designed accordingly.

2.1 Treatment Process:

The process can be run in batch mode also as in continuous mode. In above figure, the waste water is firstly come at the screening chamber through a collection pipe. The intake of screening chamber is fitted with coarse screen referred to as bar screen which removes the floating matter and suspended matter sized more than 2cm. Afterwards the mechanical coarse screen removes the fine impurities which wasn't screened through bar screen. The sewage is then transferred towards the sedimentation tank. The detention period is of 4hrs. During this the suspended particles and the other impurities get settled down. This process is done without adding any chemicals into it therefore it is plain sedimentation. The sludge produced is collected and treated for fertilizer production. Then after sedimentation the water is transferred towards the biotechnology filter through pump. To achieve the natural aeration the water is sprinkled over the plants and soil media over the filter with hydraulic loading typically about 0.04-0.06 m³/m²/h. Now here biological action of bacteria and microorganisms takes place. The water is filtered through this media and picked up in storage tanks near the filter.



The overall duration for operation of treatment process is 4- 6 hrs. The filter bed is then kept in rest for the rested time before the next cycle. In Soil Biotechnology system, problem of clogging is get overcome by propagating soil

ecology in place, alternate wetting and drying cycles. During drying cycle, this clogging layer develops cracks due to respiration; so alternate wetting and drying is required for efficient performance.

Factors affecting treatment process of SBT-

1. Seasonal variation: Reduction of nutrient concentrations during a filter is mainly by biotic, temperature-dependent activity. The losses within the treatment process are mainly evapotranspiration and water taken for growth of plants. Therefore the losses are more in summer season than winter.
2. Plantation: Plantation is a crucial tool for functioning of biological activities. It is oxygen supplying tool for the treatment. Because of photosynthesis plants supply the oxygen to bacteria or earthworm present within the soil.
3. Bacteria and worms: Earthworm body works a bio-filter which widens the microbial metabolism by increasing their population. It also grinds, aerate, crush, degrade the chemicals and act as biological stimulator.

III. EXPERIMENTAL ANALYSIS

Samples of raw waste water were collected in July 2019 and tested. In the present study, tests conducted are pH, turbidity, BOD, DO, solids etc. Conducted tests were performed as per the standard procedures according to IS procedures.

Direct measurement of pH of waste water effluent may vary dramatically due to change in temperature, water flow and any substance present in water. Therefore for the accurate measurement of the pH value of waste water, the accurate value of temperature is additionally required. IS recommends standard pH meter, a durable pH electrode, an ATC (automatic temperature compensation) probe, a stirrer with stir bar, 100-mL graduated cylinder, 100-mL beaker, deionized water and buffers. The pH electrode will be exposed to chemical contaminants and particulates; recommend a double junction electrode.

The presence of suspended particles in the sample is the turbidity. It is caused due to dissolved impurities in water. Its presence is expressed in parts per million of pure water. This can be found out by the aid of various instruments such as Nephelometric turbidimeter, Jackson's turbidimeter, Turbidity rod, Baylie's turbidimeter, etc. In present study the instrument used is Nephelometric Turbidimeter. It indicates the presence of turbidity in NTU (Nephelometric Turbidity Unit).

Biochemical Oxygen Demand (BOD):

The Biochemical oxygen demand of sewage is that the quantity of oxygen required for the biochemical oxidation of the decomposable matter at specified temperature within the specified time. During natural decomposition, the life activities of organism are stimulated by high temperatures and decreased at low temperatures. Therefore, the temperature and time during B.O.D. tests are testified.

It is often seen that within 5 days period, about 60 to 70% biochemical oxidation is completed. Within 20 days period it is about 80 to 100 % completed. As biochemical oxidation is a slow process it takes an infinite time for completion. Providing larger period for B.O.D determination is not convenient therefore 5 days period is adopted for B.O.D test. 20°C temperature is employed as an average value for slow moving streams in temperate climate and can be easily duplicated in an incubator the rate or biochemical reaction increases with temperature and B.O.D values determined at different temperatures will be different. The use of BOD test is (1) to determine the quantity of oxygen that will be required to stabilize the organic matter present, (2) to determine the size of treatment facility & (3) to measure the efficiency of plant.

Dissolved oxygen (DO) levels in environmental water depend on the physiochemical and biochemical activities in water body and it's a crucial useful in pollution and waste treatment process control. Two methods are commonly used to determine DO concentration: (1) The iodometric method which is a titration-based method and depends on oxidizing property of DO and (2) The membrane electrode procedure, which works supported the rate of diffusion of molecular oxygen across a membrane.

The term "solids" is usually used when pertaining to any material suspended or dissolved in wastewater which will be physically isolated either through filtration or through evaporation. The analysis of this features a great importance

because the planning of the filter is depends thereon. Solids may affect water or effluent quality adversely in a number of ways. Waters with high dissolved solids generally are of inferior palatability and should induce an unfavorable physiological reaction in the transient consumer. For these reasons, a limit of 500 mg total solids/l is desirable for treated effluent of waste water. The total solids comprises of two sorts of solids that are suspended solids and dissolved solids.

IV. RESULTS

Table -1: Test results

Test	Before treatment	CPCB recommendations	Remark
pH	6.7	6-9	No Treatment required
Turbidity	27.8 NTU	35 NTU	No Treatment required
DO	2.4 mg/l	5 mg/l	Treatment required
BOD	133 mg/l	50 mg/l	Treatment required
Total Solids	1000 mg/l	500 mg/l	Treatment required

After the analysis of test results the following discussion were made that are suitable treatment units to be made for the proper treatment. The units of designed treatment facility consists screening chamber, plain sedimentation tank, soil biotechnology filter (soil scape filter) with attached storage tanks.

V. CONCLUSION

After having study of waste water treatment of waste water from Vishwaniketan's college campus, we carried out different test on waste water, like pH test, turbidity, DO, BOD, TDS, etc. Some of the test results are found above the standard limits which were established or recommended by MPCB and CPCB boards. Our study and design will reduce up to 60 to 65% of total water intake of the campus. And will achieve great economy in water requirement as well as in money. The odour and fly nuisance problems get eliminated in treatment facility due to planted plants on bio-filter. And the sludge from sedimentation tanks will processed and will be useful as a soil fertiliser. The estimated cost of the Soil Biotechnology Plant (SBT) is Rs. 12, 40,000/-. The operation and maintenance cost is almost 1 to 1.5 lacks per year, which is less as compared to conventional treatment system.

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