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Study of Soil Biotechnology for Waste Water Treatment

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Abstract

Water is one of the world's most valuable resources, yet it is under constant threat due to climate changes, resulting in drought, explosive population growth, and waste. India is completely dependent on the monsoons to meet its annual water demand. Reclamation and reuse of the Wastewater would help minimize the overall supply of water. The amount of non-potable water generated in the Class 1 Cities has a population of n more than 1 la, is approximately 35,558 Million liters/day. This water goes directly into the septic tanks and becomes Wastewater. SBT involves removing organic matter by adsorption, followed by biological degradation and oxygen supply by natural aeration to the treatment system. The photosynthetic activity of green cover serves as a bio-indicator for the kind of micro-habitat in SBT. The SBT is designed to provide the requisite filtration, aeration, and biochemical processing to remove toxicity, including BOD, COD, nitrate, phosphate, suspended solids, color, odor, and bacteria. Unlike a conventional STP or septic tank where periodically the sludge has to be offloaded, everything is consumed within the plant in this SBT based STP. Raw sewage is pumped to a customized media bed for around five hours (dependent on load and capacity), and clean water flows into the collection tank.

Keywords - *Soil Biotechnology Plant, Chemical Oxygen Demand, Biochemical Oxygen Demand, Bio-Reactor.*

I. Introduction

Soil biotechnology is a system which uses living organisms for the treatment of this waste. The water that comes out after treatment is then used for agricultural, gardening & plantation purposes. The solid waste after decomposing is used as manure. Thus disposal process is eliminated.[1]

SBT is the patented process developed by Mr. Biplab Patnaik (IIT-B) of Life link Technologies. In soil biotechnology, the soil is used as a media for treating the Wastewater. SBT is a synthesis process that harnesses the energy, carbon, and other waste elements and converts them to precious "bio-energy" products like vegetation, energy-rich soil, complete bio-fertilizer, and water. [2-5]

SBT involves removing organic matter by adsorption, followed by biological degradation and oxygen supply by natural aeration to the treatment system. The photosynthetic activity of green cover serves as a bio-indicator for the kind of micro-habitat in SBT. [6-8]

The SBT is designed to provide the requisite filtration, aeration, and biochemical processing to remove toxicity, including BOD, COD, nitrate, phosphate, suspended solids, color, odor, and bacteria. SBT Uses only natural materials, natural agents (bacteria culture, worms), and natural processes (respiration, photosynthesis, nitrogen fixation)-it is ecologically 100% safe. Unlike a conventional STP or Septic tank where periodically the sludge has to be offloaded, everything is consumed within the plant in this SBT Based STP. Raw sewage is pumped to a customized media bed for around five hours (dependent on load and capacity), and clean water flows into the collection tank. [9,10]

II. Methodology: [11-15]

COMPONENT PARTS OF SBT PLANT-

1. Septic tank.
2. Screens.
3. Sedimentation tanks.
4. Primary Treatment Structure / Bioreactor Stage1.
5. Primary collection tank / Process tank 1.
6. Secondary Treatment Structure / Bioreactor Stage 2.
7. Secondary collection tank / Process tank 2.
8. Tertiary treatment (optional).
9. Storage tank

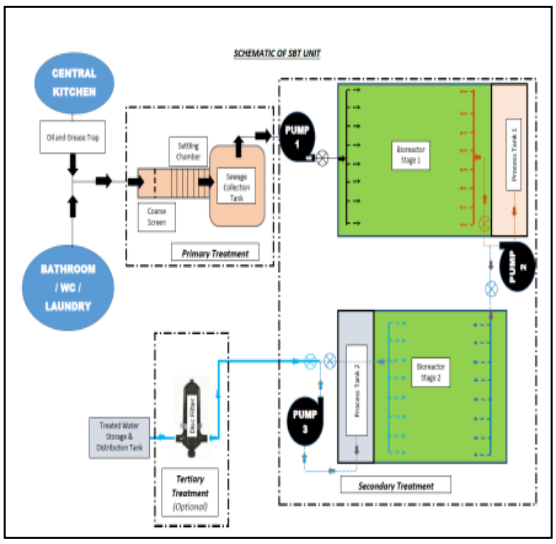


Fig. 1. The layout of an SBT Plant.

1. ***Septic tank:-***Water from the sewer falls into the septic tank. By the action of gravity, suspended and heavy matters settle down. The settled solids are anaerobically digested, reducing the volume of solids. Anaerobic bacteria act upon the complex, unstable compound and convert it into a simple, stable compound.

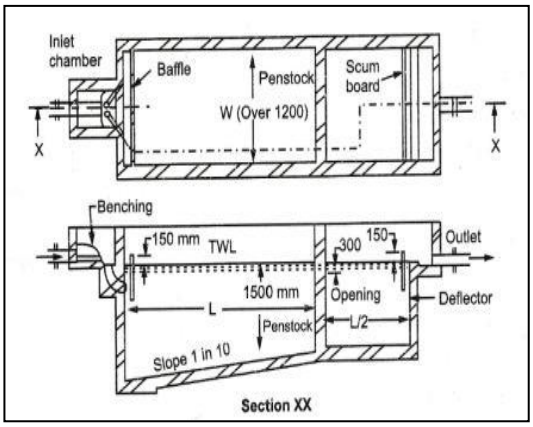


Fig. 2. Septic tank.

2. ***Screens:-***Some floating particles do not settle in the septic tank due to their lightweight. So, these matters are not allowed to pass further and removed by the screens by providing screens.

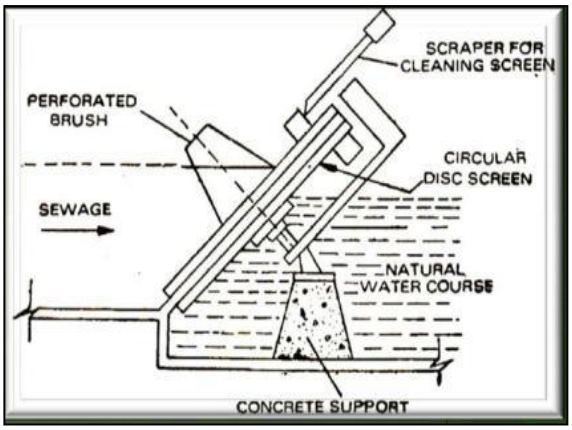


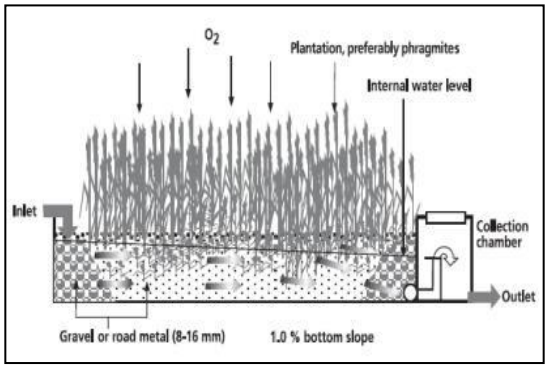
Fig. 3. Screens

3. Sedimentation tank:-The suspended solids settle as they are heavier than the liquid, i.e., removal occurs merely by gravitational force. The clarified liquid is collected by pumping. A baffle wall is provided at the inlet end to reduce the turbulence due to incoming sewage. A proper slope is given to the bottom of the tank to collect the sludge at one end. The detention time for Wastewater in this tank is about 30 –40 minutes.

Fig. 4. Sedimentation Tank.

4. ***Primary Treatment Structure / Bioreactor Stage1:-***The primary treatment objective is to remove settleable organic and inorganic solids by passing it through beds of soil and aggregates of different sizes. BOD and nitrogen are removed by bacterial activity. The finely suspended solids are held back by the top media. Nutrients and heavy metals are removed by plant uptake. Shrubs and trees are planted on top of the bioreactor to act as bio-indicators; organisms are used to monitor the environment's health. In this case, these plants' growth will determine their ecological health, thereby indicating the recirculated water quality.

Fig. 5. Primary Treatment Structure.



5. Secondary Treatment Structure / Bioreactor Stage 2:-Wastewater is processed in an ecosystem consisting of soil, bacterial culture and geophagous earthworm, mineral additives, and selected plants. Purification takes place by absorption, filtration, and biological reaction. The process operates in aerobic mode

1. Removal of total nitrogen soil temperature.
2. Micro-organisms are removed through filtration.
3. Bacteria are physically strained from the water, whereas smaller viruses are usually adsorbed.
4. Human bacteria and viruses immobilized in the soil do not reproduce and eventually die.
5. Phosphorus and trace elements are removed by absorption. Colloidal and precipitation of insoluble
6. complexes of calcium, iron, and aluminum are also removed from the soil.

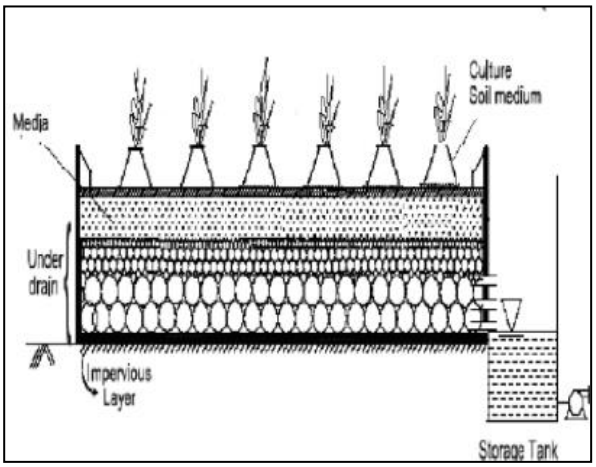


Fig. 6. Secondary Treatment Structure.

7. ***Storage tank:-***Treated water is collected in this tank. Storage tanks also serve as aeration tanks. This water is then finally pumped out and used for irrigation.

Fig. 7. Storage tank.

III. RESULTS

USES OF TREATED WATER:-

1. It can be sold to constructions/industries that normally purchase tankers. Plant costs can be recovered within a few years, depending on the amount of reuse.
2. Can be piped back to homes for flushing toilets, gardening, washing yards, cars, which can be almost 50% of daily requirements.

3. Can be used to recharge groundwater using rainwater harvesting recharge wells.
4. Can be used for agriculture purposes.
5. Can be used for gardening in residential buildings as well as public parks.
6. Can be used in the washing yards for washing of the cars.
7. Can be used for the generation of hydropower electricity.

Fig. 8. Results Summary.

The Sample Quantity 1liter drawn from a Working SBT Plant Has the following Result:

Sr. no	Parameters	Unit	Test Result	Reference Method
1	pH Value	-	8.18	In-House pH Pen Method
2	Chemical Oxygen Demand (COD)	mg/L	21.6	APHA 5220 C
3	Total Suspended Solids (TSS)	mg/L	20	APHA 2540 D
4	Total Dissolved Solids (TDS)	mg/L	18	APHA 2540 C
5	Oil and Grease	mg/L	0.6	APHA 5520 B

Table. 1. Results.

IV. CONCLUSION

Soil Biotechnology not only treats water for disposal but recycles it to the standards that it can be reused. Almost 50% of water consumption is for purposes like flushing, horticulture, cleaning, washing, etc., which can be served by the recycled water from an SBT plant.

On the other hand, setting up an SBT plant to treat the Wastewater would help to prevent the deterioration of rivers to a great extent. Since the applied technology is not demanding, i.e., no skilled labor or high operational and maintenance cost is needed; hence it would sustain easily in the adverse conditions without any breakdown.

Hence this innovative soil biotechnology would prove to be a boom in water treatment and a great step towards a better tomorrow.

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