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Study of Biofiltration System and its Applications

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Abstract - *The aim of the study was to study the bio filtration system i.e. by Vermifiltration. The study was made on several past researches, and the study was also done on the currently executed AbaBagul treatment plantlocated at Sahakarnagar Pune. This study explains the working and methodology of vermifiltration system in treatment of waste water. It also explains which species of earthworms are suitable for vermifiltration. The conclusion was made that there are four efficient species which gave exceptional results in past, the name of the species were Red tiger worm, African Night crawler, Indian blue worm and Red worm. The standard values which satisfies national and international standards for sewage disposal are also discussed.*

Key Words: Bio filtration, Vermifiltration, Earthworm, Aba Bagul Treatment plant.

1. INTRODUCTION

Indian population represents 16% of world population but we only have 2.5 % of land area and 4 % of total water resources i.e. we have less resources and a large audience as compared to other nations, Yet we are wasting our resource and polluting it. According to The International Water Management Institute (IWMI) in India one out of three people will live in conditions of absolute water scarcity by 2025.It also predicts that per capita domestic water demand in India is likely to increase from the estimated 31 m3/person/year in 2000 to about 46 and 62 m3/person/year by 2025 and 2050 respectively Therefore it is necessary for us to conserve, reduce and reuse water for our daily needs. Around 80 % of water supplied by municipal authorities return as sewage in all major cities in India. It is estimated that 38355 million liters per day (MLD) of sewage is generated in major cities of India, but the sewage treatment capacity is only of 11787 MLD this uncollected sewage is directed to the water bodies and hence is the cause of pollution. Due to high cost of conventional treatment process,. Therefore there is a huge scope for cost treatment process which is beneficial in both parameters i.e. Economy and Environmental friendly.

The reuse of wastewater is an effective solution of our current problems, if we can reuse the wastewater generated by us it will reduce the amount of wastewater to be disposed and it will also reduce the amount of water supplied by municipal authorities.

1.1 Biofilter

Any type of filter media with attached biomass on the filter media can be defined as a Bio filter. The filtration process in which the pollutants are removed due to Biological degradation rather than physical straining, is called Biofiltration. Vermifiltration is an aerobic treatment process. In vermifiltration earthworms play an important role their body works as a biofilter and it extends the microbial metabolism by increasing their population.

1.2 Methodology

Waste water is collected from the source and is stored in settling tank for the settlement of solids. In the settling tank almost 80 % of solid particle are settled down. After the settlement this water is pumped to achieve a desired head then this water is transferred to pipes which contains sprinklers then this water is sprinkled on filter bed.

The filtration unit consist different layers the bottom most layer is hard strata it may be RCC or PCC it has a sloping gradient towards outlet the second layer above hard strata is of rubbles of size 75-100 mm, then the next layer above that is of coarse aggregate of size 40 to 60 mm. Above this layer there is a layer of aggregates of 8 to 10 mm mixed with sand. Above this there is a layer of sand. The topmost layer consist of pure soil and cow dung in which earthworms are released.

2. CASE STUDY

Even as the civic administration faces a challenge in treating its daily sewage, a project has been commissioned to treat 5 lakh liters of greywater per day and reuse it for gardening and at construction sites. This plant is first of its kind initiative by the civic administration. The PMC is the first municipal corporation in the country to commission such a project. It is executed on around 5,000 square feet of area on the premises by the PMC sewage department, the project took around 6 months to finish and was set up for around Rs 1.5 crore. The plant has been set up as per Maharashtra Pollution Control Board guidelines. The concept had first been mooted by local cooperator Aba Bagul.

The project is based on Tiger biofiltration technology. The technology uses a filtration arrangement consisting of Bio media to trap and treat impurities from

wastewater. The filtration medium is arranged in stacked manner with bio media on top. The top layer serves as active zone habitat for Bacteria and earth worms specifically bred for the purpose, while bottom layers provides structural support and free drainage for clear water. The trapped Impurities (Organic matter) are then consumed by bacteria and earth worms as an energy source for metabolism and reproduction resulting in reduction in organic matter (measured as Bio chemical Oxygen Demand).The system is designed with sufficient surface area and worm quantity. The worm consumes the BOD (Organic matter) load in 24 Hrs making bed available for next day loading. As the Natural oxygen transfer takes place no need of artificial air supply in form of blower resulting in less consumption of power and consumables and is therefore cost effective and environmental friendly. The tiger bio filter uses far less energy and space compared to similar technologies. Tertiary treatment in form of Pressure Sand Filter and Activated Carbon Filter can be used as an option for polishing the effluent.

Under the project a separate line has been laid to collect greywater from 1,200 homes in nearby areas. Water is brought along the Ambilodha (nullah) by gravity up to the Late VasantraoBagulUdyan where the treatment plant is located. The water gets treated by the biofiltration technique based on vermifiltration, pressure sand filter and activated carbon filter. Then this clean water can be used to wash toilets, in garden, and for construction purposes.

Future plan:

There is a plan to increase projects daily treatment capacity up to 10 lakh liter in its second phase. After commissioned fully, the project will be able to save the city 365 MLD of water.

Fig -1: Showing actual Tiger biofilter plant at Sahakarnagar

Fig -2: Showing actual Tiger biofilter plant at Sahakarnagar

3. EARTHWORMS

Earthworms are versatile waste eaters and decomposers. Earthworms are long, narrow, cylindrical, bilaterally symmetrical, segmented animals having without bones. They weigh around 1400 to 1500 mg after 8 to 10 weeks and their life span is about 3 to 7 years which varies with different species. Soil with very coarse texture and high clay content is not suitable for Earthworms.

Earthworms grind, aerate , crush and degrades the pollutants and act as a biological stimulator. Earthworms host millions of decomposer microbes in their gut and excreta called vermicast. This action helps to build a biofilm which further helps to create a colony form degrading microbes. Earthworms and microorganisms cooperate in Vermi Filter ingests and biodegrade organic wastes and other containments in waste water. This extends the food chain in normal bioprocesses and thus greatly improves sewage treatment efficiency.

Earthworms increase the hydraulic conductivity and natural aeration by granulating clay particles .They also grind silt and sand particles, increasing the total surface area, which enhances the ability to absorb organic and inorganic from waste water. Intensification of soil processes and aeration by earthworms enable the stabilization of soil and the filtration system to become effective and smaller in size.

Fig -3: Showing Tiger worm[22]

Fig -4: Showing E. Andrei worm [21]

Fig -5: Showing Lumbricusrubellus[18]

Fig -3: Showing Indian Blue Worm [20]

Fig -3: Showing African Night crawler [19]

4. STANDARD VALUES FOR DISPOSAL

The table below shows minimum standard required for disposal of waste water, these are national and international parameters.

Table -1: Standard Values for Disposal

Sr. No.	Parameter of wastewater	Disposal Standard as per CPHEEO manual	Disposal Standard as per WHO	Reduction level for disposal	Expected % change
1	COD	250 mg/l	10 mg/l	200 mg/l	80
2	BOD	30 mg/l	30 mg/l	28 mg/l	93
3	TDS	2100 mg/l	1500 mg/l	1800 mg/l	85.17
4	TSS	100 mg/l	50 mg/l	80 mg/l	80

3. CONCLUSION

After the study the conclusion was made that our future water scarcity problem can be solved in present by conserving and reusing water. Therefore it is now necessary for us to recycle and reuse the waste water. Out of all species of earthworms the four species Red tiger worm, African Night crawler, Indian blue worm and Red worm were more effective and more resistant for severe environment conditions. Red tiger worm is best among these four species, because it can bear salinity in water and is resistant to severe chemicals. The conclusion was also made that if we can add one more layer of GAC (Granular Activated Carbon) in vermi bed then it will increase the efficiency of the treatment plant

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