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TREATMENT ON WASTEWATER BY VERMIFILTRATION

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Abstract: Water scarcity is worldwide problem. Water is vital for survival of living being. The reuse of domestic wastewater for non-potable water application is a potential solution for water deprived region world-wide. In recent days many developing nations cannot afford to construct and maintain costly wastewater treatment plants. A vermifilter (also vermi-digester) is an aerobic treatment. System, consisting of a biological reactor containing media that filters organic material from wastewater. The media also provides a habitat for aerobic bacteria and composting earthworms that produce humus. The “trickling action” of the wastewater through the media dissolves oxygen into the wastewater. This is an important feature because bacteria and worms that rapidly decompose organic substances need oxygen to survive. They need more options for wastewater treatment at low cost. In both developed and developing nations, centralized sewage treatment system may not fulfill sustainable wastewater management requirements in future due to ever-increasing demand. Therefore in the present study an attempt is made to know the efficiency of vermifilter as decentralized treatment for parameters pH, total dissolved solids, removal of biological oxygen demand and chemical oxygen demand. In this study sewage water is treated using vermifilter containing earthworms and the results are compared with permissible standards of treated water.

Index Terms – Analysis, Study, Wastewater Filtration, COD-BOD Test, Observations, Readings.

I. INTRODUCTION

Water is a fast becoming one of the most limited resources available to use. Today we are left with no option but to conserve and recycle every drop of water that we use. Wastewater is any water that has been adversely affected in the in the physical, chemical and biological characteristics. It may get generated from a combination of domestic, industrial, commercial or agricultural activities, surface runoff or storm water and from sewer inflow or infiltration. Large quantity of the water about 85-90% used by the society flows as a wastewater in the sewerage system as sewage. There are various treatment processes used to treat the wastewater but are expensive, time consuming, space consuming and include usage of chemicals. To overcome this, a new low cost, eco-friendly technique has been introduced in the developing countries. Vermifiltration technique is a new approach towards wastewater treatment to save cost, energy and eliminate chemical usages. Unlike conventional water treatment amenity, vermifilter uses no chemicals, the system is all natural. We plan to develop a sustainable and environmental friendly technology for the treatment of Canteen wastewater at low cost. Water, food and energy scarcity is emerging as increasingly important and vital issue for India and rest of the world. Most of the river basins in India and elsewhere are closing or closed and experiencing moderate to severe water shorts, brought on by the simultaneous effects of agricultural growth, industrialization and urbanization. Current and future fresh water demand could be met by enhancing water use efficiency and demand management. Thus, wastewater/low quality water is emerging as potential source for demand management after essential treatment.

II. PROBLEM STATEMENT

There are various treatment processes used to treat the wastewater but are expensive, time consuming, space consuming and include usage of chemicals.

III. AIM

To treat the canteen wastewater by using design vermifilter and reuse of treated water.

IV. OBJECTIVE

1. Wastewater quantity data collection with respect to inflow of raw waste water from canteen per day.
2. Remove the BOD, COD & Total solid by using different tests.
3. Design the vermifilter as per generated discharge from canteen.
4. Cost Analysis of designed vermifilter.

V. SCOPE

It can be used for treating waste water generated in household kitchen. Vermifilter can be used as onsite treatment plant which helps to reduce loads on municipal STP. It can be implemented at restaurants, hotels, resorts etc where large quantity of kitchen waste water is generated.

3.1 LITERATURE REVIEW

1. Bhise H. S. (2015)

"Design and suitability of modular vermifilter for domestic sewagetreatment" In this study an attempt is made to know the efficiency of vermifilter as decentralized treatment system with reference to parameters like pH, turbidity, total solids, removal of BOD and COD.

2. Anusha V (2015)

"Application of vermifiltration in domestic wastewater treatment" Vermifiltration is a treatment method that combines the conventional filtration processes with the vermi composting techniques.

3. G. Dheeran Amarpathi (2016)

"Domestic wastewater treatment" The unprecedented growth of population has placed lot of stress on natural resources like water, air, etc. Water is vital to living being and is of infinite quantity. Human activities have made water unfit for use in several cases.

3.2 Outcome of Literature Review

We studied all above journal papers and find out following conclusion. Vermifiltration is one of the simple, low cost, eco-friendly, chemical free technique used to treat the canteen wastewater using the Eisenia fetida earthworm species. The earthworms are potentially capable of digesting the waste organic material and reduce it through ingestion. It is considered to be an innovative ecofriendly technology that provides a sustainable solution for the treatment of wastewater with no sludge generation and treatment.

VI. METHODOLOGY

4.1 FLOW CHART

4.2 Materials To Be Used

1. Earthworms
2. Raw sewage
3. Aggregate
4. Cow dung, soil and saw dust Bedding matrix
5. Polyester mesh screen water filter

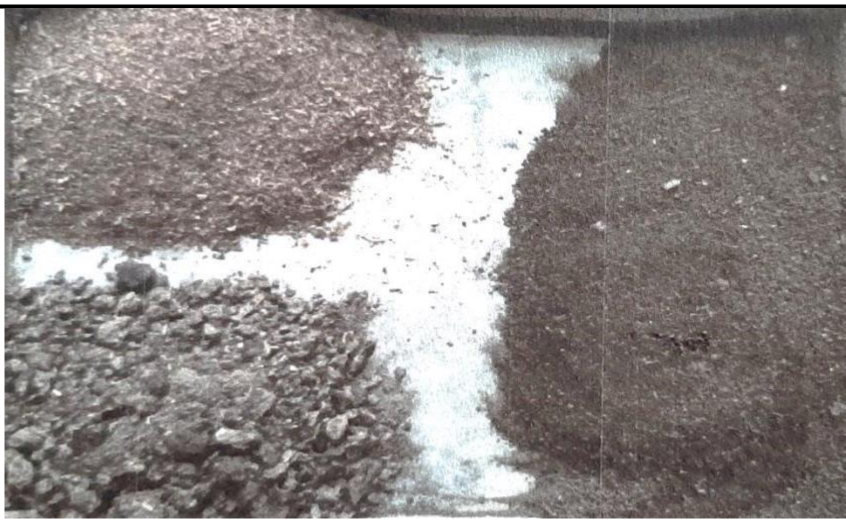
4.2.1 Earthworms: Earthworms are available from 'KNOW HOW FOUNDATION, Mulshi, Pune.' Vermifiltration was used for treatment of waste water using the 'Eisenia Fetida' earthworms species. Eisenia Fetida are long, narrow, cylindrical, segmented animal without bones. The body is dark brown. The life span of an earthworm is about 3 to 7 years depending upon the type of species and ecology situation.

4.2.2 Raw sewage: The raw sewage will be taken from college canteen outlet.

4.2.3 Aggregates: Three types of aggregates will be used in vermifiltration treatment, 20 mm, 10mm,Passing through 2.36 mm IS sieve

Fig No.4.2.3 Aggregate 10mm

4.2.4 Cow dung, Soil and Saw dust: In top most layer of the filter system, bed material placed in which Earthworms were released. The bed materials consists of pure garden soil, saw dust and cow dung. Soil and sawdust were mixed at a volume ratio 3:1. Sawdust was added as a bulking agent because it has been shown to improve soil permeability and enhance earthworm growth and survival. Cow dung was added to provide nutrients of earthworm during acclimatization period of the experiment.



4.2.5 Bedding Matrix: It is degradable type of material which is carrymoisture more than 30% greater than cow dung and saw dust.

4.2.6 Wire Mesh: A layer of net of wire mesh was placed below the layer of soil bed to allow only water to trickle down to filter materials.

Fig No.4.2.6 Wire Mesh

4.3 Design and Drawing of Laboratory Scale Reactor:

Based on material used in this study, design of vermifiltration reactor given below

HLR: 1 $m^3 m^2 d$

Earthworm density: 2800/m^3 Surface area: 0.070

No. of Earthworms: 200 Nos

Top diameter- 29cm Bottom diameter- 25.5cm

Average radius (R) - 13.62cm Height of container- 37cm Shape- cylindrical

Volume of container = □□^{2} *H

= □*$(13.62)^2$*37

= 21578.67 cm^3

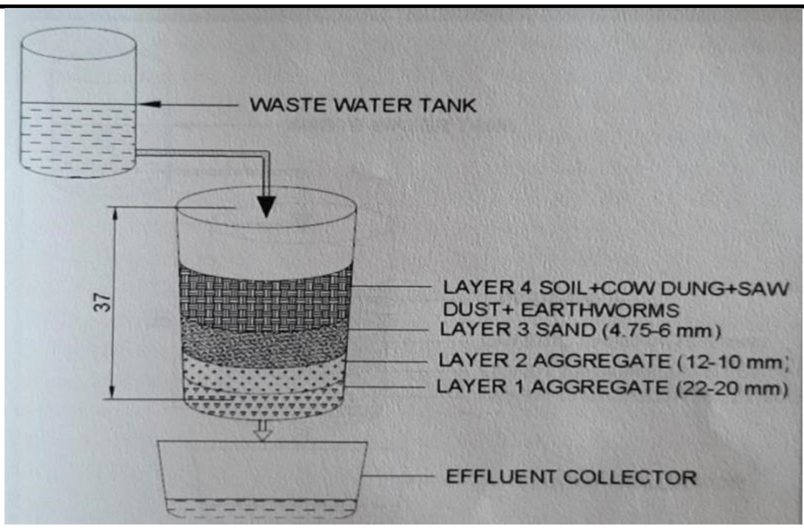


Fig No.3.4.1 Setup for Vermifilter Reactor

4.3.2 Thickness of Non-Vermifilter Layer:

Depth of layer 1 (aggregate size 20-22mm): 5cm Depth of layer 2 (aggregate size 10-12mm): 5cm Depth of layer 3 (sand size 4.75-6 mm): 8cm Depth of layer 4 (soil): 10cm

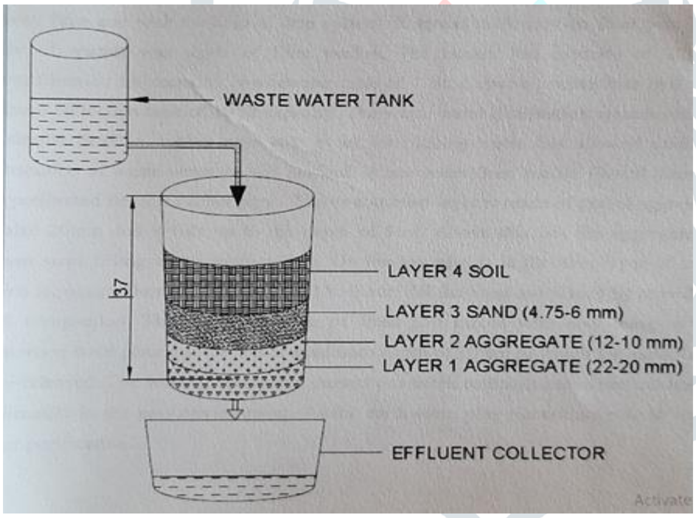


Fig No.4.2 Setup for Non-Vermifilter Reactor

4.3 Fabrication of Container/Reactor:

The experimentally reactor compromises of two reactor one is vermifilter and other is non vermifilter. Both are designed for 20 liter wastewater treatment at laboratory basis. Their fabrication process is given below.

4.4 Vermifilter Reactor:

A pilot scale vermifilter was carried out in a vermi-culture kit located in transportation lab which arrangement has been made to supply the wastewater from top as well collect the treated wastewater from the bottom of system. The wastewater was fed by gravity flow and with the help of drip system. It spread uniformly on filter bed. The body of reactor was made of fiber bucket. The bucket has capacity of 20 lit. Vermifiltration kit contain wastewater tank of 7 lit. capacity, vermifilter unit and effluent collection tank of 10 lit capacity. The waste water distribution system consist of simple flexible rubber pipe with hole for tricking water that allowed uniform distribution of waste water on soil surface. Waste water from bucket flowed through the perforated flexible rubber pipe. The bottommost layer is made of gravel aggregate of size 20mm and it fills up to the depth of 5cm.

4.5 Non-vermifilter Reactor:

The non vermifiltration kit have same unit as in vermifiltration kit. The only difference is in their layers. Earthworm are not provided on topmost layer of non vermifilter. Non vermifilter contain four layer. A non-vermifilter kit the bottommost layer is made of gravel aggregate of size 20mm and it fills up to the depth of 5cm. Above this lies the aggregate of 10mm size filling up to depth of 5cm. On the top of 10mm aggregate, sand, passing through 4.75mm IS Sieves were filled up to depth of another 8cm. The top most layer of fresh soil were placed at top of sand up to depth of 10cm. Soil and aggregate in vermifilter kit also help in cleaning if waste water by absorbing the impurities.

Fig No.4.5.1 Vermifilter and Non-Vermifilter Reactor

5.1 Wastewater of Sample:

The sample wastewater was collected from the canteen. At first, wastewater from canteens may not seem so important. However, if you think about the fact that there is often a large amount of organic fats in the water that slowly turn acid on their way to the wastewater treatment plant. High oil and grease contents were detected.

5.2 Working of Reactor:

Before starting the experiment water is sprinkled over the vermifilter for 10 days for acclimatization system. 20 lit of wastewater collected from college canteen are kept in small tank having capacity 20 lit. These buckets were kept on an elevated platform just near the vermifilter. The bucket had tap at the bottom to which an irrigation system was attached. The wastewater distribution system consist of simple flexible rubber pipe with holes for trickling water that allowed uniform distribution of wastewater on soil surface. Wastewater from bucket flowed through the perforate flexible rubber pipe.

5.3 Apparatus required for test:

1. Burette
2. Pipette
3. 500ml & 1000ml measuring cylinder
4. 300 ml BOD bottle
5. pH meter
6. BOD incubator
7. 50 ml burette
8. 10 ml pipette
9. 100ml measuring cylinder
10. 250ml beaker
11. Crucible
12. Filter papers. (what man pepper no.40) & funnel with stand 1m half cone
13. Hot air over muffle furnace.

5.4 Chemicals required for test:

1. Manganese sulphate (240g MnSo4, 4H20, or 200g MnS04, 2H2O, 182g MnSo4, H20 dissolved in 250 ml distilled water, filtered & diluted to 500ml.)
2. Alkali-Iodide-Azide (250g NaoH + 62.5g Na +/- dissolved in 400ml distilled water using a plastic container & dissolved in 20ml distilled water.
3. Concentrated Sulphric acid.
4. Starch
5. Phosphate buffer (K2PH04 8.5g + KH2PO4 21.75g + Na2 HPO 4.7 H20 33.49g + NH4cl 1.79g) per liter.
6. Provide nutrients N&P necessary for bacterial growth.
7. Magnesium Sulphate-(MgSo4.7 H2O)

8. Calcium chloride-(FeC13.6 H20)
9. Ferric Chloride-(FeC13.6 H20)
10. IN NAOH & IN H2SO4 used for neutralizing waste water samples iftheir PH is outside the range of 6 to 8.5.
11. 0.25 N Potassium dichromate-Oxidizing agents.
12. Concentrated N2SO4 (36N) provides 1000 PH necessary for oxidation.

5.4.1 Experimental analysis: (*For procedure refer Annexure)*

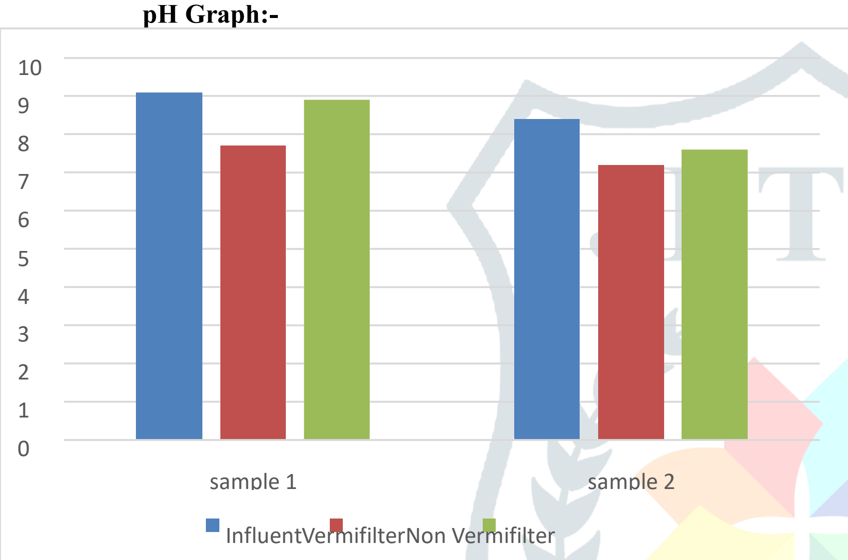
5.4.1.1 pH:-

Name of Sample: Canteen wastewater Amount : 20 lit

Table No.5.1.1 Result of pH in Wastewater

Sample No.	Original pH	Result of VF	Result of NVF
1	9.1	7.7	8.9
2	8.4	7.2	7.6

pH Graph:-



6.1 Conclusion

From the present study following conclusions are drawn:

1) From the experimental data it was found that vermifilter is more efficient than non-vermifilter in efficiency of removal of BOD, COD as well as solids. Results of vermifilter technology are most cost effective, odor free for treatment with efficiency, economy and potential decentralization.

2) It is found that as H.R.T and number of earthworms" increases; the removal efficiency also increases. The removal efficiency of parameters analyzed were 69-70%, 85-90%, 7585%, 87-89% of COD, BOD, TDS, TSS respectively by the presence of earthworms.

3) Vermifiltration is found to be suitable technique for decentralized wastewater treatment.

6.2 Future Scope:

1) It can be use for domestic sewage treatment in developing cities.

2) This is implemented for every canteen premises, which will reduce load on STP qualitatively and quantitatively. It can be also implemented at domestic houses, restaurants, hotels, resort, bakery, dairy outlet etc.

Vermifilter can be tested for the treatment of secondary liquid effluents generated by a gelatine manufacturing industry.

3) It can be tested in the treatment of palm oil mill effluent.

6.3 REFERENCES

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