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WASTEWATER TREATMENT BY VERMI-FILTRATION TECHNOLOGY

Prasad Bhuwad, Onkar kolatkar, Harshit Bhoir, Kishor Bandarkar
(Civil Engineering, Viva Institute of Technology / Mumbai University, India)

Abstract : *Vermifiltration units are sludge-free, noise-free and low- or no-electricity-requiring systems of operation. The aim of this study was to emphasize wastewater treatment by vermifiltration technology using waste-eater earthworms to highlight the benefits of clean and nutritive vermifiltered water (vermiaqua) uses in agriculture to the farmers. They work on natural capacity of earthworms to treat wastewater from different sources. In view of rising concern about pollution of water bodies due to discharge of waste in them, it is necessary to initiate alternative thinking as conventional methods through STPs (Sewage treatment Plants) have had limited success. In recent years the application of specifically designed filtration based technology (popularly known as Vermifiltration technology) for treatment of wastewater municipal, urban and agricultural, is becoming widely acceptable. It treats the wastewater in natural manner without the use of chemicals. In short, Vermifiltration technology is an improved filtration system for treatment of wastewater. The main objective of present research work is to provide and popularize a simple, feasible, practically sound, eco-friendly and cost effective technology for wastewater treatment. Vermifiltration technology is such a type of system, which reduces the impact of sewage and converts into useful water for gardening and irrigation purpose.*

Keywords - *Vermifiltration, wastewater treatment, locally available Vermifiltration earthworm species and Vermifiltration technology*

I. INTRODUCTION

Nowadays scarcity of water is one of the major issues of the present world due to growing demands of water. It has been reported that about 80% of the water supply used by the society returns as domestic wastewater in the sewer system. In most cases, huge amount of diverse nature of effluents released from varied industries are disposed in open environment causing pollution of soil and water resources. Individual wastewater treatment through physical, chemical or biological method is often very costly and results in a large amount of sludge. Thus there is a need to look for an alternative treatment processes. Efforts are ongoing in order to develop new sustainable, low cost technologies for the treatment of wastewater. Therefore, an alternative onsite wastewater treatment process is needed to seek that is economically affordable, environmentally sustainable and socially acceptable. Even though numerous solutions were adopted for the treatment of wastewater but among all the technologies it has been found that Vermifiltration is more effective and a newly confined novel technology. Vermifiltration is a low cost, odourless and non-laborious intensive method of wastewater treatment and do not occupy large area for the treatment facility to set up.

II. MATERIALS AND METHODOLOGY

2.1 MATERIALS.

Microfiber Cotton Cloth, Coarse Aggregates, Fine Aggregates, Sawdust, Soil, Vermicompost, Earthworms, Other Fixtures, Glass Tank, etc. materials are used for making a Vermifiltration unit.

2.1.1 Microfiber Cotton Cloth

Microfiber Cotton Cloth of 01 mm thickness is used. The main objective of using Microfiber Cotton Cloth is to final stage filtration and does not allow any dirt to enter in the collection container.

2.1.2 Coarse Aggregates

Coarse aggregate of size 20 mm, 16 mm and 10 mm diameter are used. The main objective of using aggregates is to provide support to the top layers and filtration of the waste water also to allow easy passage of water through the tank. In the Vermifiltration process the aggregates are provided generally in different layers in different sizes. Two or three layers can be provided depending upon depth of tank and volume of waste water at the source.

2.1.3 Fine Aggregates

Fine aggregates are the particles that pass through 4.75 mm sieve and retain on 0.075 mm sieve are used in the layer of vermifilter bed. The pollutants in wastewater are adsorbed and stabilized by fine aggregates. The sand offers excellent 'hydraulic conductivity' in vermifilter layers because of being porous for cleaning sewage. Fine aggregate layer will not allow any sewage dirt to pass to the next layer.

2.1.4 Sawdust

The fine sawdust, collected from a nearby wood workshop, was composed of Khayaivorensis, Mansoniaaltissima and Miliciaexcelsa tree species. Sawdust performed slightly better than the Cow dung. This layer consists of 10 cm thickness.

2.1.5 Soil

When water passes through soil, it is cleaned via physical, chemical and biological processes. In addition to soil's physical filtration capacity, soil contains important biota that helps transform and decompose certain chemicals and other contaminants from soil, thus helping filter them out of the water.

2.1.6 Vermicompost

Vermicast (also called worm castings, worm humus, worm manure, or worm faeces) is the end-product of the breakdown of organic matter by earthworms. These castings have been shown to contain reduced levels of contaminants and a higher saturation of nutrients than the organic materials before vermicomposting. Vermicomposting can also be applied for treatment of sewage. A variation of the process is vermifiltration (or vermidigestion) which is used to remove organic matter, pathogens and oxygen demand from wastewater or directly from black water of flush toilets.

2.1.7 Earthworm

Globally, 4400 species of earthworms are reported out of which 509 species have been reported in India, out of them, e.g. Eisenia *fetida*, Perionyx excavatus, and *Eudrillus eugeniae* are most commonly available species used in waste management and having maximum bio-accumulating potency. Most of the earthworm species consume organic wastes (solid wastes and wastewater), half of their body weight in a day except *E. fetida* that consumes waste equal to their body weight in a day to increase their population by two times in every 2–2.5 months. Therefore, we will use *E. fetida* in this project.

2.1.8 Glass Tank

Tank is of rectangular shape of size 0.3m x 0.3m x 0.8m. According to the weight of aggregates and volume of sewage the thickness of glass is determined. The size of tank is decided according to the volume of sewage and the retention time required to maintain the velocity of the flow and time of travel appropriate size and shape (rectangular) of tank are adopted. The holes are provided at inlet and outlet of tank for entrance and removal of waste water. The number and size of holes are provided according to the volume of wastewater.

2.1.9 Other fixtures

It consists of mostly the PVC pipes, connectors like elbow bends and to regulate the flow valves are provided.

2.2 METHODOLOGY

The waste water was sample collected in half liter two bottles (i.e. 1 liter) from wash basin pipe. And the wastewater was collected from the sink and bath room. (Wastewater generated from bathing, laundry, kitchen and cleaning activities). In this study, Eisiena Fetida and Eudrilus eugeniae, commonly known as Tiger worm and African Night Crawler earthworm species are used.

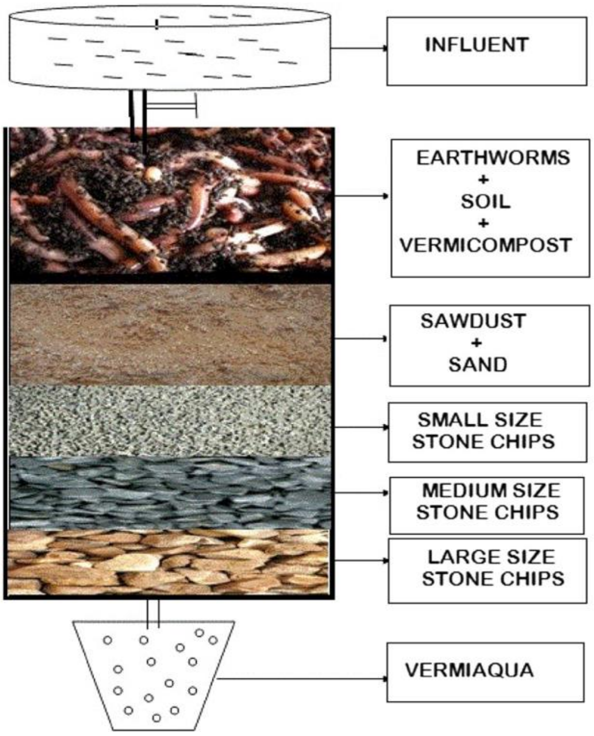

Fig.2.2 Flow Chart of Vermifiltration System

Initially, the base model was constructed as per the design by using 12 mm thick glass and PVC pipes and corks. Additional glass plates were provided at the bottom to ensure sufficient stability during loading and transporting. The dimensions of the base model were checked and all the connections were glued. Now, the bed assembling of the model was started. The bottommost layer was made by 20 mm aggregate, up to a level of 10 cm. After that, 16 mm aggregate was placed in the model, up to a height of 10 cm. Then 6 mm aggregate was placed. After placing the bottom three layers, the intermediate layer was made by sand and sawdust of 10cm, on which the top layer of soil, vermicompost, and earthworm were placed. Some water was sprayed on the top layered, and the model was left for 24 hours. Meanwhile, various tests (mentioned previously) were done on the initial sample. After that, the raw sample was placed in the bed by means of an inlet pipe up to the influent pipe level. Influent container having water controller knob was adjusted to trickle down @ 15 ml wastewater per minute onto the top layer of vermi bed. After draining the sample, the inlet pipe was closed by means of cork, and the arrangement was kept for 2 hours (retention period for batch process). After the retention period was over, the final sample was taken out by means of effluent pipe, and various tests (mentioned previously) were done on the final sample. At last, a comparison of the final results was done in order to calculate the efficiency of the Vermifiltration bed. Moreover, the efficiencies were compared with the pre-defined efficiencies obtained by the standards provided by National Environmental Engineering Research Institute (NEERI).

III. PRELIMINARY RESULTS

Sr No.	Tests	Results Of Waste Water Sample	Unit	Sr No.	Tests	Results Of Waste Water Sample	Unit
1	Color	50	Hazen	8	Ammonia	0.2	mg/l
2	Odour	Disagreeable	…	9	Iron	0.51	mg/l
3	pH	6.06	…	10	Phosphorous	N.D	mg/l
4	TDS	320	mg/l	11	TSS	150	mg/l
5	COD	352	mg/l	12	Turbidity	325	NTU
6	BOD	140	mg/l	13	E. Coli	>100	CFU/100ml
7	Nitrate	0.54	mg/l				

IV. CONCLUSION

Based on the above analysis, the results we have is the preliminary results and the project is concluded on the basis of final results. But the preliminary results we got are in there range which we required. Therefore, the project is on their correct path and the final conclusion will get only after we get the main results, weather it is feasible to adopt the method or not.

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