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DECENTRALIZATION OF SEWAGE BY VERMIFILTRATION: A REVIEW

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Abstract : Wastewater is water which has been adversely affected in physical, chemical and biological characteristics. The wastewater generation and its treatment has become a consequential health issue in the developing countries due to the inadequate treatment facilities. The most important source of contamination of water resources is discharge of untreated wastewater in surface and sub-surface water courses.

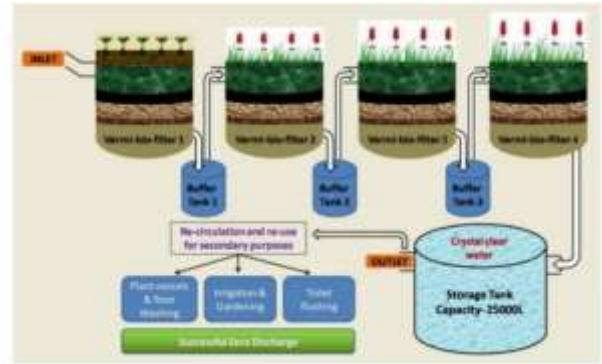
Wastewater consist organic matter such as polysaccharides, methanol could be degraded by the bacteria, fungus and algae. Some of them, such as acetone and methanol, could cause acute toxicity when existed in wastewater at high concentration. It also causes different waterborne diseases like diarrhea, cholera and some other. Vermifiltration is more dependable than various other wastewater treatment technologies as they need more area, high maintenance cost, high energy consumption. The treatment systems that require comparatively low costs, energy and maintenance are better for treatment of rural domestic wastewater. There is no sludge formation in this process which requires more expenditure on landfill disposal. This is an odor free process and resulting vermifiltered water is clean enough to be reused in parks, gardens and for farm irrigation.

Index Terms - bio-filter, Eisenia fetida, sewage wastewater treatment, vermifiltration, earthworms, enzymes, microfiltration, greywater, decentralization of wastewater

I. INTRODUCTION

In the recent past, developing countries like India have changed their approach towards the treatment of liquid effluents. The research has been intensively directed towards simpler, energy saving, environmentally bio-safe and cost-effective technological solutions. In addition, the environmental regulations by Pollution Control Boards have undergone vast changes. (Kumar et al. 2008). Today, most of the wastewater treatment plants have started looking for biotechnological alternatives in their systems. Apart from the benefits of improved capacity, efficiency and lowered operative costs, microorganisms, enzymes and earthworms also keep the treatment process as natural as possible. (Ghatnekar et al. 2010). There has been considerable achievement on drinking water supply, but the problems of excreta and wastewater disposal have received less attention. The world met the MDG for drinking water by the end of 2011 (WHO, 2012) but the target for the sanitation has not been achieved. Greywater, a major component of the domestic wastewater, is usually generated from dishes, showers, sinks, and laundry. (Amare Tinush Adugna et al. 2016). Vermifiltration technique is a new approach towards wastewater treatment to save cost, energy and eliminate chemical usage. Unlike conventional water treatment amenity, vermifilter uses no chemicals, the system is all natural. We have tried to develop a sustainable and environmentally friendly technology for the treatment of college canteen wastewater at low cost. (Nandini Misal and Mr. Nitish A. Mohite et al. 2017). Earthworms are long, narrow, cylindrical, bilaterally symmetrical, segmented animals without bones. Earthworms' body works as a 'biofilter' and they have been found to remove the 5 days' BOD (BOD5) by over 90%, COD by 80–90%, total dissolved solids (TDS) by 90–92%, and the total suspended solids (TSS) by 90–95% from wastewater by the general

mechanism of 'ingestion' and biodegradation of organic wastes, heavy metals, and solids from wastewater and also by their 'absorption' through body walls. (Rajiv K. Sinha, Gokul Bharambe, Uday Chaudhari et al. 2008). When technique integrated with vermifilter sludge produced on surface was reduced by 40%. He also discovered and studied almost 44 species of earthworms. Out of 44, only 13 are suitable when integrated with constructed wetland technique. (Nathasith Chiarawatchai et al. 2010) The objectives of this project are to assess the suitability of vermification process for wastewater of hostel mess, to evaluate the treated efficiency by using the two plants (Canna and Ginger) with the combination of vermiculture soil and to study the effect of variation in terms of removal of BOD as well as COD by differing the organic loading. (Jothilakshmi, Sivaranjani, Subasri, Thilagavathy and Vishali et al. 2018). So, vermifiltration is more economic process for sewage treatment.



Layout of vermifiltration

II. Materials And Methodology used

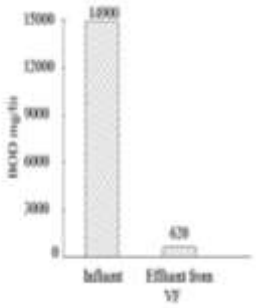
Nandini Misal and her friends collected wastewater sample from college canteen. Eisenia fetida earthworm species were used in the study. The study was carried out in a vermifiltration kit made up of plastic having 20 lit capacity. The kit contains a layer of aggregates of 20mm size of 7 cm with layer of 10-16 mm size of 7 cm and 5 mm size of 7 cm aggregates above which 5 cm layer of sand and sand boulders with layer of cowdung, clay of 10 cm with vermis on the top. The WW was allowed to pass through beds of Vermifilter at a maintained velocity (Nandini Misal and Mr. Nitish A. Mohite et al. 2017).

According to Ghatnekar S. D., around 80-85 sq. m area is required to set-up this novel plant having capacity to treat 12,000 Liters of effluents every day. He used four-stage vermi-bio-filter plant consists of four 'Sintex' tanks each of 10,000 liters capacity. All the four tanks are connected together. The principle of trickling filter is used in the system. The lower most layer of each tank consists of coarse rubble. This followed by layer of semi-crushed bricks and double layer of gravel and fine sand. The upper most layer consists of semi-sterilized bedding material inoculated with selected and effective microorganisms, enzymes and earthworms. The topmost layer however, needs to be replaced after six-eight months of operation. All four tanks have been planted with 25 seedlings of Canna. The roots of these plants absorb and degrade the pollutants by osmotic filtration apart from giving aesthetic and ornamental appearance to the vermi-bio-filtration system. (Ghatnekar et al. 2010).

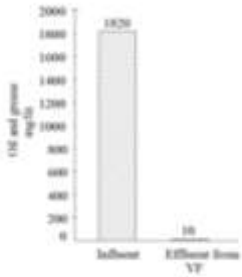
Rajiv K. Sinha, Gokul Bharambe, Uday Chaudhari (2008) studied vermifilter kit and formation of bed produced by Griffith University, Brisbane. Along with, they explained some factors which can affect vermifiltration and earthworms during processes. In this paper they also explain some earthworm characteristics. Hydraulic retention time is about 1-2 hr so that worms can ingest organic matter from wastewater completely. Vermifiltration is effectively used for removal of EDCs (Endocrine Disruptive Chemicals). Reverse osmosis is one of the methods for purification of EDCs which is cost prohibitive at present and rural areas cannot afford it. (Rajiv K. Sinha, Gokul Bharambe, Uday Chaudhari et al. 2008).

Earthworm is an important factor in this technique. It decomposes organic matter present in sewage and convert into simpler substances. *Eisenia fetida* is specific type of earthworm has high tendency of survival, multiplication and conversion ability of waste. Due to consumption of waste residue generation and management problem is also resolved.

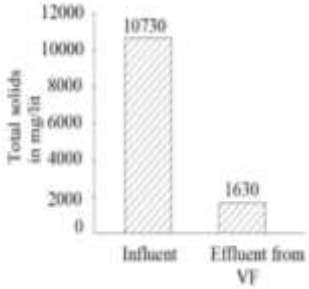
III. INTERPRETATION OF SOME RESULTS BY GRAPHICAL METHOD



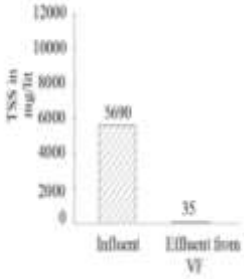
Biochemical oxygen demand in mg/lit



Oil and grease in mg/lit



Total Suspended solid in mg/lit



Total solids in mg/lit

CONCLUSION

Vermifiltration of wastewater using earthworms is a newly conceived technology. It is effective process which help for proper and easy management of sewage. Due to use of vermifiltration technology excess expenditure required for sewer line construction and for purification of wastewater decreases effectively. As like decentralization of solid waste, liquid waste also decentralized with this technique. Even basic functional unit of this filter i.e. Earthworm is easily available, economic and can survive in huge climatic diversity if moisture is present. So, this is one of better emerging technology for rural and urban sanitation facility development.

FUTURE SCOPE

Vermifiltration can be use under septic tanks so water table contamination due to seepage is prevented. Also, this will implant for treatment of sewage collected to municipal sewage treatment plant on large scale.

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References:

- Ghatnekar S. D., Kavian M. F., Sharma S. M., Ghatnekar S. S., Ghatnekar G. S. and Ghatnekar A.V., "Application of vermifilter based effluent treatments from the gelatineindustry."Dynamic Soil, Dynamic Plant (2010), pp.83-88.
- Patel Jatin B., "Wastewater treatment by vermifiltration: A review", (IJLTEMAS), volume VII, Issue I, January 2018, ISSN 2278-2540.
- Amare Tirunesh Adugna, "Concentration Greywater Treatment by Vermifiltration For Sub-Saharan Urban Poor" (2016), International Institute for Water and Environmental Engineering Thesis, Ref. No. 2iE/2015-05.

- Nandini Misal, Mr. Nitish a. Mohite, "Community Wastewater Treatment by Using Vermifiltration Technique", International Journal of Engineering research and Technology, ISSN 0974-3154, Volume 10, Number 1 (2017).
- Rajiv K. Sinha, Gokul Bharambe, Uday Chaudhari, "Sewage treatment by Vermifiltration with synchronous treatment of sludge by earthworms: low-cost sustainable technology over conventional system with potential for decentralization", The Environmentalist: the international journal for all environmental professionals (2008), https://research-repository.griffith.edu.au/handle/10072/23488
- Ranjeesh Singh, Matteo D'Alessio, Yulie Meneses, Shannon L. Bartelt-Hunt, Bryan Woodbury, Chittaranjan Roy, "Development and performance assessment of an integrated vermifiltration based treatment system for the treatment of feedlot runoff",Journal of Cleaner Production 278 (2021) 123355.
- Aliva Patnaik, Dnynraj Baban Bidkar, "Bioremediation of wastewater from drain in Burla town, Odisha, by vermifiltration", Asian Journal of Science and Technology, Vol.08, Issue 08, pp.5313, August 2017.
- Kirill Ispolnov, thesis on "Combining vermifiltration with Hydroponics to trat organic and produce food." February 2021. https://run.unl.pt/bitstream/10362/115106/1/Ispolnov_2021.pdfhttps://run.unl.pt/bitstream/10362/115106/1/Ispolnov_2021.pdf
- Krishnasamy K., Nair J., Hughes R. J., "Vermifiltration systems for liquid waste management: a review", International Journal of Environment and Waste Management, 12 (4), pp. 382-396, 2013.
- Nathasith Chiarawatchai, "Implementation of earthworm assisted constructed wetland to treat wastewater and possibility of using alternative plants in constructed wetland", (GFEU), 2010.
- Pali Sahu, Swapnalu Raut, Sagar Mane, "Treatment of grey and small scale industry wastewater with the help of vermifilter", Civil Engineering and Urban Planning: An International Journal (CiVEJ) Vol.2, No 1, 29-35, (2015).
- Anusha V., K. M. Sham Sundar, "Application of vermifiltration in domestic wastewater treatment", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 4, Issue 8, 7301-7304, (2015).