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Domestic Wastewater Treatment by Vermifiltration- A Review

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Abstract: ***Water performs an important role in human life. Today water is becoming important and limited natural resources present on the earths surface. To deal with water scarcity and conservation, only reuse and recycle of the wastewater is the option. In recent days the construction and maintenance of the costly wastewater treatment plants cannot afford by many developing countries. They need any other techniques for treatment of wastewater at low cost. Centralized wastewater treatment system may not fulfill the sustainable wastewater management in upcoming scheduled increasingly ever increasing demand. Vermifiltration is one of the best method in which wastewater is treated by using earthworms. The mechanism involved in treatment of organic pollutants from wastewater is degradation by earthworms and adsorption by bed material. Eartworms increase the natural aeration and hydraulic conductivity by granulating the soil particles, due to this earthworms also known as environmental engineers. A treatment of domestic wastewater by using vermifilter is found to be more effective compared to trement by using non vermifilter. Overall review found that vermifiltration is an environmentally sustainable,socially acceptable and economically viable.***

Keywords: Vermiiltration, earthworms, wastewater, Biochemical oxygen Demand (BOD), Chemical oxygen Demand (COD),

I. INTRODUCTION

Now-a-days fresh water is becoming one of the most limited natural resources available to us. Today we are left with no another option to face scarcity and conservation of the water but reuse & recycle every drop of water that we use is another way to save the water on the surface of the earth. The wastewater generation and its treatment has become a consequential health problem in the developing countries due to the inadequate treatment facilities.

The most important source of contamination of water resources is the discharge of untreated wastewater into surface and sub-surface water bodies. In developing countries most of the population living in rural and urban areas depends upon onsite systems for the treatment of domestic wastewater. The wastewater treatment systems that require energy efficient, comparatively low costs and maintenance are better for the treatment of rural domestic wastewater.

The water supply used by the society returns as domestic wastewater in the sewer system as sewage is nearly 80%. Sewage carries high loadings of organic matter and hazardous chemicals referred as BOD (biological oxygen demand) and COD (chemical oxygen demand) and solids which include both suspended and dissolved solids. Sewage has to be treated to reduce the organic loads before discharging into environmental natural water bodies (rivers and oceans).

If wastewater is directly discharged into the natural water bodies, this would seriously affect the survival of all aquatic organisms in the rivers and oceans. Individual wastewater treatment through chemical, biological or physical 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 which is economical, ecofriendly and socially acceptable.

Vermifiltration of wastewater using waste eater earthworms is a new technology and earthworm's body works as a 'biofilter'. Vermifiltration is a logical extension of 'soil filtration' which has been used for 'sewage silviculture' (Growing plants) since ancient days. Vermifiltration technology is most ecofriendly, cost effective and odor-free process for domestic wastewater treatment with potential for decentralization, efficiency, economy and convenience. Vermifiltration technology is efficient in removal of Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Total Dissolved Solids (TDS), Total Suspended Solids (TSS) from wastewater by the mechanism of Biodegradation and Adsorption. Absence of sludge formation in the vermifiltration process which requires additional expenditure on landfill and disposal, it makes vermifiltration process economically viable.

II. LITERATURE REVIEW

Anusha V and K M Sham Sundar [1] concluded that vermifiltration is a logical extension of soil filtration and can be a most odor free and cost effective technology for wastewater treatment with efficiency. Experimental results shows the average vermifilter removed chlorides and chemical oxygen demand (COD) for about 70-77% and 57-66% respectively as well as it is found that as numbers of earthworms and hydraulic retension time (HRT) increases; the removal efficiency of vermifilter also increases. Domestic wastewater treatment using earthworms is found to be more effective as compared to treatment without earthworms.

Lakshmi C, Ranjitha J and Vijayalakshmi S [2] carried study of the experimental data it was discovered that vermifilter is more efficient as compared to non-vermifilter in efficiency of removal of biochemical oxygen demand (BOD), chemical oxygen demand (COD) as well as solids. Experimental results to the acceptable value for BOD in treated wastewater is 1-15 mg/l, COD is 40-70 mg/l and pH is 7.0. The values obtained from the experimental results are well within the limits which indicates that vermifiltration technology has better performance in treatment of wastewater. It is also investigated from experiment, reduction of wastewater characteristic was greatly affected by addition of sawdust to the soil, which results in enhance the porocity of soil. The earthworms production, growth, breed and survive ion the moist environment is very well was observed during the process of experiment.

Dr. Mahendra Pratap Choudhary and Pratibha Medok [3] analyzed that in treatment of domestic wastewater, effluent efficiency of removal of biochemical oxygen demand (BOD), chemical oxygen demand (COD) were 86.91% and 83.29% respectively. About 90-99% pathogen removal efficiency was observed for total coiliform and faecal coliform. Results shows that the vermifiltration process is more efficient in treating the domestic as well as clinical wastewater as well as vermifiltered water can be reused for irrigation, gardening etc. Also found that vermifiltration of wastewater should be started with higher number of earthworms atleast 15,000-20,000 worms/ cubic meter of soil to attain good results.

Pali Sahu, Swapnil raut and Sagar Mane [4] performed the experimental comparison between vermifilter and non-vermifilter. It can be seen that the percentage reduction of BOD in vermi-filter ranges from 87- 90% while in non-vermi-filter it was found to be 33-37%, percentage of reduction COD in vermi-filter ranges from 70- 90% and non vermi-filter was found to be 16- 20%, percentage reduction in concentration of TSS of waste water by vermi-filter ranges from 90- 99% whereas in non-vermi-filter it was found to be 80- 90%. The pH of waste water in the initial stage was 5.5 to 6.5 (acidic nature). But as the degradation started in vermi-filter the pH scale was set to be 7.2 to 7.4 (alkaline) while pH remains same in effluent as in influent in non-vermi-filter due to this it is found that vermifilter has an in-built pH buffering ability and hence can accept waste water within a pH range 4 to 9 without any pH adjustment.

Himanshu Gupta [5] concluded that earthworms are useful for treatment of waste water from industries as well as domestic and residential sewage. The mechanism of biodegradation is used by earthworms to treat organic matter present in wastewater. Their removal efficiency is about 80-90% for BOD and 70-80% for COD. It morever helps in the treatment of different industrial wastewater of Dairy, Gelatine, Palm oil mills and fruit industries. They stabilized organic content in wastewater and converted to stable product. It is investigated that among all earthworms E. Fetida is best suitable for treatment of waste water from different fields.

Ankur Rajpal, Sudipti Arora, Tarun Kumar [6] investigated that the pollutant concentrations of effluent of the vermifilter reached the discharge standard of pollutants for municipal wastewater treatment Plant (secondary standards) and standards for irrigation water quality, India. The experimental results shows that effluent quality of vermifilter showed higher percentage removal of Biochemical Oxygen Demand (BOD) is 97.6 %, Chemical Oxygen Demand (COD) is 70.2 %, Suspended Solids (SS) is 80 %. The Vermifiltration technology is a economical process for wastewater treatment with convenience, efficiency and potential for Decentralized wastewater treatment.

Jatin B. Patel [7] carried study of the basic mechanism of vermifilter and technology of vermifilter was found to be suitable technique for highly efficient treatment technology for wastewater in rural area as well as the treated effluent had higher value of nitrate and phosphate concentration which is best suited for horticulture or sewage farming. Vermifiltration treatment is low energy dependent as well as it has distinct advantage over all the conventional biological wastewater treatment systems, also achieve greater utilization of waste materials that cannot be achieved by other technologies.

Gokul Bharambe and Rajiv Kumar Sinha [8] concluded that any wastewater from the households and commercial organizations can be successfully treated by the earthworms as well as the technology can also be designed to suit a particular wastewater. Vermifilter can treat concentrated wastewater as well as dilute (less than 0.1% solids) also it has an in-built pH buffering ability and hence can accept wastewater within a pH scale of 4 to 9 without any pH adjustment. Vermifiltration technology by earthworms adopts all major bio-conversion, bio-treatment and bio-degradation technologies. It is found that greater hydraulic retention time (1–2 h) is allowed not only the worms can ingest (bio-accumulate) the toxic chemicals but also eat the pathogens completely as well as greater

interaction with wastewater components also provides better opportunity for the worms to eat all the solids and prevent any sludge formation.

Hema Patel and Sarika Telang [9] performed the analytical study of the vermifilter on dairy industrial wastewater.

The wastewater generated in dairy industry or milk processing industries contains very high organic loading and total solids and is mostly treated in ETP (Effluent Treatment Plant). A combination of conventional filtration process along with vermicomposting is used in vermifiltration technology. Earthworms body act as a 'biofilter' and they were found to decrease COD-91.64%, BOD-97.95%, TSS-76.39%, TDS-84.27%. Oil and grease subject matter was originate to be reduced by 84.13%. After completing the study of vermifilter technology it is found that treatment was cost effective, 60 to 70% of cost reduction is possible, odor free and environmentally sustainable.

Anaokar G. S. and Bhise H. S. [10] studied the effect of vermifiltration technology in which wastewater is being treated using vermifilter containing earth worms and the results are compared with non-vermifilter which is not containing earthworms for the treatment of domestic wastewater. The degradation of organic materials present in the vermifilter bed was performed by earthworms in vermifilter process. After completing experimental study it is found that the removal efficiency of parameters analyzed were improved 24.38%, 25.86%, 17.06%, 25.26%, 35.47% of COD, BOD, Turbidity, TDS, TSS respectively by the presence of earthworms.

III. CONCLUSION

Affter studying all of above research articles, it can be concluded that, vermifiltration is most ecofriendly, cost effective and odor free technology as compare to conventional technology for domestic wastewater treatment with efficiency. In vermifiltration process, earthworms are used in the treatment of domestic wastewater treatment, among them Eisenia Fetida is most suitable for treatment. Vermifilter technology is more efficient in efficiency of removal of Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Total Dissolved Solids (TDS), Total Suspended Solids (TSS) and other wastewater parameters. No sludge formation is major advantage of vermifiltration technology because reduction of expenditure on landfill and disposal of sludge. Vermicompost is formed instead of sludge which can be used as fertilizer. Vermifiltered water is suitable for irrigation purpose.

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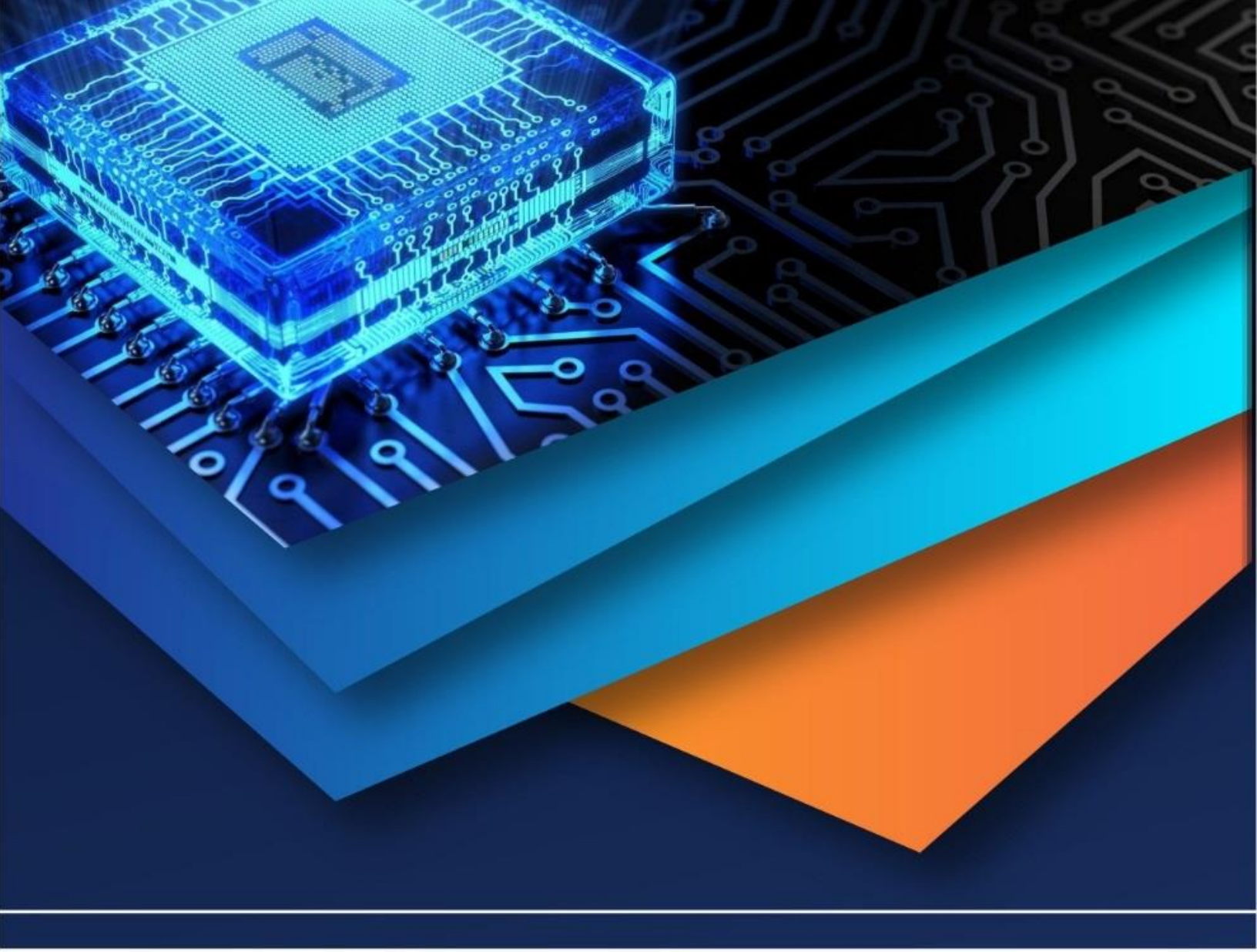

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