International Journal of Scientific Engineering and Research (IJSER)
ISSN (Online): 2347-3878
Impact Factor (2020): 6.733

Treatment of Sugar Industry Effluent by Vermifiltration

Darsh Brahmbhatt[1], Bindya Soni[2], Vispute Gurudas[3], Twinkal Patel[4]

[1]Gujarat Technological University, Dr. S & S. S. Gandhy Government Engineering College, Dr Gandhy campus, Opp. old RTO, Surat, Gujarat, India
brahmbhattdarsh[at]ymail.com

[2]Gujarat Technological University, Dr. S & S. S. Gandhy Government Engineering College, Dr Gandhy campus, Opp. old RTO, Surat, Gujarat, India
sonibindya29[at]gmail.com

[3]Gujarat Technological University, Dr. S & S. S. Gandhy Government Engineering College, Dr Gandhy campus, Opp. old RTO, Surat, Gujarat, India
gurudasvispute[at]gmail.com

[4]Gujarat Technological University, Dr. S & S. S. Gandhy Government Engineering College, Dr Gandhy campus, Opp. old RTO, Surat, Gujarat, India
twinkal.p[at]yahoo.com

Abstract: ***Sugar production is a water intensive process that produces a large amount of wastewater with high concentration of chemical oxygen demand (COD), mostly consists of organic carbon compounds, biochemical oxygen demand (BOD), Glucose, Fructose, Total solids. By the application of vermifiltration technique effluent can be treated in the presence of Earthworms which acts as a biofilter to remove physio-chemical parameters from sugar industry effluent. Vermifiltration units are sludge free, noise free and low or no energy requiring system for operation.***

Keywords: earthworms, vermifiltration, sugar industry, effluent

1. Introduction

The effluent generated in sugar industry contains high amount of organic loading and total solids. Both of them are treated in Effluent Treatment plant (ETP), which results into generation of sludge which increases the cost of processing and disposal. Vermifiltration can be considered as a combination of composting along with the typical filtration. Body of worms act as a 'biofilter' and are found to decrease BOD-, COD-, TSS-, TDS-.'Feeding' and 'biodegradation' are the mechanism through which treatment is carried out along with increase in natural aeration by grinding soil particle. When the water is passed through the top layer all the solids get trapped in the different soil layers of vermifiltration whereas organic loading is treated by the Earth worms. At the end the effluent collected was analyzed and parameters were tested and are clean enough to be used for irrigation purposes. Overall in process there is no generation of sludge which saves the expenditure of landfill and disposal.

2. Materials and Method

2.1 Materials used

Construction of bed was carried out by using different sizes of gravels, sand and soil suitable for worms and a sprinkler. Eisenia Fetida species of Earthworms were used approx 150-200 on 1000 worms/m^2 and 20 liter of plastic drum. Earthworms were obtained Main cotton research station, surat and effluent was collected from Chalthan Vibhag Khand Udhyog, Surat.

Table 1: Characteristics of effluent

Parameters	Values
Odor	Unpleasant
Color	Yellowish
Ph	6.25
Total Dissolved Solids	3852 mg/l
Total Suspended Solids	102.40 mg/l
BOD	920mg/l
COD	3700 mg/l

Table 2: GPCP Standards for disposal of wastewater

Parameters	GPCP Standards
pH	5.5-9.0
BOD	<350
COD	<250
TSS	<100
TDS	<2100

2.3 Preparation of Vermifiltration bed

Different layers of sand, gravel and soil containing Earthworms.Each layer had a depth of 50mm. Moving from bottom to top. First layer consists of large aggregate followed by medium aggregate. While another layer consist of sand. Top most layer consist of soil having earthworms. Total depth of then bed was 200mm with 10mm freeboard.

2.4 Experimental Procedure

2L of sugar industry wastewater was stored in a bottle kept at an elevation from the vermifiltration bed. the plastic drum in which bed was constructed consisted of small opening at the bottom to collect the treated effluent. A rubber pipe was used

to convey the effluent to bed. At the end, the pipe had multiple holes to sprinkle the water throughout the bed uniformly such that it takes 24hrs of retention time in bed. At the end of the detention period effluent was collected and analyzed for BOD, COD, TSS & TDS.

Figure 1: Large size aggregates (Size: 10-12.5mm)

Figure 2: Meduimsize aggregates (Size:6-8mm)

Figure 3: Small aggregates (Size: 2-4mm)

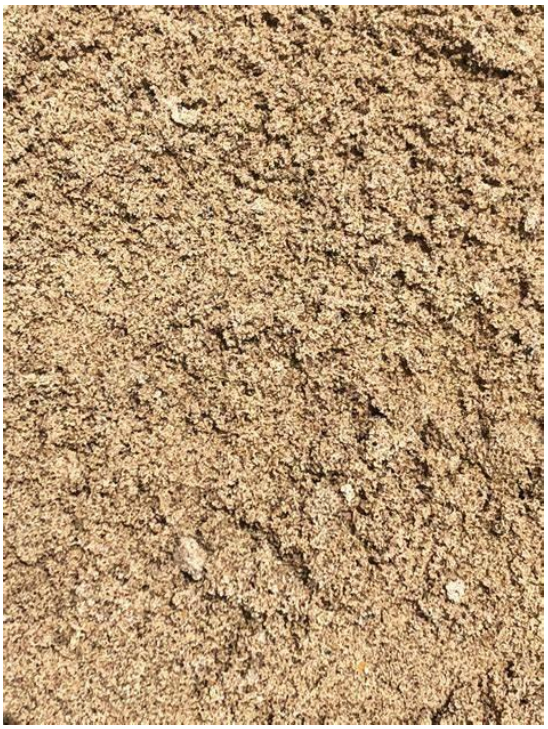


Figure 4: Sand

Figure 5: Soil containing Earthworms

Figure 6: Actual experimental setup

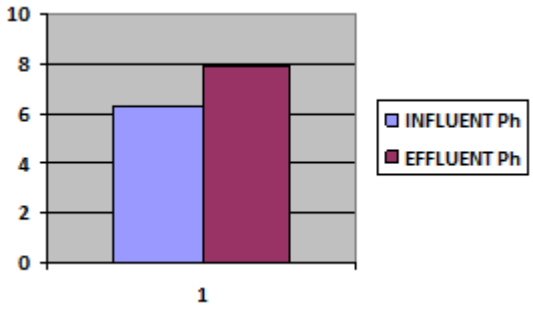
3. Results and Discussion

3.1 Changes in pH

No significant change in the pH was observed in treated effluent by vermifiltration as well as untreated effluent. The bar graph shows the variation in pH within time limit.

Table 3: Reduction in pH

Influent pH	Effluent pH
6.25	7.89



3.2 BOD & COD Removal

Results show that overall efficiency of the BOD & COD removal from the sugar industry effluent is greater than 90% and 85%. Earthworms are responsible to biodegrade waste as compared to inorganic waste through biocatalysts which quicker the reaction rate. Removal efficiency of BOD was found to better than compared to COD removal efficiency.

BOD values are acceptable as per the discharge standards for irrigation purpose.

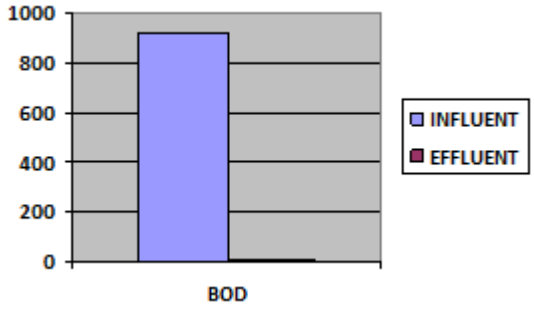
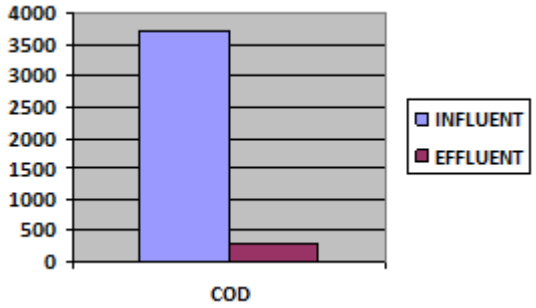


Table 4: Reduction in BOD_5

Influent	Effluent
920 mg/l	8 mg/l

Table 5: Reduction in COD

Influent	Effluent
3700mg/l	290.03mg/l



3.3Removal of TDS &TSS

Both of it refers to the particles present in the effluent either in dissolved or suspended form. In initial trials TDS as well as TDS increased because of dissolution of soil particles present in the bed. The species of the worm significantly removed the TDS & TSS. TSS was removed by 83% whereas TSS with an efficiency of 55% but greater can be achieved once the vermifiltration beds get set with time.

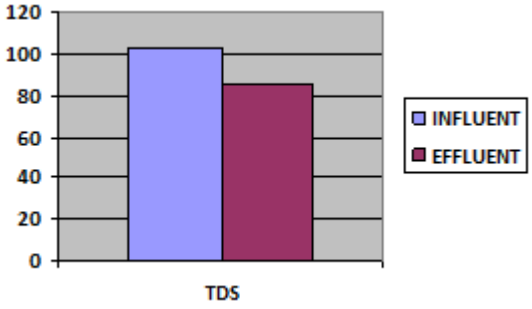


Table 6: Reduction in TSS

Influent	Effluent
102.40mg/l	85mg/l

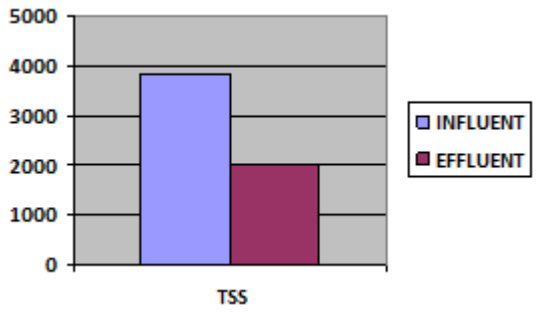


Table 7: Reduction in TDS

Influent	Effluent
3852	2100

4. Conclusion

As per the overall result observed, the efficiency of the vermifiltration bed in the treatment of sugar industry is good in comparison to conventional water treatment plant. Cost saving of about 65% can de done by using this method with in addition offers zero sludge generation at the end, no electricity consumption and noise free process. It also saves the cost and land used for the processing and disposal of sludge. BOD, COD, TSS, TDS were reduced by 99.13%, 92.16%, 83%, 55% respectively. The compost formed at the end can be used as a fertilizer and treated effluent can be used for irrigation purpose or as cooling water in sugar industry.

References

[1] Anusha V, K. M. (2015). Application Of Vermifiltration In Domestic Wastewater Treatment. International Journal Of Innovation Research In Science Engineering And Technology, 4.
[2] Lian, J. (2013). Effect of Earthworm Loads on Organic Matter and Nutrient Removal Efficiencies in Synthetic Domestic Wastewater, And On Bacterial Community Structure And Diversity In Vermifiltration. Water Science & Technology, 14.
[3] Singh, Rajneesh & Samal, Kundan & Dash, Rajesh & Bhunia, Puspendu. (2019). Vermifiltration as a sustainable natural treatment technology for the treatment and reuse of wastewater: A review. Journal of Environmental Management. 247.
[4] Singh, Rajneesh & Bhunia, Puspendu & Dash, Rajesh. (2017). A mechanistic review on vermifiltration of wastewater: Design, operation and performance. Journal of Environmental Management. 197.
[5] Sinha, R. K. (2008). Wastewater Treatment By Vermifiltration With Synchronous Tratment Of Sludge By Earthworms: A Low Cost Suitable Technology Over Conventional System With Potential For Decentralization. Research Gate, 13.
[6] Misal, N. (2017). Community Wastewater Treatment By Using Vermifiltration Technique. International Journal of Engineering Research and Technology, 6.
[7] N V, Pradeep & Anupama, S. & Kumar, J. & Vidyashree, K. & Lakshmi, P. & Ankitha, K. & Pooja, J.. (2014). Treatment of Sugar Industry Wastewater in Anaerobic Down flow Stationary Fixed Film (DSFF) Reactor. Sugar Tech. 16
[8] Sahu, O. (2019). Suitability of chemical and electrocoagulation process on sugar industry wastewater treatment: Examining of classic coagulation and electro coagulation process. International Journal of Energy and Water Resources
[9] Rajneesh Singh, Pushspedu Bhunia, Rajesh R. Dash (2018), "COD Rmovalindex- A Mechanistic Tool For Predicting Organics Removal Performance Of Vermifilters", Science Of The Total Environment.
[10] Jatin.P. (2018). Wastewater Treatment by Vermifiltration: A Review. International Journal of Technology in Engineering, Management and Applied Science, 5.
[11] D. Ghatnekar, S. (2010). Application of Vermi-Filter-Based Effluent Treatment Plant (Pilot Scale) For Biomanagement Of Liquid Effluents From The Gelatine Industry. Global Science Books, 6.
[12] M D. Sutar (2016). Feasibility Study of Vermi-Filtration For The Treatment Of Sugar Wastewater. International Journal of Innovative Research In Science, Engineering And Technology, 10.
[13] Gupta, H. (2015). A Review on Effectiveness of Earthworms for Treatment of Wastewater. International Journal of Engineering Development and Research