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Studies on the Treatment of Abattoir Wastewater using a Soil Aquifer Treatment System in Conjunction with Natural Adsorbents

Sowmya. P[1], Nagarajappa D.P[2]

[1]*PG Student, Department of Civil Engineering, U.B.D.T College of Engineering Davanagere, Karnataka, India*
[2]*Professor, Department of Civil Engineering, U.B.D. T College of Engineering Davanagere, Karnataka. India*

Abstract –*The main objective of this project was to determine how well okra seed and chicken feathers worked as adsorbents in a SAT system to clean wastewater from slaughterhouses. The goal of the study was to evaluate the removal of contaminants from wastewater, including TSS, COD, BOD, nitrate (NO3-N), phosphate (PO4), iron, and nickel. The findings suggested that okra seeds and chicken feathers could both function as effective and environmentally benign adsorbents for wastewater treatment. In a column of silty soils, the research investigated changing the adsorbent locations at different percentages (20%, 40%, 60%, and 80%). When silty soil was combined with okra seed powder and applied in the SAT system at a position 60 percent from the bottom of the column, the effectiveness of silt removal increased. The advancement of sustainable pollution reduction is aided by this study*

Key Words: **Abattoir Wastewater, Soil Aquifer Treatment System, Okra Seeds, Chicken Feathers, Silty soil.**

1. INTRODUCTION

Water is the most precious resource on the planet. All living things, including people and plants, depend on water for their survival. Due to the increasing population, urbanisation, industrialization, and modern agricultural practises that are leading to increased contamination of various water resources, people are today facing a water crisis. The amount of water covering the surface of the globe is over 70.9%, with seas accounting for 97% of that total, polar ice caps for 2.4%, and other local surface water bodies, such as lakes and streams, for 0.60%. The treatment of wastewater by land has been made permissible as an alternative to conventional wastewater treatment methods in order to address these problems. Although the soil was able to purify wastewater by adsorption, filtration, chemical reactions, and biological processes [1]. The usage of water for feeding (storm rainwater or leftover water from the treatment plant output) during soil passage is now in better condition thanks to the controlled aquifer recharge method, also known as SAT, as well as soil section research. This method of wastewater recovery is both practical and aesthetically pleasing a system. The aquifer and soil serve as natural filters. The SAT method may eliminate solids that have suspended pathogens, viruses, and other microorganisms. Percolation causes filtration, and after water gets inside the aquifer, mixing and maybe other physiochemical processes may occur. This technique may be reused to recover water or Treated Red water [2].

Most wastes that are created, either beneficial to humanity or detrimental. The most of garbage, particularly solid waste, is conveyed to Runoff from the outside, however much runs into the soil, transports water to streams and lakes. Human activities like raising livestock and preparing meat detrimental effects on the land and waters natural makeup in numerous areas of the universe. Such soils, natural water supplies to the surroundings become contaminated as a result.[3] Typically, meat processing takes place in a specialized setting called an abattoir or slaughterhouse. Wherever animals are murdered for their flesh, it takes places in an abattoir. An abattoir is a place where the goods intended for people to consume processed, preserved, and slaughtered in a hygienic manner [7].

2.MATERIALS AND METHODOLOGY

2.1 Collection of Soil

a soil sample from ICAR's Taralabalu Krishi Vinganan Kendra Davanagere. gathered to see if effluent from an abattoir could be used to treat soil specimens. A soil sample is collected in accordance with the instructions in SP 36(2). Silty soil is the category for soil analysis.

2.3 Adsorbents Preparation

Okra seeds are being purchased from the nearly full market. Collected seeds are occasionally rinsed with fresh water to eliminate pollutants and debris. The cleaned seeds are left to naturally dry in the sun for 24 hours. The large seed particles are then eliminated by sifting the powder through a mesh size of 600 microns after such dry seeds are ground into a fine powder using a pestle and mortar. Combine 10g of powder that has been sieved with 1000 ml of distilled water to create a 100-ml suspension. Using a fresh magnetic stirrer, thoroughly mix the suspension and let it sit for 5 minutes to extract the component. The solution is suspended for 15 minutes, filtered to remove any impurities, and then allowed to dry for 6 to 8 hours [4,8].

Chicken Feathers was collected from khan chicken centre in Hosadurga. Wash with fresh water and detergent, then air dry outside. Blend it thoroughly when it has dried. It should

be placed in the glass beaker before being submerged in Acetone. Then stir it for another 15 minutes, filter it, and spread it out on a tray.In a 40℃ oven dry it out, take it out of the oven once it has dried.10g of dry chicken feathers should be measured.4g of NaOH should be dissolved in 1 litre of water. it has completely dissolved, combine it with 10g of chicken feathers, stir it, and then wait 20 minutes. Take the beaker glass after 20 minutes, filter the mixture [5].

2.2 Wastewater Collection

Abattoir Wastewater was collected from Gandhi Nagara Chicken and Mutton, Davanagere. Grab sampling, also called as catch sampling, accustomed towards gather samples predetermined intervals. Samples was taken at a single location without standing water. Massive concentration of liquid waste from slaughterhouses are produced, and their uncorrected disposal could potentially extremely harmful to both the well-being of humans and our surroundings[6].

2.4 Experimental Setup

For the tests, polyvinylchloride pipe-based pillars were built. Each pillar has an inside diameter of 15cm, a length of 1.1meters, a bottom drain, and an elevated side discharge pipe. The bottom of each column was kept dry using 60-micron screen to stop soil from evaporating. By maintaining the soils field density, Columns are filled. Once effluent has been provided from the topmost level and processed, water is gathered using an outlet supplied at the base to every column. A feeding tank with a wastewater sample is located on top of this structure. A steady ponding depth of 30cm above soil level is maintained. Columns can be filled with silty soil.

3.RESULTS AND DISCUSSION

The experiment's goal was to evaluate how successfully soil column studies handled abattoir discharge both with and without adsorbents. Chicken feathers, and okra seeds are utilized to be adsorbents in an experiment and positioned at different levels in the sample, Silty soil coloration, experiments they had been executed for 0.8m of soil depth, and the best removal efficiency was found.

Table 1: Performance of SAT for a Single Depth of Silty Soil without Adsorbent

SL No	Parameters	Influent	Effluent	**Efficiency %**
1.	pH	6.96	6.51	-
2.	TSS mg/L	196	127	35.20
3.	COD mg/L	600	200	66.66
4.	BOD mg/L	114	50	56.14
5.	Nitrate (NO3-N) mg/L	12.4	8.0	35.48
6.	Phosphate ($PO4^{-}$) mg/L	5.81	3.5	39.75
7.	Iron mg/L	5	2.12	57.6
8.	Nickel mg/L	3.98	3.0	24.62

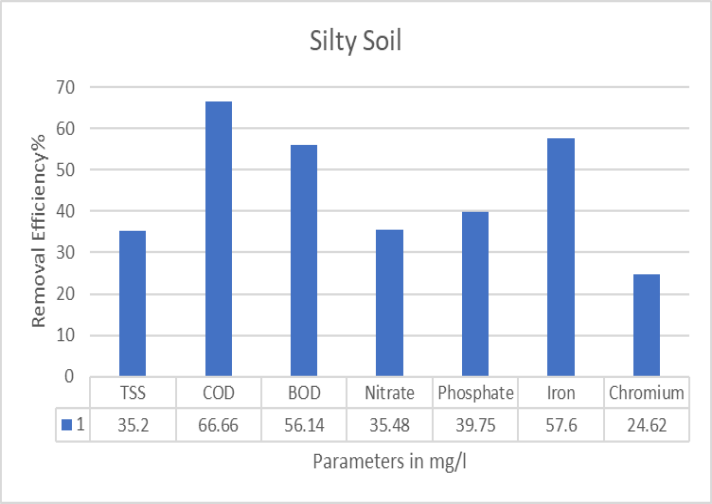

Figure1: Efficiency of all parameters for SAT System of Without Adsorbents for Depth of Soil is 0.8m

Determined filtering efficiency as shown in table1 and figure1: Chromium has the lowest filtering effectiveness (24.62%), while COD has the Highest (66.66%).

Table 2: Performance of the SAT System Using Silty Soil, Wastewater from Slaughter House.0.7m of Soil Depth and Adsorbent; Adsorbent Depth; 0.1m at an 20% Height from Bottom.

SL NO	Parameters.	Influent.	Effluent.		Removal Effectiveness %	
			Okra seed	Chicken feathers	Okra seed	Chicken feathers
1.	pH	6.96	6.60	6.83	-	-
2.	TSS mg/L	196	80	88	59.18	55.10
3.	COD mg/L	600	300	400	50.00	33.33
4.	BOD mg/L	114	45	60	60.00	47.36
5.	Nitrate (NO3-N) mg/L	15	5.231	8.12	65.12	45.86
6.	Phosphate ($PO4^{-}$) mg/L	5.93	2.012	3.23	66.07	45.53
7.	Iron mg/L	5	1.98	4.12	60.40	17.60
8.	Nickel mg/L	3.98	2.00	3.00	49.75	24.62

Table 2 shows, Nitrate has the highest removal effectiveness, while Nickel has the highest using adsorbent okra seed powder. The highest Iron and Lowest Nickel are removed using chicken feather powder. As compare to chicken feather powder and Okra seed powder, highest removal efficiency occurs in Okra seed powder.

Table 3: Performance of the SAT System Using Silty Soil, Wastewater from Slaughter House.0.7m of Soil Depth and Adsorbent; Adsorbent Depth; 0.1m at an 40% Height from Bottom.

SL NO	Parameters.	Influent.	Effluent.		Removal Effectiveness %	
			Okra seed	Chicken feather	Okra seed	Chicken feather
1.	PH	6.96	6.53	6.72	-	-
2.	TSS mg/L	196	75	78	61.734	60.20
3.	COD mg/L	600	289	435.3	51.833	27.45
4.	BOD mg/L	114	25	53	78.07	53.508
5.	Nitrate (NO3-N) mg/L	15	4.01	7.13	73.27	52.47
6.	Phosphate ($PO4^{-}$) mg/L	5.93	1.98	2.01	66.61	66.10
7.	Iron mg/L	5	1.598	2.89	68.22	42.20
8.	Nickel mg/L	3.98	1.87	2.7	53.02	32.16

Table 3 shows, COD has the lowest removal efficiency, while BOD has the highest using adsorbent okra seed powder. The highest Phosphate and Lowest COD are removed using chicken feather powder. As compare to chicken feather powder and Okra seed powder, highest removal efficiency occurs in Chicken feather powder.

Table 4: Performance of the SAT System Using Silty Soil, Wastewater from Slaughter House,0.7m of Soil Depth and Adsorbent Depth; 0.1m at an 60% Height from Bottom.

SL NO	Parameters.	Influent	Effluent.		Removal Effectiveness %	
			Okra seed	Chicken feather	Okra seed	Chicken feather
1.	pH	6.96	6.5	6,71	-	-
2.	TSS mg/L	196	50	70	74.48	64.28
3.	COD mg/L	600	200	339	85.00	43.50
4.	BOD mg/L	114	20	38.2	82.45	66.49
5.	Nitrate (NO3-N) mg/L	15	2.00	6.01	86.67	59.93
6.	Phosphate ($PO4^{-}$) mg/L	5.93	1.01	1.50	82.96	74.70
7.	Iron mg/L	5	1.32	2.3	73.60	50.00
8.	Nickel mg/L	3.98	1.00	2.00	74.87	49.74

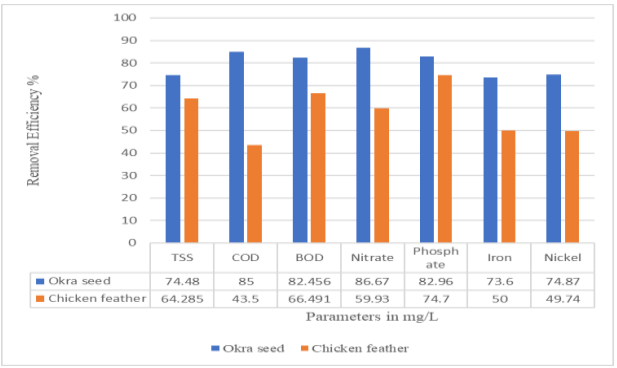

Figure 2: Removal Effectiveness of 60% Height Silty Soil from the Column's Bottom with Okra Seed and Chicken Feather Powder

According to table3 and figure 2, Iron has the lowest removal effectiveness, while Nitrate has the highest using adsorbent okra seed powder. The highest Phosphate and lowest COD are removed using chicken feather powder. As compare to chicken feather powder and Okra seed powder, highest removal efficiency occurs in Okra seed powder.

Table5*:* Performance of the SAT System Using Silty Soil, Wastewater From Slaughter House,0.7m of Soil Depth and Adsorbent Depth; 10cm at an 80% Height from Bottom.

SL No	Parameters.	Influent.	Effluent.		Removal Effectiveness %	
			Okra seed powder	Chicken feather powder	Okra seed powder	Chicken feather powder
1.	pH	6.96	6.70	6.73	-	-
2.	TSS mg/L	196	63	71	67.85	63.775
3.	COD mg/L	600	250	400	58.33	33.33
4.	BOD mg/L	114	26	40	77.19	64.91
5.	Nitrate (NO3-N) mg/L	15	2.32	6.50	84.53	56.66
6.	Phosphate ($PO4^{-}$) mg/L	5.93	1.50	1.90	74.70	67.95
7.	Iron mg/L	5	1.3571	2.72	72.858	45.60
8.	Nickel mg/L	3.98	1.5	2.3	62.31	42.211

Table 4 shows, COD has the lowest removal effectiveness, while Nitrate has the highest using adsorbent okra seed powder. The highest Phosphate and Lowest Nickel are removed using chicken feather powder. As compare to chicken feather powder and Okra seed powder, highest removal efficiency occurs in Okra seed powder.

3. CONCLUSIONS

- Use of an adsorbent increases the effectiveness of the SAT system.
- The adsorbent made from Okra seed powder removed TSS (74.48%), COD (85%), BOD (82.456%), Nitrate (86.67%), Phosphate (82.96%) Iron (73.60%), Nickel (74.87%) from effluent from slaughter house Wastewater more efficiency.
- When compared to using chicken feather powder to treat abattoir effluent, okra seeds powder form has the greatest elimination effectiveness.
- The bottom 60% location of the adsorbent is more effective than the top 20%,40% and 80% positions.

REFERENCES

[1] Vidyashree B.K, Nagarajappa D.P and Manjunath N.T"Treatability Studies of Domestic Wastewater by Soil Aquifer Treatment system in Conjunction with Palm Empty fruit Bunch Adsorbent", International Research Journal of Engineering and Technology (IRJET), vol.3(11), 2016, pp.132-137.

[2] Raji V.R and Packialakshmi "Assessing the Wastewater Pollutants Retaining for a Soil Aquifer Treatment using Batch Column Experiments", Civil Engineering Journals, vol.8(7),2022.

[3] Nasiru A, Osakwe C.E, Lawal I.M and Chinde A.U "Assessment of Physicochemical parameters and heavy metals in Gombe Abattoir Wastewater", American Journal of Engineering Research (AJER), vol.5(3), pp 64-69

[4] Sneha Singh and Ruchika Srivastava "Okra Seed an Efficient coagulant", Internal Journal for Research in Applied Science and Engineering Technology (IJRASET), vol.5,2017.

[5] Sameer Al-Asheh and Fawazi Banat "Reusing Chicken Feathers to Eliminate the Heavy Metals from Wastewater is Desirable", Journals of Cleaner Production, Vol. (11), 2003, pp; 321-326.

[6] Metcalf E, Asano T, Burton F, Leverenz H, Tsuchihashi R, and Tchobanoglous G. Water Reuse: Issues, Technologies, and Applications, Mc-Graw Hill. New York, USA. 2007.

[7] Ubwa S.T, Atoo G.H and Offem J.O "The Impacts of Gboko, Nigeria, Slaughtering Activity on Several Physical Characteristics and Heavy Metal Levels in the Neighbouring Soil", International Journal of Chemistry, vol.5, Issue 1,2013.

[8] Yusuf Olabode Raji and Lawal Abubakar "Evaluation of Okra Seed Extract Disintegration Effectiveness for Surface Water Treatment", International Journal of Scientific Research, Vol.6(2), pp;2,2015.

[9] Wilson P, Molina JM and Jaray P "Adsorption of Heavy Metals using a Low-Cost Adsorbent", World Applied Science, vol,28(11), pp;518-530.1995.