

Textile Wastewater Treatment by Soil Aquifer Treatment (SAT) System Using Natural Adsorbent

Dr. D.P Nagarajappa¹, Rashmi .B², Dr. P. Shiva keshava Kumar³.

Professor and Chairman, Dept. of Civil Engineering, UBBDTCE, Davanagere, Karnataka, India¹

PG Student, Dept. of Civil Engineering, UBBDTCE, Davanagere, Karnataka, India²

Professor and Head, Department of Civil Engineering, Proudadevaraya Institute of Technology, Hosapete, Karnataka, India³

ABSTRACT: From past for treatment and disposal of wastewater land has been utilized. Application of wastewater on land is used not only for treatment of municipal wastewater and disposal, but also provides an abundant range of benefits on economic, environmental and social aspects. The soil aquifer treatment (SAT) is land treatment that make use of land and aquifer which take part in wastewater treatment. Industrial effluents are signalizes by their anomalous turbidity, chemical oxygen demand (COD), total suspended solids (TSS), biological oxygen demand (BOD), total hardness, conductivity. In the above work collaboration of soil aquifer treatment system and adsorption technique is exhibited which helps in identifying the removal efficiency of various parameters such as color, TDS, COD, BOD and chlorides from Textile wastewater with the aid of adsorbent and soil. Rice straw used as adsorbent and two soil Clayey Sand and Silty Sand are used. Removal efficiency of color, TDS was maximum in clayey sand without adsorbent. Removal efficiency of BOD and COD was maximum in clayey sand with adsorbent and removal efficiency of chlorides was maximum in silty sand with adsorbent. Thus from the analysis of result SAT system with Rice straw as adsorbent in clayey sand performs better than silty Sand with Rice straw as adsorbents.

KEYWORDS: Soil Aquifer Treatment, Rice Straw, Clayey Sand, Silty Sand, Textile Wastewater.

I. INTRODUCTION

Pollution of Environment is potential risk to living and non living creatures on earth. Rapid urbanization and industrialization led to environmental pollution and increase in water demand resulting in depletion of water resources. Industries such as pulp mills, dye synthesis, printing, textiles, cosmetics, food and plastic industries widely uses dye as their coloring agent. Water pollution due to textile industries are very serious issue as large quantity of effluents are discharged into the water bodies. Effluents from these industries are extremely toxic in nature as it holds high COD, suspended solids, dye and chemicals along with dense accumulation of heavy metals like Zn, Pb, Cu, Ni and Cd. The soil aquifer treatment(SAT) is land treatment that make use of land and aquifer which take part in wastewater treatment.. Soil aquifer treatment (SAT) is an artificial ground water recharge option. under controlled condition by soil percolation process the wastewater is made to pass through groundwater. In SAT system treatment benefits are achieved during infiltration of wastewater effluent firstly through unsaturated zone and then in the saturated zone in the aquifer where effluents mixes with the neighbouring groundwater before it is recovered through a production well for further use. SAT system being cost effective and environmental friendly technology helps efficiently to reduce the pressure on fresh water resource.

II. RELATED WORK

[1] Aniket V. Patil et al.,(2007) carried out study on soil aquifer treatment (SAT) system for impoverishment of pollutants in wastewater and thereby lowering the degeneration of groundwater resources and its reuse for Marathwada region. From the above study author observed maximum removal of most of the nutrients at hydraulic loading rate of 114mm/hr, along

with this other parameter like BOD, COD and TDS achieved are efficiently removed. Thus SAT system is highly proficient, sturdy, viable compared to other wastewater treatment and favorable for implementation.[2] **Dr. Deepa meghavathu et al.,(2017)** according to author, studies carried through environmental biotechnology proved that adsorbent available in nature has high tendency to adsorb dye from wastewater. The Methylene blue dye was adsorbed on an adsorbent prepared from leaves of the Psidiumguajava leaf powder from 30ml of aqueous dye solution. The results of the experiment best fitted with, Freundlich , Langmuir and Tempkin isotherm models. [3] **Shivaleela Chavan et al.,(2017)** in this study in order to make wastewater suitable for drinkable and non-drinkable use, Soil aquifer treatment system is adopted. Textile mill wastewater is used to determine the efficiency of SAT system in removing impurities from these wastewater under different experimental conditions. Clayey sand and silty sand are used for experiment along with natural adsorbents such as peepal leaf and almond leaf. It was observed in clayey sand, removal efficiency of chlorine, BOD and COD was maximum. Also color and TDS removal in clayey sand was maximum when compared with silty soil. [4] **Neem et al.,(2000)** carried studies of river bed in Ahmadabad, India to restore primary treated municipal wastewater through SAT system. The study consist of two numbers of primary settling tanks and infiltration basins and wells to pump restored water. This studies showed higher efficiency in removing nutrients and microorganisms. It proved to be more economical than other existing methods for treatment.

III. METHODOLOGY

COLLECTION OF WASTEWATER SAMPLES

Textile industry wastewater is used as a source of wastewater for experimentation. In large plastic can samples are collected. To maintain the characteristics of wastewater throughout the experiment they are preserved in refrigerator.

COLLECTION OF SOIL

In this study two kinds of soil samples were used to appraise the applicability of soils in treating the wastewater. One of the soil samples were collected from the construction site near Royal Enfield showroom, Hadadi Road, Davanagere and other from Magenahalli which is 20km away from the davangere city. Based on the examination of geotechnical properties of soil samples collected , they were classified as clayey sand (SC), and silty sand (SM).

COLLECTION AND PREPARATION OF ADSORBENT



Figure 1: Collection and Preparation of Rice Straw adsorbent

Rice straw were collected from rice mill are thoroughly washed using distilled water to remove dirt. In oven at 50°C for 9 hours washed rice straw were heated so that moisture content from rice straw were removed Oven dried rice straw is crushed, grounded and sieved through desired mesh of size 300-500 µm.

EXPERIMENTAL SET UP

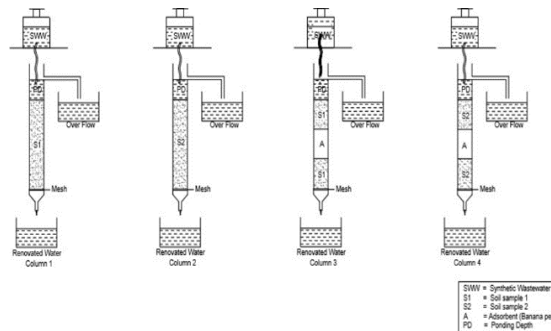


Figure 2: Schematic line diagram of Experimental Setup, SAT system

To study the behaviour of SAT system in co-existence with natural adsorbent in treating textile industry wastewater with and without adsorbent column studies are made. Four column of PVC pipes are used for the experiment. The length of each column is 115cm and inner diameter is 16cm. Outlet is provided at the bottom of the column and overflow pipe is at the side in top of the column. The bottom of each column is provided with 60 micron mesh inside to prevent the get-away of soil along with effluent. The field density of soil is maintained while filling the soil in the column. Wastewater is stored in feeding tank and at the top of the column it is placed. Wastewater to be treated is allowed to flow into the column from feeding tank. 30cm pounding depth is provided above the soil to maintain the flow of water. Experimental setup is shown in fig 2.

IV. EXPERIMENTAL RESULTS

CLASSIFICATION OF SOIL FOR EXPERIMENT

Soil samples used for experiments are collected from the site are analysed for their geotechnical properties. Various tests on soil are conducted in the geotechnical lab. The soil sample collected are categorized as clayey sand (SC) and silty sand (SM) based on the result obtained. The soil samples are tested for various parameters to classify the soil.

PERFORMANCE OF SAT SYSTEM IN TREATING TEXTILE WASTEWATER

Table 1: SAT system performance in treating textile wastewater without adsorbent for Clayey Sand and silty sand

Sl. No	Parameter	Removal Efficiency (%)	
		Clayey Sand	Silty Sand
1	Color (Pt Co)	88.45	57.86
2	Chlorides (mg/l)	70.53	53.65
3	TDS (mg/l)	72.19	47.90
4	BOD (mg/l)	63.28	57.70
5	COD (mg/l)	63.58	62.85

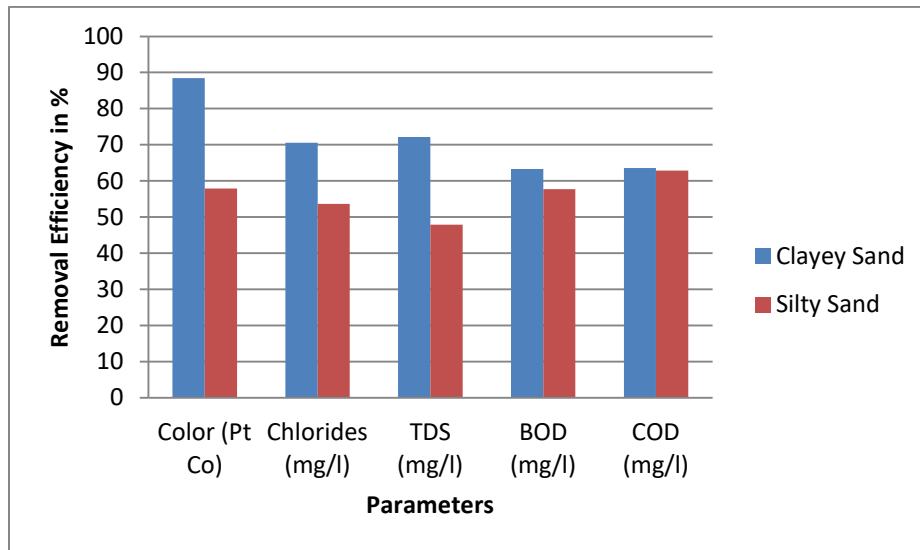


Figure 3 : Effect of SAT system in treating textile wastewater without adsorbent for clayey sand and Silty sand

From table 1 and fig 3 the removal efficiency of clayey sand is better compared to silty sand without adsorbent. Highest removal efficiency was observed for color 88.45% by clayey sand. Least removal efficiency was observed for TDS 47.90% by silty sand.

Table2: SAT system performance in treating textile wastewater with adsorbent(Rice Straw) for clayey sand and Silty sand

Sl. No	Parameters	Removal efficiency	
		clayey sand	Silty sand
1	Color (Pt Co)	40.49	17.57
2	Chlorides (mg/l)	76.07	77.08
3	TDS (mg/l)	53.42	37.51
4	BOD (mg/l)	78.65	73.65
5	COD (mg/l)	75.76	69.55

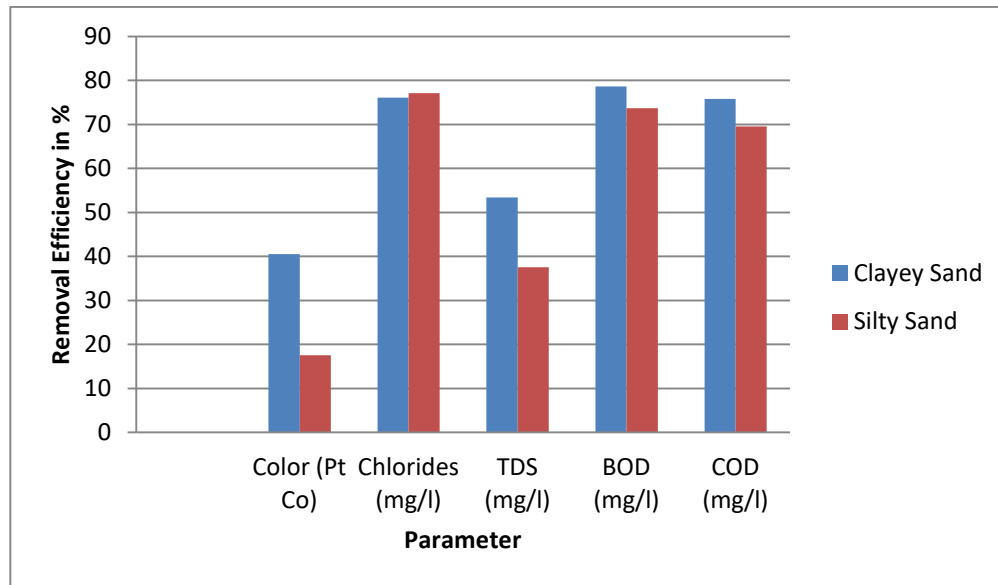


Figure4: Effect of SAT system in treating textile wastewater with adsorbent (Rice Straw) for clayey sand and Silty sand

From table 2 and fig 4 the performance of SAT for Clayey sand with rice straw as adsorbent is better than the silty sand with rice straw adsorbent. The maximum removal efficiency is observed for BOD 78.65% by clayey sand with adsorbent and least removal efficiency was observed for color 17.57% by silty sand with adsorbent.

V. CONCLUSION

To assess the capability of SAT system in treating textile wastewater bench scale column studies were carried. Different experimental conditions are considered such as soil type, different adsorbents, soil layer in conjunction with adsorbent, initial concentration of pollutants. The following conclusions were drawn based on the examination of results.

- Behaviour of SAT system without adsorbent in treating textile wastewater was more efficient in clayey sand than compared to silty sand.
- SAT system with rice straw as adsorbent in clayey sand performs better than silty Sand with rice straw as adsorbents.
- SAT system with adsorbent perform better than without adsorbent for both soil except for colour and TDS.
- Thus SAT system can be employed for treating textile wastewater and the renovated water can be reused.
- The adsorbents used in the experiments are locally available, biodegradable and eco-friendly, they can be employed for water and wastewater treatment.

REFERENCES

- [1] Aniket V. Patil, Tejaswini S. and Mankar (2017) “Wastewater Renovation using Soil Aquifer Treatment (SAT) System : Case Study of Latur District (Marathwada)” International Research Journal of Engineering and Technology (IRJET), vol. 04, Issue-04, pp:2275-2280.
- [2] Shivaleela Chavan ,Nagarajappa D.P , Shrikant Chavan (2017) “Textile Mill Wastewater Treatability Studies By Soil Aquifer Treatment System In Conjunction With Natural Adsorbents” International Journal Of Engineering Sciences & Research Technology vol. 6 Issue-09, pp:148-152.
- [3] Nagarajappa D.P, Manjunatha K and Manjunath N.T. (2010),“Effects of Soil Types on Performance of Soil Aquifer Treatment (SAT) System” Journal of Indian Geotechnical Conference, pp.425-428.
- [4] Akber A, E. Al-Awadi and Rashid (2003) “Assessment of the use of Soil Aquifer Treatment (SAT) Technology in Improving the Quality of Tertiary Treated Wastewater in Kuwait”, Emirates Journal for Engineering Research, vol. 8(2), pp:25-31.

- [5] Deepa K and M. Krishnaveni (2012) “Water Quality Performance of Soil Aquifer Treatment (SAT) using Municipal Treated Wastewater of Chennai City, India” Journal of Environmental Hydrology, vol. 20(2), pp:1-8.
- [6] Manjunatha K R and Vagish M (2016) “Study On Adsorption Efficiency Of Neem Leaves Powder In Removal Of Reactive Red Dye Color From Aqueous Solution”, International Research Journal of Engineering and Technology (IRJET), vol.3(7), pp: 437-44
- [7] S Giraldo A P Ramirez, M Ulloa, E Flórez and N Y Acelas (2011) “Dyes removal from water using low cost absorbents” , IOP Conf. Series: Journal of Physics, series 935.
- [8] Ghadir A. El-Chaghaby, Eman S. Ramis and Abeer F. Ahmad (2018) “ Rice Straw and Rice Straw Ash for Removal of Brilliant Green Dye from Waste water” , Asian Journal of Applied Chemistry Research, Vol. 01, Issue- 02, pp: 1-8.
- [9] Nagarajappa D.P, Manjunatha K and Manjunath N.T (2010)“ Effect of soil types on performance of soil aquifer treatment (SAT) system” , Journal of Indian Geotechnical Conference, pp.425-428.
- [10] Deepa K and Krishnaveni M (2012) “Water Quality Performance of Soil Aquifer Treatment (SAT) using Municipal Treated Wastewater under Saturation Conditions”, Journal of Water Research, vol. 45, pp: 4211-4226.
- [11] Hussain .J , Hussain .I and Arif . M (2004) “Characterization of Textile Wastewater”, Jr of Industrial Pollution Control, Vol. 20(1), pp: 137-144.
- [12] Chin-Inn Tay and Siew- Teng Ong (2019) “Guava leaves as adsorbent for the removal of Emerging Pollutant: Ciprofloxacin from aqueous Solution”, Journal of Physical Science, Vol. 30(2), pp: 137-156.
- [13] Sharada D K, Nagarajappa D P, Shiva Keshav P, Manjunath N T (2015) “ Domestic Wastewater Treatment by Soil Aquifer Treatment Using Corn Cobs”, International Journal of Science, Engineering and Technology Research (IJSERTR), Vol. 4 , Issue 7, pp:2462-2465.