"Treatability Studies of Domestic Wastewater by Soil Aquifer Treatment (SAT) in Conjunction with Palm Empty Fruit Bunch Adsorbent"

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Abstract- *Palm empty fruit bunch powder used to enhance the removal efficiency of Soil Aquifer Treatment (SAT) for removal of TS, TDS, Cl, COD and TKN. The studies were carried out using domestic sewage wastewater and varying adsorbent heights at 25%, 50% and 75% in 0.9m soil depth and 0.1m depth of adsorbent. Soil properties were determined and Silty sand was used. The efficiency of SAT to remove domestic waste water pollutants without Palm Empty Fruit Bunch resulted in 55.43% for TS, 56.45% for TDS, 55.02% for Chlorides, 57.89% for COD and 56.30% for TKN. The maximum removal efficiency with Palm Empty Fruit Bunch was obtained in 50% height of the adsorbent showed 75.50% for TS, 76.75% for TDS, 69.30 for Cl, 74.73% for COD and 69.50% for TKN. While the efficiency was observed maximum at 50% height of the adsorbent in the Silty sand tested. The comparison study shows maximum removal efficiency was found in SAT in conjunction with adsorbents than the SAT without Adsorbent.*

***Keywords*: Palm Empty Fruit Bunch, Domestic Wastewater, Silty sand , SAT**

1. INTRODUCTION

Water is necessary need of life for both creature and plants. Water covers over70.9% of the Earth's surface, of which 97% of the aggregate water is secured by seas, 2.4% by polar ice tops and 0.60% by other area surface water bodies like waterway, lakes. People are putting an expanding weight on the planet's water assets. In the prior days when earth's populace was less, it was envisioned that seas were too enormous to dirty. In any case, in the late century with expanding populace the seas is by all accounts excessively littler for getting contaminated. Water contamination has gotten to be significant issue in the late years due to manmade exercises. The mechanical upset in the 19thcentury has given the base to whole late pollutional issues (Harush *et al.*2011).

Domestic wastewater could be a made supply of each and harmful components. Disposal of wastewater on agricultural soils in the longer-term may doubtless adversely have an effect on soil health. The implications related to significant heavy metal contamination are of great significance, mainly in agricultural production systems (Bincy K. et al 2015).Therefore, the treatment of Domestic wastewater is essential prior to its reuse in irrigation. Innovative methods in wastewater treatment for reuse have been developed. One of technique is renovation of Domestic wastewater with rapid infiltration system, known as Soil Aquifer Treatment (SAT). Many studies proved that sewage is sufficiently renovated by SAT (Bouwer:1985, Wilson et al.: 1995,Vishwanathan et al.: 1999). The performance of SAT system is site specific and is controlled by wastewater quality, hydrogeology and duration of sewage application on the infiltration basin. Furthermore, the SAT system in conjunction with adsorbents may treat the wastewater to a better extent.

SAT is an artificial groundwater aquifer recharge technology which is increasingly adapted to enhance water resource. It has been found to be low cost sustainable water, wastewater treatment technology. During SAT saturated and unsaturated zones of natural soil and groundwater aquifer act as medium for physical, chemical and biological processes improve the quality of wastewater effluent during its infiltration through soil strata and yield water of acceptable quality for reuse purposes (Mahmoud et al 2014). SAT is only process used to recharge groundwater aquifers from the outside or from underneath the surface. In this method it is used to enter the storm water or pre treated wastewater through a recharge basin as the wastewater infiltrates through the soil and aquifer, it can undertake considerable quality improvements. Then the purified water stored in the underlying unconfined aquifer for subsequent reuse, such as irrigation or even for drinking water purpose. The SAT consists of infiltration of secondary wastewater through recharge basin with succeeding removal of pollutants through recovery wells, unsaturated zone and storage within the saturated zone (Gary Amy et al 2005).

2. MATERIALS AND METHODS

2.1 Waste water Sample collection

Domestic sewage was collected from a Drain Flowing near Vidhyarthi Bhavan Davangere District, Southern part of India. Grab sampling also called as catch sampling was followed for the collection of sample at a specific time. Sample was collected at a single point where water was not stagnant.

Details of Wastewater sample used

- Type of Sample – Grab sampling
- Collected Location – Near Vidhyarthi Bhavan Davanagere
- Collection Season – Rainy
- Date and Time –25 June 2016 at 9:30 am
- Temperature – 18^{o}C

2.2 Characterization of wastewater

The untreated domestic wastewater is analyzed for Chemical Oxygen Demand (COD), Total Kjeldhal Nitrogen (TKN), Total Dissolved Solids (TDS), Total Solids (TS) and Chlorides parameters. The Concentration determines organic load and nutrients, the quality of water.

2.3 Adsorbent Preparation

Palm empty fruit bunch adsorbent is prepared as per procedure given by NurHaziqahMohd et al., (2015). Palm Empty Fruit Bunch was washed many types using tap water to remove dirt and mud washed with distilled water. The sample then oven dried at 90^{o}C for 24h and then cut in to approximately 5cm size. EFB is then soaked in 0.1M HCL for a night and then washed with distilled water.

2.4 Preparation of Soil

Silty Sand was characterized by the geotechnical properties obtained by the experiments. The dry density of soil was found to be 1.65 g/cm^3 and it was maintained by mixing water and compaction. Experiments were carried for single depth of soil 1.0m and 3 heights of adsorbent. A layer of 10 cm adsorbent was introduced in the soil column at 25%, 50% and 75% in different trials and experimented.

2.5 Experimental Setup

Column studies were conducted in PVC columns of 5 inches diameter and 1.5m length. Silty Sand was used for SAT and filled up to 1.0m depth. When conducting experiment with adsorbent, 3 adsorbent heights were tried from bottom at 25%, 50% and 75% of 1.0m soil depth. Domestic wastewater to be tested for removal efficiency was passed through the overhead tank and a pond depth of 30cm was maintained above the soil mass. The effluent sample was collected from the bottom of the column and the renovated water was tested. For each predetermined condition of experimentation, the soil was filled afresh in the column.

3. RESULT AND DISCUSSION

3.1 Performance of Silty Sandy Soil without Palm Empty Fruit Bunch Adsorbent

Table – 1: Shows the performance of Silty Sand soil of 1.0m depth without adsorbent.

Sl. No	Parameters	Influent	Effluent	Removal efficiency in %
1	pH	6.7	7.10	-
2	TS	1820	811	55.43
3	TDS	520.96	226.87	56.45
4	Chlorides	277.90	125	55.02
5	COD	380	160	57.89
6	TKN	50.66	22.13	56.30

All units are in mg/l except pH

Table 1 shows the performance of SAT system without adsorbent. The Silty Sand was used to remove the TS, TDS, Cl, COD and TKN which are present in the domestic wastewater. It was recorded that the Silty sand removes TS 55.43%, TDS 56.45%, Cl 55.02%, COD 57.89% and TKN 56.30%. The values were recorded at optimum values which were calculated by saturation studies.

3.2 Performance of Silty sandy soil with Palm Empty Fruit Bunch as adsorbent at 25%, 50% and 75% of 1.0m depth soil

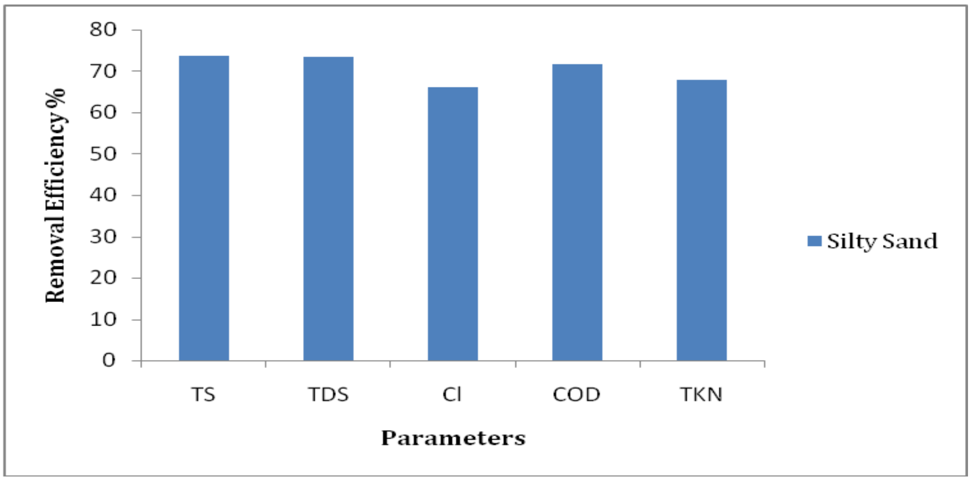

Fig 1: Removal Efficiency of all Parameters in Silty Sand Soil with Adsorbents at 25% Height

Fig 1 show performance of Silty sandy soil for 0.9m depth with adsorbents at different height. The Silty sand with adsorbent Palm empty fruit bunch at 25% height is observed remove all parameters efficiently. The maximum removal efficiency of TS, TDS, Cl, COD and TKN recorded are 73.62%, 73.50%, 66.00%, 71.65% and 68.00%respectively with palm empty fruit bunch adsorbent. With practical limitation, removal efficiency of all parameters in Domestic Sewage wastewater was recorded without great difference.

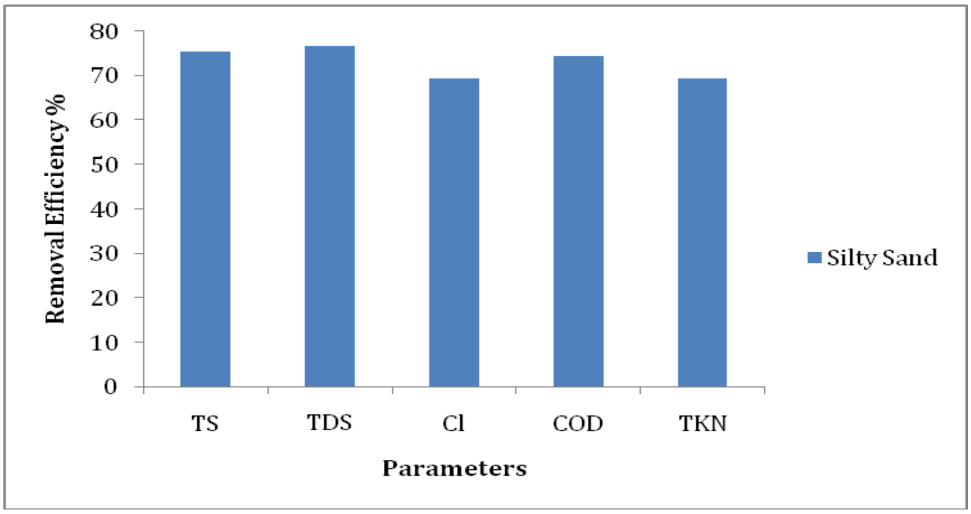

Fig 2: Removal Efficiency of all Parameters in Silty Sand Soil with Adsorbents at 50% Height

Fig 2 show performance of Silty sandy soil for 0.9m depth with adsorbents at different height. The Silty sand with adsorbent Palm empty fruit bunch at 50% height is observed remove all parameters efficiently. The maximum removal efficiency of TS, TDS, Cl, COD and TKN recorded are 75.50%, 76.75%, 69.30%, 74.73% and 69.50%respectively with palm empty fruit bunch adsorbent. With practical limitation, removal efficiency of all parameters in Domestic Sewage wastewater was recorded without great difference.

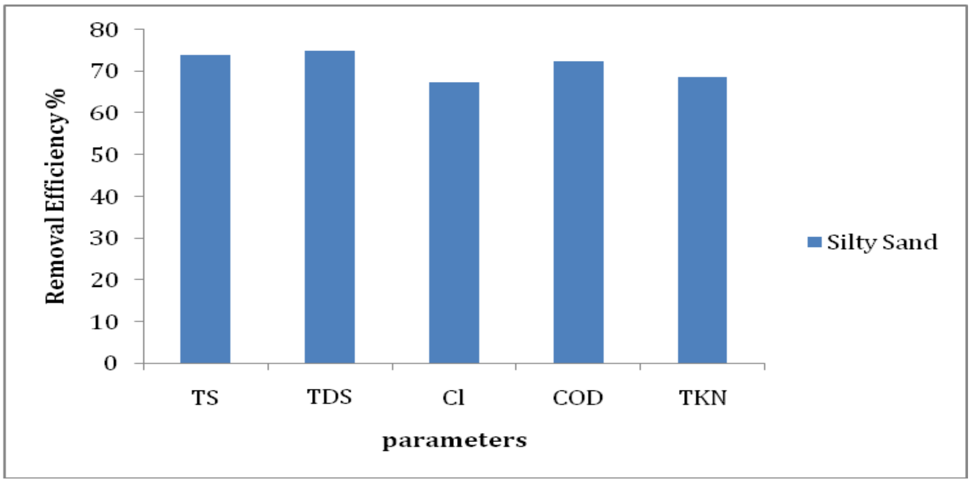

Fig 3: Removal Efficiency of all Parameters in Silty Sand Soil with Adsorbents at 75% Height

Fig 3 show performance of Silty sandy soil for 0.9m depth with adsorbents at different height. The Silty sand with adsorbent Palm empty fruit bunch at 75% height is observed remove all parameters efficiently. The maximum removal efficiency of TS, TDS, Cl, COD and TKN recorded are 74.00%, 74.90%, 67.50%, 72.46% and 68.73% respectively with palm empty fruit bunch adsorbent. With practical limitation, removal efficiency of all parameters in Domestic Sewage wastewater was recorded without great difference.

The maximum removal efficiency was observed in 50% height of the adsorbents from the bottom of the column. Fig.4. shows the comparison for performance of SAT for removal of all parameters without adsorbent and adsorbent at 50% height. From the statistics, removal of all parameters is significantly increased by combining it with Palm Empty Fruit Bunch. The results showed that Palm Empty Fruit Bunch increases the removal efficiency of SAT above 40% which is admirable. It was observed that Silty Sandy Soil is more effective in removing all parameters in conjunction with Palm Empty Fruit Bunch adsorbent.

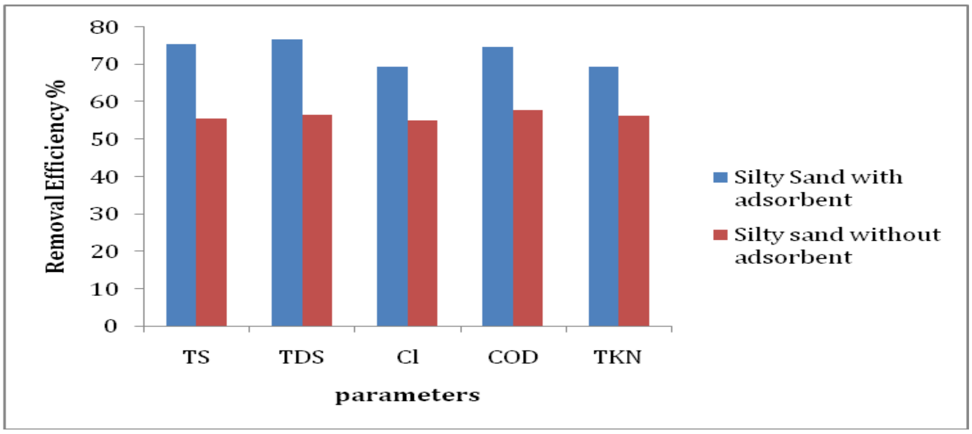

Fig.4: Comparison of removal of all Parameters by SAT without and with adsorbent (at 50% height).

4. CONCLUSION

The experimental studies show that Silty Sand soil increases the removal efficiency of TS, TDS, Cl. COD and TKN in conjunction with Palm Empty Fruit Bunch as adsorbent in between the soil columns. Removal efficiency was observed maximum at the adsorbent height of 50%, showing TS, TDS, Cl, COD and TKN recorded are 75.50%, 76.75%, 69.30%, 74.73% and 69.50% respectively with adsorbent . Silty Sand soil can be merged with Palm Empty Fruit Bunch and can used to treat contaminated effluents more effectively. Thus results obtained can be utilized for further studies by increasing the concentration and also it can therefore be used in treatment of effluents from industries, thereby reducing the level of water pollution from domestic wastewater and industries.

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