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# Treatment of Wastewater by Soil Aquifer Treatment (SAT) in Conjunction with Natural Adsorbent

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**Abstract** - *One of the most essential thing that we frequently use in our day to day life is water and due to our activities we tend to generate wastewater by cooking, bathing and industrial production etc. hence it is very important to treat and reuse this water because of water shortage. Hence we have decided to use the soil aquifer treatment system after studying different research works conducted by N. Othman etc. the column study is adopted where the soil density etc. is maintained same as that in the site from where the soil sample was collected. Then the wastewater is allowed to pass in the columns containing clayey sand, silty sand, clayey sand with adsorbent and silty sand with adsorbent. The influent wastewater characteristics and effluent wastewater characteristics are compared for removal efficiency and treatability aspects of wastewater are determined. Experiments when conducted showed that the removal efficiency of turbidity was maximum i.e. 99.44% in silty sand with adsorbent, TDS was least removed i.e. 61.86% in clayey sand with adsorbent. Therefore SAT system is an efficient method that can be used for wastewater treatment by land usage. This method is cost effective, easy and less supervision required.*

***Key Words***: Soil Aquifer Treatment, Adsorbent, Soil, Wastewater.

## 1. INTRODUCTION

One of the most essential need of a living and non-living organism is water. But even that need is difficult to fulfil because of water scarcity. Water scarcity is mainly due to day by day increase in population, change in standards of living, deforestation etc. In order to battle and solve the problems to meet the requirement of water, certain changes were to be made to increase and maintain the sustainable environment.

Wastewater treatment through land use is an alternative technology to purify the water. Since the soil has the property to adsorb the impurities and filter the wastewater and also the pre-treated wastewater when it is allowed to percolate through the unsaturated aerated soil region and aquifer, even the chemical process and biological degradation takes place during percolation.

The land treatment method to be adopted is called as SAT i.e. soil aquifer treatment. This method is proved to be very efficient, economical and also environment friendly. It is easy to operate, easy to maintain and aesthetic in nature. As we know the soil is a natural filter and this SAT system can eliminate suspended solids, biodegradable materials, bacteria, viruses and other microorganisms the quality of the water is improved when tested after this treatment. As previously reported by many there is a significant reduction of phosphorous, nitrogen and removal of heavy metals from wastewater was also possible by sorption and physio-chemical stabilization.

The industries in our country treat the wastewater as per rules and tend to dispose that treated water into rivers or sea. But if this treated water is subjected to SAT system and reused to meet our day to day needs can help solve the water shortage problems.

## 2. MATERIAL AND METHODOLOGY

### 2.1 COLLECTION OF SOIL

Two soil samples were used in order to assess the suitability of soil in treating the wastewater. Soil samples belonging to different classes were used for the work. The soil samples were collected from a site near Royal Enfield Showroom, Hadadi Road, Davanagere and Magenahalli which is about 20km away from the Davanagere city. Based on the analysis of soil samples collected, soil samples were classified as Silty sand and clayey sand.

### 2.2 ADSORBENT PREPARATION

The banana peel was collected and washed several times in tap water and then with distilled water. The washed banana peel is sun dried for a week. Then crush it into small pieces and permitted 24 hours of drying in a hot air oven at 80°C. The peel will have lost the moisture content, and the color will shift from yellow to brownish black as observed. The dried material was finely ground and screened in 150-212µm cut size sieves.

### 2.3 EXPERIMENTAL SETUP

The experiments are carried out to do the SAT efficiency studies for the treatment of industrial wastewater with individual adsorbent. For this experiment, two soils are used, and the adsorbent used is the banana peel. For the experimentation four columns made of PVC pipe were built. Column has a length of 115 cm and an inner diameter of 16 cm, with outlet at the bottom and overflow pipe at the top side. It is considered that the soil is filled in the column by calculating the pipe volume with respect to the depth of soil to be filled. The bottom of each column was plugged with 60 micron mesh inside to prevent soil from escaping. The columns are filled by preserving soil density in the field. Feeding tank, containing wastewater sample placed at the top, wastewater is fed from the top and is collected from the outlet at the bottom of the columns after having been treated.

Column 1 (C1) is filled with clayey sand at a depth of 85 cm, column 2 (C2) is filled with silty sand at a depth of 85 cm, column 3 (C3) is filled with banana peel adsorbent placed between the layers of silty sand at a depth of 38 cm and 37 cm and an adsorbent depth of 10 cm, column 4 (C4) is filled with banana peel adsorbent placed between the layers of clayey sand. The efficiency of removal such as turbidity, TDS etc. is noted for individual adsorbent, i.e. banana peel and other characteristics.

### 3. RESULTS AND DISCUSSION

The experiments were performed to determine the efficiency of Soil Aquifer Treatment with or without the adsorbent in treating the wastewater obtained from different industries. Two types of soils and a adsorbent was used, i.e. clayey sand, silty sand, and banana peel powder. The results obtained from the experiment and the interferences thus drawn will be discussed here.

The removal efficiency is being calculated by using the following formula:

$$\text{Removal efficiency in \%} = \left[\frac{Cinf - Ceff}{Cinf}\right] * 100$$

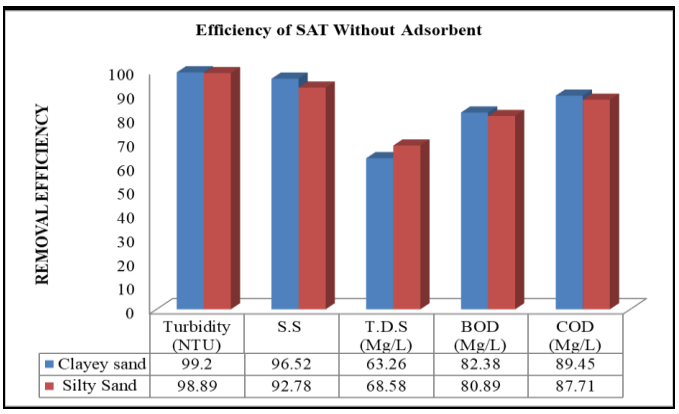


**Chart -1**: removal efficiency of SAT without adsorbent

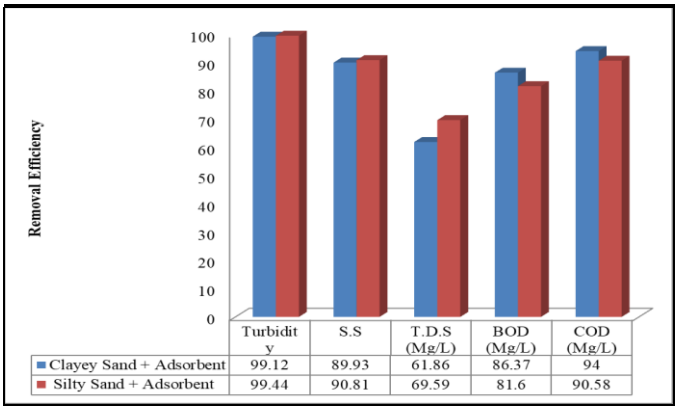


**Chart -2**: Removal Efficiency of SAT With Adsorbent

From Chart 1 and 2 following can be observed

- Maximum removal efficiency of turbidity took place in silty sand with banana peel as adsorbent i.e. 99.44% and minimum removal in silty sand without adsorbent is 98.89%.
- The efficiency of sat system for removing Suspended Solids took place in clayey soil without adsorbent i.e. 96.52% and least removal efficiency was observed in clayey sand with banana peel as adsorbent which is nearly 89.93%.
- Removal efficiency of total dissolved solids (TDS) was maximum in silty sand (69.59%) with banana peel as bio sorbent and minimum removal efficiency was observed in clayey sand (61.86%) with adsorbent.
- BOD was removed to maximum extent in clayey sand with adsorbent that is 86.37% and minimum removal efficiency took place in silty sand without adsorbent 80.89%.
- The maximum removal efficiency of COD took place in clayey sand with adsorbent and minimum removal efficiency was observed in silty sand without adsorbent. (87.71%).

### 4. CONCLUSIONS

Small scale column studies was conducted to assess the capacity of SAT system in the treatment of wastewater from various industries under different experimental conditions i.e. soil type, placing the adsorbent in between the soil layers, initial effluent concentration. Depending on the outcomes obtained conclusions can be drawn as follows:

- In SAT system the removal efficiency of turbidity was observed to be maximum (99.44%) in silty sand in conjunction with adsorbent as compared with other cases.

- The least removal efficiency by SAT system was in case of T.D.S i.e. 61.86% in clayey sand with adsorbent.
- By analysis of results, SAT system efficiency for treating wastewater is better in clayey sand with banana peel as adsorbent compared to silty sand and silty sand with adsorbent.
- The SAT system may be used to treat wastewater from different industries, and treated water may be used for secondary application.
- The adsorbents used are environmentally friendly, compostable and it is available locally and plays an effective role in the treating of water and wastewater.
- SAT system can be easily adopted for increasing groundwater recharge as well as for treating storm water, pre-treated water etc. depending on the soil type and hydrological conditions of the area or location.

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