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Investigative Study on the Treatmentability of Domestic Waste Water by Soil Aquifer Treatment (Sat) Using Adsorbent

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ABSTRACT: Water of high quality is essential to human life and water of acceptable quality essential for agriculture, industrial, domestic and commercial uses. All these activities are also responsible for polluting the water. The constant blending of heavy metals from industrial effluents by activities like mining, metal processing, electro plating, etc., to water stream induce various unfavorable effects on human health and the environmental. Toxic metals tend to bio accumulate by entering into the food chain. Elimination of toxic heavy metals from industrial wastewater has been done by several conventional methods like electro precipitation, membrane separation, evaporation, ion exchange, etc., which are expensive and inefficient for low concentrations of heavy metals. Novel technologies in treatment of industrial wastewater for reuse have been elaborated. Soil Aquifer Treatment (SAT) is one of the techniques with high infiltration system. Numerous studies have established positive and effective results for treatment of wastewater by SAT.

Copper and zinc are toxic heavy metals dismissed into the environment by the industrial activities, anthropogenic actions etc., heavy metals are non-biodegradable unlike other organic pollutants. Copper and zinc are widely used in metal industries like mining, metal cleaning, plating baths, pulp and paper mill, fertilizers, etc., which produce high levels of copper and zinc in effluents. Even though copper and zinc are vital for human health, excess amounts can become hazardous to the body.

KEYWORDS: Soil Aquifer, Adsorbent, SAT

I. INTRODUCTION

Water scarcity is likely to become more problematic in the near future due to rapid population growth, increasing per capita water consumption, and the draught condition of the world. These have forced various countries and communities to look towards alternative water resources to meet the growing needs and to be as long term water supplies.

To overcome these problems land treatment of wastewater has emerged as a promising alternative to the conventional wastewater treatment technologies. In land treatment, appropriately pretreated wastewater is allowed to infiltrate through the aerated unsaturated soil zone where it undergoes purification through unit operation and processes via filtration, adsorption, chemical processes and biodegradation. After reaching the water table, the soil treated wastewater further moves laterally for some distance through underlying saturated zone (aquifer) where it receives additional purification by dispersion and dilution. Since, both soil and aquifer participate in renovation process, such a land treatment system is called Soil-Aquifer Treatment (SAT) system. (Nema et al.2000) overcome through ground water recharge. (Mokhtaret al.2011).

The kinds of process used to produce recycled water have an impact on effectiveness of the soil aquifer treatment process. This is important, for example in making management decisions about whether or not to remove certain compounds, such as nitrogen, in the recycled water before SAT or to let SAT do the work. The type of pretreatment is noncritical forth removal dissolved or trace organic compounds, which can be accomplished with SAT. The different study sites performed in the same way even if they had different site./ soil characteristics.

The performances of SAT system is site specific and are controlled by wastewater quality, soil type, hydrogeology and duration of wastewater application on the infiltration basins and hence study is required to come out with reproducible results.

II. MATERIALS AND METHODOLOGY

Materials and methodology is used to carry out the present research work to meet the objectives stated below:

- Sources of Wastewater.
- Soil sample used.
- Adsorbent used (Ashoka tree leaves).
- Parameter monitored and analyzed.
- Experimental setup.

As stated in objectives medium strength wastewater is used for experimentation to assess the treatment efficiency of SAT system in treating this wastewater under varied experimental conditions.

Medium strength domestic sewage rich in BOD used in experimentation was collected from a drain flowing in BIT mens's hostel.

To assess the suitability of soil in treating wastewater soil belonging to IS class was used. Based on reconnaissance soil sample being from Lakshman Rao Park, Jayanagar was identified and sample from this site was collected as per standard procedure given in SP 36 part (II). Based on analysis of sample collected, soil sample was classified as Medium sand.

It was planned to maintain the dry density of soil filled in the columns, same as that of field dry density of soil. Under such conditions the results obtained, inferences drawn and thereby design parameters established can be used directly to design SAT system for in situ condition. Thus soil samples collected from the field were so filled into the columns such that dry density of soil filled in the column will be same as that of soil in the field.

To establish this condition, to begin with weight of the soil that can be filled in the column was calculated by multiplying volume of the column and field dry density of the soil. The weight of the soil so calculated was multiplied by field water content of the soil which resulted in amount of water to be added. The calculated amount of water was added to weight of the soil determined and soil paste was prepared. Soil paste prepared was filled in three layers in a column. Whenever adsorbents were placed in the column with soil, calculations were carried out.

The present study explores the effectiveness of treating wastewater using Soil Aquifer Treatment in conjunction with Asoka tree leaves powder adsorbent. In this column study efforts have been taken to find the removal efficiency of SAT under varied positioning of adsorbent at 20%, 40%, 60% and 80% height from bottom of column. The parameters like color, turbidity, total dissolved solids, total suspended solids, chemical oxygen demand and biological wastewater is treated by SAT under conditions like types of soil and different depth of soil. 1m depth of medium sand exhibited better removal efficiency than clayey soil.

Water of high quality is essential to human life and water of acceptable quality essential for agriculture, industrial, domestic and commercial uses. All these activities are also responsible for polluting the water. The constant blending of heavy metals from industrial effluents by activities like mining, metal processing, electro plating, etc., to water stream induce various unfavorable effects on human health and the environmental. Toxic metals tend to bio accumulate by entering into the food chain. Elimination of toxic heavy metals from industrial wastewater has been done by several conventional methods like electro precipitation, membrane separation, evaporation, ion exchange, etc., which are expensive and inefficient for low concentrations of heavy metals. Novel technologies in treatment of industrial wastewater for reuse have been elaborated. Soil Aquifer Treatment (SAT) is one of the techniques with high infiltration system. Numerous studies have established positive and effective results for treatment of wastewater by SAT.

Copper and zinc are toxic heavy metals dismissed into the environment by the industrial activities, anthropogenic actions etc., heavy metals are non biodegradable unlike other organic pollutants. Copper and zinc are widely used in metal industries like mining, metal cleaning, plating baths, pulp and paper mill, fertilizers, etc., which produce high levels of copper and zinc in effluents. Even though copper and zinc are vital for human health, excess amounts can become hazardous to the body.



III. RESULTS AND DISCUSSION

The experiments were conducted to evaluate the effect of soil types on performance of Soil Aquifer Treatment (SAT) system. Soil namely Silty loam Soil was used for experimentation. Experiments are carried for a depth of soil 1.0m. The observations of experimentation and results obtained are presented in Tables and are also represented by means of graphs and bar charts.

CHARACTERISTICS OF WASTEWATER USED FOR EXPERIMENTATION

Parameters	Medium Strength Wastewater
pH	7
Total solids	1140 mg/l
T.D.S	1100 mg/l
Chlorides	260.46 mg/l
COD	360 mg/l

GEOTECHNICAL PROPERTIES OF THE SOILS USED FOR EXPERIMENTATION

PARAMETER	SAMPLE
In- situ dry density g/cc	1.724
Specific Gravity	2.63
Liquid Limit%	35.35
Plastic limit%	16.53
Plasticity Index %	18.82
Compaction test	
$\gamma_{dgm/cc}$	1.737
OMC %	14
Sieve Analysis	
% of Gravel	2.9
% of Sand	92
% of Silt & Clay	5
Cu	7.5
Cc	1
Soil classification	Medium sand
Soil Classification	Silty loam

Performance of SAT System

The results of experimentation under varied experimentation conditions namely the varying depth of soil i.e. 1.0 m depth of soil were filled in columns. In this soil acts as a natural filter bed. Thus the various parameters were analyzed and removal efficiency was calculated.

Saturation Studies

To evaluate removal efficiency strength with respect to time, saturation studies are carried out on soil. The results are listed in the upcoming tables. Only parameters like Chlorides and COD are done.

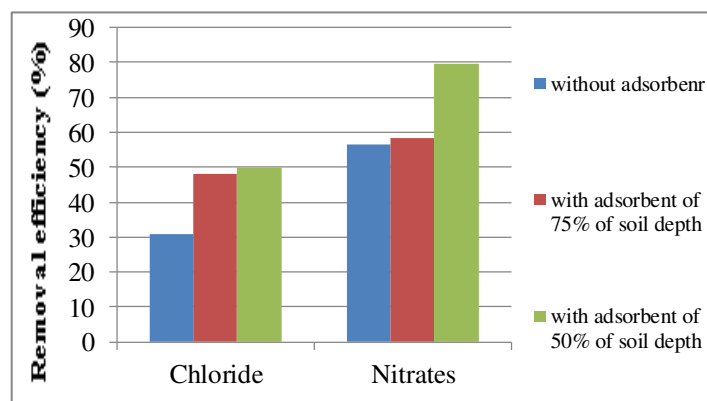
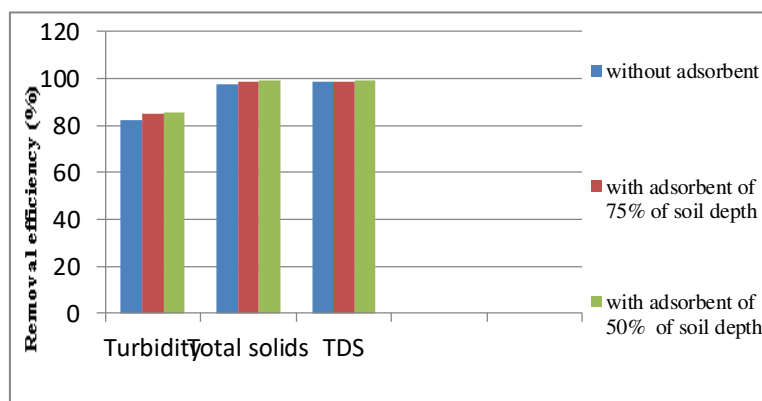
Table 3: Performance of SAT system for 1.0m soil depth in medium sand (with adsorbent of 75% of soil depth)

Parameter	Influent	Effluent 75% of soil	(%) η
pH	7	8.5	
Total solids	1140 mg/l	15	98.6
T.D.S	1100 mg/l	12	98.9
Chlorides	260.46 mg/l	135	48.16
COD	360 mg/l	0	100

Table 4: Performance of SAT system for 1.0m soil depth in medium sand (with adsorbent of 50% of soil depth)

Parameter	Influent	Effluent 50% of soil	(%) η
pH	7	8	
Total solids	1140 mg/l	8	99.29
T.D.S	1100 mg/l	8	99.27
Chlorides	260.46 mg/l	130	50.08
COD	360 mg/l	0	100

SAT REMOVAL EFFICIENCY



IV. CONCLUSION

Bench scale column studies were carried out to evaluate the potential of SAT in domestic wastewater by using adsorbents and soil. Based on the analysis of results the following conclusions have been arrived.

- The characteristics of wastewater like pH, Total solids, Total dissolved solids, Chlorides, Chemical oxygen demand are reduced to acceptable levels as shown in above table.3 and 4
- From the results obtained the Commercial wastewater sample treated with adsorbent is more efficient than without adsorbent.
- The use of geopurification system i.e. SAT is effective in treating Domestic wastewater.
- Bench scale column studies were carried out to evaluate the potential of SAT in Domestic wastewater by using adsorbents and soil. Based on the analysis of results the following conclusions have been arrived.
- The characteristics of wastewater like pH, Total solids, Total dissolved solids, Chlorides, Chemical oxygen demand, Nitrates are reduced to acceptable levels as shown in Graph.
- From the results obtained, the Domestic wastewater sample treated with adsorbent is more efficient than without adsorbent.
- The use of geo purification system i.e. SAT is effective in treating Domestic wastewater.
- A very high quality of reclaimed water is obtained after SAT which is suitable for a variety of non potable uses such as unrestricted agricultural uses, industrial uses, non potable municipal uses .

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