Rural Wastewater Treatability Studies by Soil Aquifer Treatment

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Abstract-*Soil Aquifer Treatment System is one of method used for treating Rural wastewater.SAT is used for treating various wastewaters.SAT is a geo-purification system which utilizes physical, chemical, biological processes during infiltration of wastewater effluent through soil strata to improve quality of water. A large section of people lives in villages and they are mainly engaged in agriculture. The scarcity of water which creats more problems in living organisms. Due to this problem treatment is adopted for reuse of water.SAT system provided maximum removal efficiencies for various parameters such as Chlorides 79.54%,for Total Hardness 81.13%,for Sulphate 89.13%,for Phosphate 89.07%.*

Keywords-Soil Aquifer Treatment, Rural Wastewater, Soils

I. INTRODUCTION

A large section of Indian population lives in villages and they are mainly engaged in agriculture. They mainly engaged in agriculture and belongs to weaker section of the society. There is a definite trend of rural population migrating to the urban areas due to lack of employment opportunities, low earnings, insufficient means of transport and insanitary living conditions.The latter is mainly responsible to repel the educated youth from working in rural areas. One source of insanitary condition in rural areas is the drainage of rural wastewater from bathing cooking areas of dwellings over the kachcha roads and lanes having inadequate slopes.The situation is further aggravated due to the movements of carts and animals which result in the creation of plot holes and ditches that gets filled up with dirty stagnant water.The mosquitoes and files find good breeding centres in these places and spread diseases.Poor health in developing countries is largely due to diseases like cholera,dysentery,gastroenteritis and worm infections carried by contaminated food water and ground.some of the village roads are brick paved with drains for waste water disposal but these have not served the required purpose due to improper slopes,insufficient maintenance and unpredictable flow of water.Rural dwellings having their own source of water supply like hand pumps discharge more water on the streets.Some of the village panchayats have suggested individual pits for collection of wastewater and its disposal by intermittent sprinkling on large areas,either in the countyard or on the streets.The villagers adopt this practice for some time,but their enthusiasm dies with time.A few progressive farmers have access to the technical know-how and capacity to invest finance to make large sized soakage pits filled withbrickbats.these are frequently choked with ash and soil used by the villagers to clean their utensils.This requires cleaning of pit and involves considerable expenditure.The high cost of construction and costly maintenance make it beyond the reach of poor.A detailed study of the problem.including the living habits of rural population.

II.SCOPE OF THE WORK

The literature studies describes that Soil Aquifer Treatment (SAT) is a improving aquifer technology,which in association with other convenient wastewater treatment technologies,could furnish effluent of acceptable quality for consumable potable reuse. The present study combines the use of adsorbents SAT system to improve the treatment. Adsorbents used are mango leaves and coconut leaves which has the capacity of attracting metal groups and their significant is getting more efficiency.treatment of this wastewater can be reuse.The wastewater initial characteristics,adsorbent height and soil type analyzed to explore the attainability of SAT system and establish optimum working parameters,the present project work is proposed.

III. MATERIALS AND METHODOLOGY

Rural wastewater was collected from a gutter flowing near Lakshmipura village Davangere district,Southern part of india.Sample was collected from single point where water was not stagnant.

- Collected Location-Lakshmipura village,Davangere
- Collection season-Summer
- Date and Time-15th march 2017 at 4:20 pm
- Temperature-30°

A. Soil Samples Used for the Experiment

Two soil samples were used to evaluate the suitability of soils in treating wastewater. soils fitting two classes were used. Based on investigation, soil samples sites from SS layout in Davangere and other from J.H.patel nagara

in Davangere were identified as in fig 3.2.1 and fig 3.2.2 and samples are from these sites as collected as per standard procedure. Based on the study of samples collected, soil samples were classified as Silty Sand and Clayey sand.

B. Preparation of Soils

The dry density of soil filled in the columns was kept same as that of field dry density of soil. under such conditions result that are obtained ,readings drawn and there by design parameters established can be used directly to design the SAT system for insitu conditions. To achieve the condition ,the weight of the soil which is to be filled in the column was calculated by multiplying volume of the column and field dry density of soil. The weight of soil is calculated was multiplied field water content of soil which result in amount of water to be added. The soil paste was prepared by calculating amount of water added to the weight of soil which is determined. The soil paste was filled in three layers in the columns. Each soil layer was compacted so that space occupied by the soil will be one third of the volume of the column. Whenever adsorbents were placed in the column in conjunction with soil ,calculations were carried out excluding the depth of adsorbent filled in the column.

C. Parameters Monitored and Analyzed

Table 1:Monitoring and Analysis of Parameters

Sl.No.	Type of soil	Parameter
1	Soil sample	Geotechnical properties of soil such as In-situ dry density, Specific gravity ,Differential free swell, Liquid limit, Plastic limit, Plasticity index, Compaction test, Sieve analysis, Hydrometer test, Permeability
2	Wastewater:Influent and Effluent	Chlorides, Total Hardness, Sulphate, Phosphate

D. Experimental Setup of SAT System

To evaluate the effect of soil texture and primary treatment of the sewage on Soil aquifer Treatment it is proposed to carry out series of experiments in the following manner. Three PVC pipes of diameter 20cm and 80cm length are used as soil columns. At end of each column a reducer is fitted with a 60 micron mesh inside it in order to prevent soil flow.Each column is sealed with PVC end plugs and fixed to sand Soil is packed in columns such that bulk density of column packed soil is same as field density.

Important Parameters of the Experiment:

Sl.No.	Parameter considered	Description
1	Type of Soil	Silty Sand and Clayey Sand
2	Depth of Soil	50cm
3	Ponding Depth	12cm

The experiment was conducted that for various parameter that have initial concentration the percentage of removal efficiency was calculated by this formula which is given below

Removal Efficiency(%)=(Yi-Yf)/Yi

Where Yi is represents initial concentration and Yf represents final concentration

Fig: Experimental Setup of Column Studies

IV. RESULTS AND DISCUSSIONS

A. Analysis of Wastewater

The rural wastewater collected from source as mentioned in chapter 3 were analyzed for various parameters

and are shown in table. The rural wastewater characteristics to be analyzed that are phosphate (PO4), chlorides, total hardness, sulphate.

Table 3:Characteristics of Wastewater Used for Experimentation

Sl.No.	Parameters	Values
1	Chlorides, mg/l	352
2	Total Hardness, mg/l	424
3	Sulphate, mg/l	184
4	Phosphate, mg/l	57.3

B. Classification of Soils

The soils that are collected from various regions that are tested in the laboratory for their geotechnical properties. Based on the geotechnical properties of the soil the soil is classified as Silty Sand and Clayey Sand. The geotechnical properties of soil as shown in table 4.The geotechnical properties of soil that are tested in laboratory are in-situ dry density, differential frees well, specific gravity, liquid limit, plastic limit, plasticity index, compaction test, hydrometer test, permeability test,Sieve analysis.

Table 4 Geotechnical Properties of Soils Used for Experimentation

Sl.No.	Parameter	Sample1	Sample2
1	In-Situ Dry Density(gm/cc)	1.64	1.72
2	Specific Gravity	2.2	2.4
3	Differential Free Swell %	20	40
4	Liquid Limit %	23	31.5
5	Plastic Limit %	Non-Plastic	21.80
6	Plasticity Index	Non-Plastic	9.7
7	Compaction Test γ_d gm/cc OMC %	 2.2 11.4	 1.6 16
8	Sieve Analysis % of Gravel % of Sand % of Silt & Clay Cu Cc	 11.52% 52.80% 35.68% 4.17 0.80	 1.4% 69.8% 28.8% 5.91% 0.78
9	Hydrometer Analysis % of Silt % of Clay	 23.45 12.23	 8.65 20.15
10	Permeability(cm/sec)	0.0132	0.02565
11	Soil Classification	Silty Sand(SM)	Clayey Sand(SC)

C. Performance of SAT System

The experiment is carried by filling two types of the soils in the columns with 60cm depth.In this soil acts as natural filter bed.Thus the various parameters are analyzed and removal efficiency was calculated and graphs were plotted.

Table 5 Performance of SAT for Silty Sand

Sl. No.	**Parameters**	**Initial Wastewater Concentration**	**Renovated wastewater Concentration**	**Removal Efficiency (%)**
1	**Chlorides, mg/l**	352	276	21.59
2	**Total Hardness, mg/l**	424	316	25.47
3	**Sulphate, mg/l**	184	132	28.26
4	**Phosphate, mg/l**	57.3	44.72	21.95

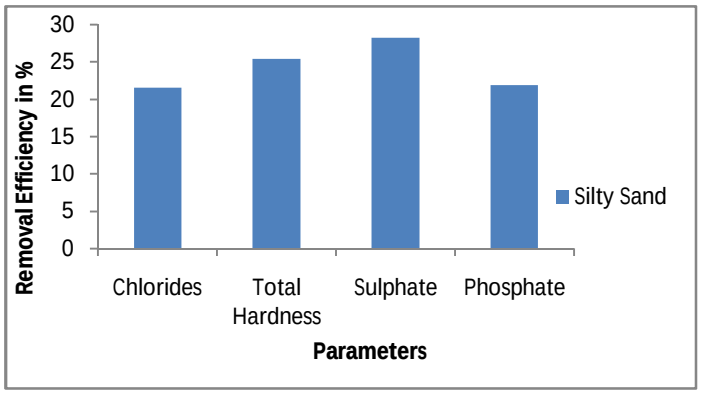
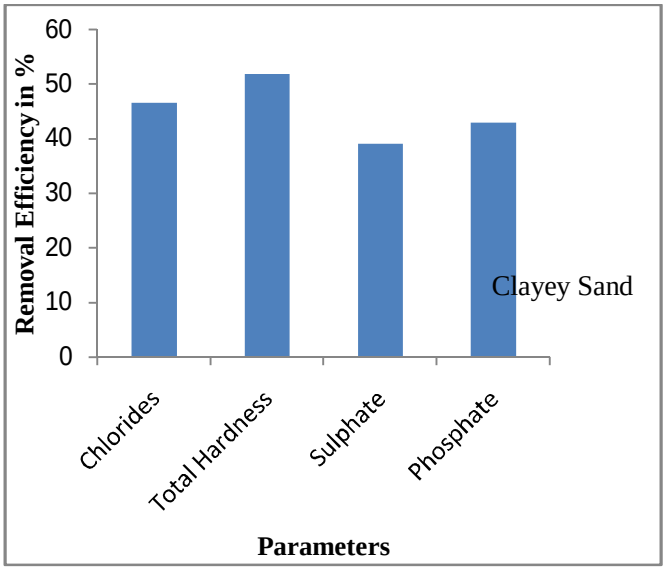


Fig:Variation of all Parameters with Silty Sand

Table 6 Performance of SAT without Adsorbent for Clayey Sand

Sl.No.	Parameters	Initial Wastewater Concentration	Renovated Wastewater Concentration	Removal Efficiency (%)
1	Chlorides, mg/l	352	188	46.59
2	Total Hardness, mg/l	424	204	51.88

3	Sulphate, mg/l	184	112	39.13
4	Phosphate, mg/l	57.3	32.64	43.03



V. CONCLUSIONS

Based on the analysis of the results of the studies carried out that following conclusions have been drawn.

- SAT system which shows more efficient in removing pollutants with conjunction with adsorbents than without adsorbents.
- The maximum removal efficiency is shown for mango leaves compared to coconut leaves and treating rural wastewater.
- It is concluded that Clayey Sand Soil shows more efficiency compared to Silty Sandy Soil in treating rural wastewater.

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