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"Removal of Heavy Metals by Soil Aquifer Treatment System in Conjunction with Natural Adsorbents"

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Abstract - *Water is a fundamental requirement for life. If there was no water there would be no life on earth. Wastewater is a big health issue, as it carries and transports a myriad diseases and illness. Wastewater effluents are major contributors to a variety of water pollution problems. Iron and metal industries are one of the heavy polluting industries in India. They produce heavy metals as effluent. Nowadays heavy metals are the environmental priority pollutants and are becoming as the most serious environmental problems. Soil aquifer treatment is an effective natural and economically feasible tertiary treatment for wastewater reuse. Soil Aquifer Treatment are applied for groundwater recharge with polluted water, the unsaturated zone and aquifer act as natural filters that reduce the concentration of various pollutants due to physical, chemical and microbiological processes. SAT is set up to be best, low cost, bearable and reclaimable technology, which has the ability to produce higher quality of water from the treated wastewater effluent for portable and non-portable uses. Research work has been carryout by reviewing the various research papers by considering the SAT System process to study the removal efficiency of Lead and copper using two different Adsorbents viz Jackfruit Seed and Arecanut Shell. The study between heavy metals and Adsorbents removal of Copper is more when compared to lead by using SAT system. Jackfruit seed adsorbs more than Arecanut shell.*

***Key Words*: SAT System, Lead, Copper, Jackfruit Seed, Arecanut Shell etc**

1. INTRODUCTION

Water is the most important resource in the world. All animals plants and human beings need water to survive. Industrialization is leading to increase in per capita consumption of available natural resources. Now s days people are facing shortage of water due to increasing in population, urbanization, industrialization, modern agriculture practice causing more contamination in various water sources. wastewater is a byproduct of domestic, industrial, commercial or agricultural activities. The characteristics of wastewater vary depending on the source. Wastes from industry serve as major sources for all water pollutants.

1.1 Objectives of the Study

- Identification and characterization of wastewater with typical characterization that are difficult to treat by conventional treatment methods.
- Identification and characterization of soils with reference to their physical properties suitable for SAT method.
- To study the effect of selected adsorbents on the efficiency of SAT method.
- Determining the filtering efficiency of soil by using adsorbents in soil column.
- Statutory studies on soil aquifer treatment system in conjunction with natural adsorbents.

1.2 Soil Aquifer Treatment (SAT)

SAT system is a proven technology for improvement of wastewater quality. It improves the quality of sewage effluent and reduces the risk from water born diseases. SAT is a geo-purification system that utilizes physical, chemical and biological process during infiltration of wastewater effluent through soil strata to improve water quality. SAT facilitates to polish stormwater and treated wastewater and provides natural storage capacity prior to reuse or groundwater recharge. SAT is set up to be best, low cost, bearable and reclaimable technology, which has the ability to produce higher quality of water from the treated wastewater effluent for portable and non-portable uses.

2. Materials and Methodology

2.1 collection of soil sample

To assess the suitability of soils in treating wastewaters two soils belonging to two classes were used. Based on reconnaissance two different soil samples sites viz one being from Hadadi road near royal Enfield showroom and other being from agriculture land, harapanahalli road , situated at about 15km from davanagere were identified and samples from these sites were collected as per standard procedure

given in SP 36 part (2). Based on the analysis of samples collected, soils were classified as silty sand and gravely sand soil.

2.2 collection of wastewater

As stated in objectives wastewater used for experimentation to assess the treatment efficiency of SAT system in treating these wastewater under varied experimental conditions. Wastewater used for experimentation was collected from one of the industries in Davanagere.

2.3 collection and preparation of adsorbents

The adsorbents were collected from nearby market. The seeds were first separated from the edible flesh. They were then washed with distilled water, diced into small pieces and oven dried at 70°C. In the same way, Arecanut husk cut into small pieces, dried in sunlight, then oven dried at 70°C. All the above treated materials are then grinded into powdered form. After obtaining the powdered form of all adsorbents, each of them is equally weighed. Then it is mixed manually and required amount of the mixed sample is taken for further proceedings.

2.4 Experimental Setup

Six columns made up of PVC pipes were fabricated for the experiments. Each column of 115cm length and 16cm inner diameter with outlet at the bottom and overflow pipe at the side of top. In order to avoid the escape of soil the bottom of each column was persevered with 60 micron mesh inside. The columns are filled by retaining the field density of the soil. Feeding tank containing wastewater sample is placed at the top, wastewater fed from the top and after getting treated renovated water is collected from the outlet provided at the bottoms of columns. In column 1 (C1), 30 cm filled with soil 1, 30cm filled with adsorbent 1, 30cm filled with soil 1 and 25cm space allowed for wastewater. In column 2 (C2), 30cm is filled with soil 1, 30cm filled with adsorbent 2, 30cm filled with soil 1 and remaining 25cm allowed for wastewater to flow from top. In column 3 (C3), 30cm filled with soil 1, 30cm filled with mixer of adsorbent 1 and adsorbent 2, 30cm filled with soil 1 and remaining 25cm is allowed for wastewater to flow. In column 4 (C4), 30cm filled with soil 2, 30cm filled with adsorbent 1, 30cm filled with soil 2 and remaining 25cm allowed for wastewater to flow from the top. In column 5 (C5), 30cm filled with soil 2, 30cm filled with adsorbent 2, 30cm filled with soil 2 and remaining 25cm is allowed for wastewater to flow from the top. In column 6 (C6), 30cm is filled with soil 2, 30cm is filled with mixer of adsorbent 1 and adsorbent 2, 30cm filled with soil 2 and remaining 25 is allowed to flow the wastewater from the top of the pipe.

3. RESULTS AND DISCUSSIONS

The qualities of effluent from industries were obtained and the experimental outcome on SAT system using jackfruit seed and arecanut natural adsorbents by various researcher using previous research papers. The values given below are analysed and the various parameters monitored under sat system process are given below.

3.1 INITIAL CHARACTERISTICS OF WASTEWATER

Table -1: Characteristics of Wastewater

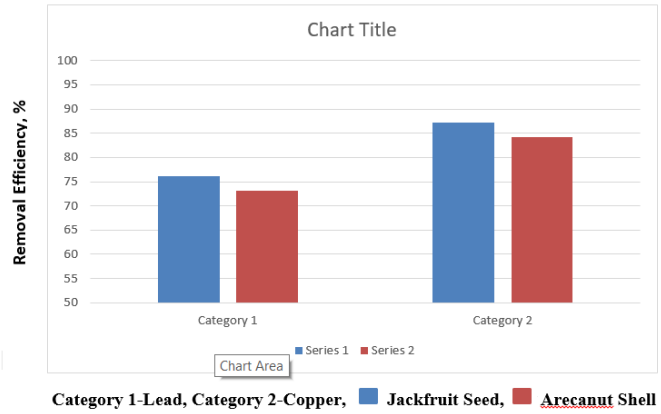
Sl. No	Parameters	Mg/l
1	pH	7.2
2	TDS	2250
3	Total Solids	2381
4	COD	220
5	TKN	9.3
6	Lead	1.3
7	Copper	0.7

3.2 Performance of SAT in Silty Sand

Table -2: Performance of SAT in Silty sand with both Adsorbents.

Sl. No	Parameter	Influent	Effluent		Percentage Removal	
			JackFruit Seed Powder	Arecanut Shell Powder	JackFruit Seed Powder	Arecanut Shell Powder
1	pH	7.2	4.44	5.91	38.33	17.9
2	TDS	2250	308	338.74	86.311	84.49
3	Total solids	2381	365.89	401.53	84.63	83.13
4	COD	220	31.98	37.66	85.46	82.88
5	TKN	9.3	4.67	1.91	49.78	79.46
6	Lead	1.3	0.31	0.35	76.15	73.07
7	Copper	0.70	0.09	0.11	87.14	84.28

From the above table we can see the removal of copper is more when compared to lead in Silty sand and also efficiency of jackfruit seed is more when compared to arecanut shell when compared both adsorbents. In the below graph removal efficiency of both metals and adsorbents are shown.



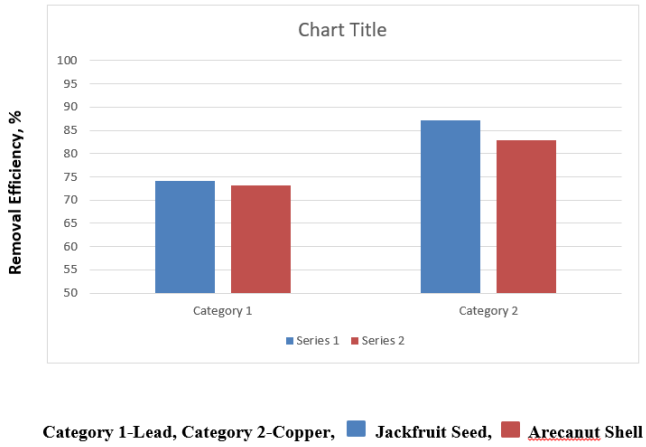
Graph -1: Representation of Removal Efficiency in SAT

3.3 performance of SAT in gravely Sand

Table -3: Performance of SAT in Gravely Sand with both Adsorbents.

Sl. No	Parameter	influent	Effluent		Removal Efficiency	
			Jack Fruit Seed Powder	Arecanut Shell Powder	Jack Fruit Seed Powder	Arecanut Shell Powder
1	pH	7.2	4.66	5.11	35.27	29.02
2	TDS	2250	417.84	421.84	81.14	81.25
3	Total Solids	2381	498.32	490.19	79.07	79.41
4	COD	220	42.65	46.32	80.61	78.94
5	TKN	9.3	1.39	1.59	85.05	82.90
6	Lead	1.3	0.35	0.35	74.07	73.07
7	Copper	0.70	0.09	0.12	87.14	82.85

From the above table we can see the removal of copper is more when compared to lead in Gravely sand and also efficiency of jackfruit seed is more when compared to Arecanut shell when compared both adsorbents. In the below graph removal efficiency of both metals and adsorbents are shown.



Graph -2: Representation of Removal Efficiency in SAT

4. CONCLUSIONS

Column studies were carried out to evaluate the potential of SAT system with adsorbents in treating with wastewater under varied experimental conditions viz. soil type, adsorbent type, initial concentration of effluent. Based on the analysis of results the following conclusions have been drawn.

- SAT system in conjunction with adsorbents performs well.
- SAT system with silty sand is more efficient in treating wastewater compared to gravely sand. Silty sand removal percentage is 82.13 and gravely sand is 81.06%.
- Removal of copper is more when compared to lead by using SAT system. Copper removal percentage is 85.35% overall and lead is 74.09%.
- Jackfruit seed is a good adsorbent when compared to Arecanut shell. Jackfruit seed has a overall removal efficiency of 81.12% and Arecanut shell has 78.31%.

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