Bench Scale Studies to Treat Leachate by Soil Aquifer Treatment

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Abstract- *Leachate from Municipal Solid Waste (MSW) dumping site can cause serious environmental problems if it is not properly collected, treated and disposed of. Among the various methods available for the treatment of leachate Soil Aquifer System (SAT) using locally available soils is found to be techno- economical option for treatment of leachate. The findings of studies carried out to explore the adsorption potential of clayey sand and gravelly soilwith varying soil bed depths are presented in this paper. The better removal efficiencies were observed with Clayey sand with soil bed depth of 45cm.*

Keywords- MSW, Leachate,Clayey sand, Gravelly soil, Bed depth

I. INTRODUCTION

Landfilling is one of the most common method of disposal of MSW in developing countries. Such a practice if not properly managedmay lead to various problems. Generation of leachate is the main problem amongst these. Severity of the problem depends upon the characteristics of leachate. However leachate composition and characteristics depends upon the factors like composition of waste, age of landfill, moisture content, temperature etc. In generalhigh inorganic, organic, heavy metal content and toxic characteristics of leachate due to its infiltration may results in contamination of surrounding land and ground water. The researchers across the globe reported the various treatment techniques to treat the leachate and are ammonium stripping, membrane filtration, electrochemical treatment, coagulation flocculation etc.(Visvanathan et al (2007), Quasim(1994), Nishapriya et al (2005), Liu et al (2012), Amokrane et al (1997),Ghafari et al.(2010), Kurniawan et al.(2006)).

The soil aquifer treatment is found to be techno-economically feasible option for the treatment of leachate. This is attributed to capacity to bind various chemicals by soil particles. The amount of clay and organic fraction, pH, water content, temperature of soil is found to be parameters which decide the adsorption capacity of soil. Therefore it is felt that there is a need to explore the feasibility of utilizing locally available soils in treating synthetically prepared leachate for its chemical constituents. This paper takes stock of results of bench scale studies carried out on SAT system in treating leachate.

II. MATERIALSAND METHODOLOGY

The lysimeter is used for generation of leachate in the laboratory. The material used for fabrication of lysimeter and its size, the components of the lysimeter are depicted in fig (1).

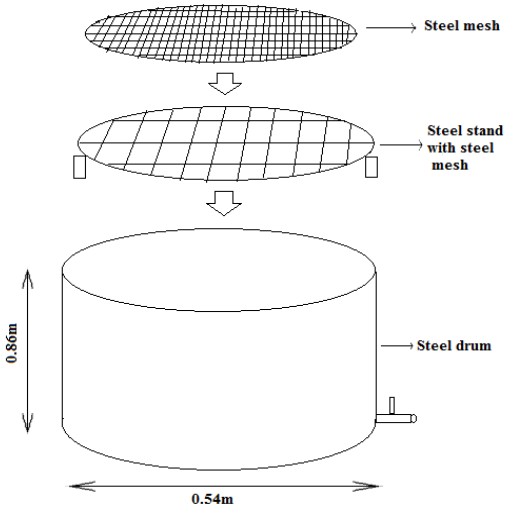

Fig1: Schematic diagram of Lysimeter

2. 1. Loading of Lysimeter

The solid waste is filled in the lysimeter simulating the characteristics of municipal waste of study area considered (Davangere District headquarters,Karnataka, State).Further corresponding to rainfall and evaporation data of study area, the amount of water to be added is calculated by using the equation suggested byAish et al. (2014). The leachate is analysed for its characteristics corresponding to 20 days age of solid waste composted. The leachate characteristics namely pH, COD, Hardness, Chlorides and TDS are considered for study and are analysed as per standard methods (APHA 2005).

2.2 Column Studies

The bench scale studies were conducted to evaluate leachate treatment potential of soils. The line diagram of column used for the present work is presented in fig.2.Transparent pipe of 0.61m height and of inner diameterof 0.254m was used as column. To prevent the escape of soil, the bottom of column is plugged with 5mm pore size steel mesh. A filter cloth is placed above the steel mesh to prevent the soil to clog the pores in the steel mesh. Further a reducer is fitted to the pipe at the bottom.

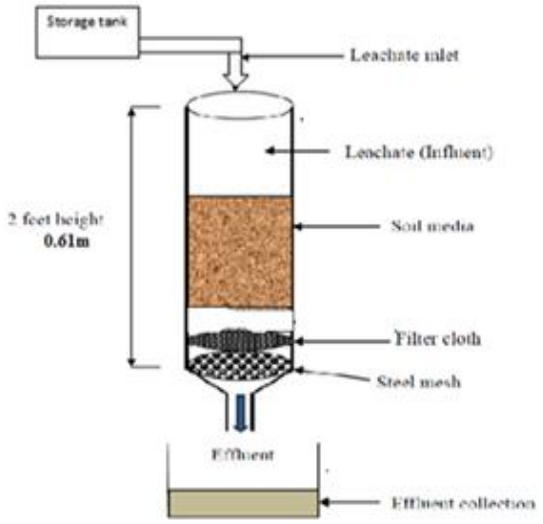

Fig 2 : Line Diagram of Column

Two soils from different localities are collected from study area and are analysed for various parameters of importance leading to classification of soils as mentioned in Compendium of Indian Standards on Soil Engineering – Part 2. The classification showed that the soils analysed are clayeysand and gravellysoil.

The experimentations are carried out for two soil bed depths of 15 cm and 45 cm adopting a constant flow rate of 1.5 l/h.

III. RESULTS AND DISCUSSIONS

The properties of soils and their classification as per Indian Standards are presented in table 1.

Table1: Soil Classification

Type of Soil	%Gravel	% Sand	% silt	% clay
Clayey sand	5	52	10	33
Gravelly soil	56	31.4	5.1	7.5

The results of experimentation corresponding to 15 cm bed depth of soil are presented in Table 2. Fig.3 summarizes the results of experimentation corresponding to bed depth of 45 cm.

Table 2: Leachate Treatment Potential of Soil Studied

Parameters	Influent concentration	% Removal with Stated Soil	
		Gravelly Soil	Clayey sand
COD	65000 mg/l	31.38	45.23
Hardness	7800 mg/l	40.32	50.32
Chloride	3625mg/l	37.38	46.74
TDS	4250 ppm	33.88	42.59

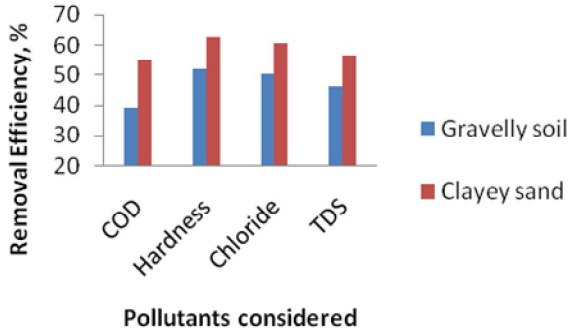

Fig 3 : Removal Potential with 45 cm bed depth

Based on the analysis of results the inferences are drawn and are documented as below:

- The treatment potential of Clayey sand is found to be better than gravelly soil.
- The results revealed that the better removal efficiency can be achieved with the soil bed depth of 45 cm.
- The effect of bed depth in adsorbing metals has also been reported by Chowdhary et al (2012), Mobasherpuret al (2014) andAgeena (2010). They inferred that at higher bed height there will be increase in specific surface area of adsorbent and thus it provides more scope for fixation of cations with active binding sites for the adsorption process. Also the increasing bed height would increase the mass transfer zone.

- The maximum removal efficiencies by Clayey sand corresponding to bed depth of 45 cm are found to be 54.69% (COD), 62.64%(Hardness), 60.64%(Chloride) and 56.28% (TDS) .
- The minimum removal efficiencies of these pollutants observed with gravelly soil, bed depth being 15 cm are respectively is 31.38%, 40.32%, 37.38% and 33.88%.

IV. CONCLUSIONS

- Within the limitations of Soil bed depths considered it is concluded that for relatively better treatment of leachate for parameters studied, the Clayey sand with bed depth of 45cm can be used.
- However it is suggested to carryout studies to arrive at optimised bed depth.

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