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Experimental Investigation of Leachate Treatment Using Cost Friendly Materials

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ABSTRACT: This project work is carried out to treat the landfill leachate before disposal. If leachate is directly disposed into environment it creates serious problems on the surrounding soil, ground water aquifers and nearby surface water. Therefore great attention has been directed towards new techniques based on physico-chemical process, and heavy metals removal using cost friendly materials as filter media with down flow reactor. Leachate generation is a major problem for municipal solid waste (MSW) landfills and causes significant threat to surface water and groundwater. Leachate can be defined as a liquid that passes through a landfill and has extracted dissolved and suspended matter from it. Leachate results from precipitation entering the landfill from moisture that exists in the waste when it is composed. This paper presents the results of leachate treatment from the solid waste land fill by using cost friendly materials.

KEYWORDS: Leachate, Physico-Chemical Process, Landfill, Precipitation, Municipal Solid Waste (MSW).

I. INTRODUCTION

Sanitary landfill is a process in the solid waste management system. It can be defined as a method of disposing of refuse on land without creating nuisances or hazards to public health or safety, by utilizing the principles of engineering to confine the refuse to the smallest practical area, to reduce it to the smallest practical volume, and to cover it with a layer of earth at the conclusion of each days operation or at such more frequent intervals as may be necessary.

Solid waste landfills may cause severe environmental impacts if leachate and gas emissions are not controlled. Leachate generated in municipal land fill contains large amounts of organic and inorganic contaminants. Leachate may also have a high concentration of metals and contain some hazardous organic chemicals. The removal of organic material based on COD, BOD and ammonium from leachate is the usual prerequisite before discharging the leachate into natural waters. Our main objective is to treat the landfill leachate using cost friendly materials. To utilize a natural low cost materials for treating leachate concentration to avoid potential risks and hazards to public health and also the ecosystem. On purpose of purifying leachate liquid for final discharge to natural water body and land disposal to reduce the filtration of leachate through waste thus minimizing the migration of toxic pollutant.

II. RELATED WORKS

The Atomic Absorption Spectrophotometer (AAS) (SHIMADZUAA-7000, Japan) was used for the determination of concentration of the metal ions present in the samples by reading their absorbance and comparing it on the respective standard calibration curve. Three replicate determinations were carried out on each sample and same analytical procedure was employed for the determination of elements in digested blank solutions and for the spiked samples. The limit of detection for the heavy metals Cd, Cu, Pb, Zn and Cr was found to be 0.003, 0.01, 0.015, 0.002 and 0.01 mg /L respectively.

There were significant differences in the heavy metal concentrations of the leachates from the various waste dumpsites. The minimum and maximum mean concentrations of cadmium in leachates were 0.03 and 0.10 mg/L from Kojokrom and Essipong waste dumpsites respectively. Leachates from Effiakuma and Ntankoful waste dump sites recorded the same concentrations for cadmium (0.05mg/L). The minimum and maximum mean concentrations of zinc in leachates were 0.20 and 5.48 mg/L from Kojokrom and Essipong waste dump sites respectively. Mean lead concentrations in the leachate samples from Kojokrom and Essipong waste dumpsites were the same. The minimum and maximum mean concentrations of chromium in leachates were 0.38 and 0.55 mg/L from Essipong and Effiakuma waste dumpsites

respectively. The minimum and maximum mean concentrations of copper in leachates were 0.17 and 0.90 mg/L from Effiakuma and Essipong waste dumpsites respectively.

III. METHODOLOGY

The method of systematical, theoretical analysis applied to a field of study is called methodology, it comprises the theoretical analysis of the body of method and principles associated with the branch of knowledge.

- Sample Collection
- Sample Testing
- Treatment by Natural Materials
- Testing after treatment
- Result & Discussion

3.1 SAMPLE COLLECTION

We have collected the leachate sample at the landfill site in Natham. The sample was collected using cans. The cans were cleaned by rinsing them with acid initially and then with distilled water. They were dried and taken out to the sampling location. The cans were rinsed once again with the sample and then filled in cans. The sample were immediately brought to the laboratory and using grab sampling method, the sampling cans are 15 liter capacity which are cleaned several time with tap water, then with distilled water and rinsed fully with 1N HNO₃ for removal of living micro-organisms, pathogens and odor of the sample cans.

3.2 SAMPLE TESTING

It is estimated that each person contributes about 4 L/yr of hazardous chemicals to their MSW stream. Lee and Jones (1991) listed a wide variety of house hold products, which eventually reach MSW landfill, that contain Priority Pollutants, Brown and Nelson(1990) also discussed sources of hazardous chemicals in MSW leachate.

Parameter	Concentration Range(Mg/L)	Average (Mg/L)
BOD	1000-30000	10500
COD	1000-50000	15000
Total volatile acids	70-28000	NA
Nitrate	0.1-10	4
Ammonia	100-400	300
Phosphate	0.5-50	30
Ortho phosphate	1.0-60	22
pH	5-7.5	6.3
Chromium	0.05-1	0.9
Cadmium	0.001-0.1	0.05
Copper	0.02-1	0.5
Lead	0.1-1	0.5
Nickel	0.1-2	1.2
Iron	10-10000	430
Zinc	0.5-30	21

IV. MATERIALS USED

The following are the materials used to treat leachate,

- Sugarcane bagasse
- Laterite soil
- Brick bat.

4.1 SUGARCANE BAGASSE

Sugarcane bagasse is a lingo cellulosic fibre residue obtained from sugar cane culm, after the culm is milled and the juice is extracted. The average composition of sugar cane is 65–75% water, 11–18% sugars, 8–14% fibres and 12–23% soluble solids. The cane basically consists of juice and fibre. The sugar cane bagasse has the following composition (by weight): cellulose-41.8%, hemi cellulose (aspenosan)-28.0%, lignin-21.8%. Developing countries account for more than 67% of current global sugar consumption and particularly in Asia and are expected to be the primary source of future demand growth. Brazil is the major player and the most competitive supplier in the world sugar market, with the lowest production costs both infield and factory Sugarcane bagasse presented a lower content of lignin than the other lingo cellulosic materials evaluated, and a high average content of extractives and holo cellulose.

4.2 LATERITE SOIL

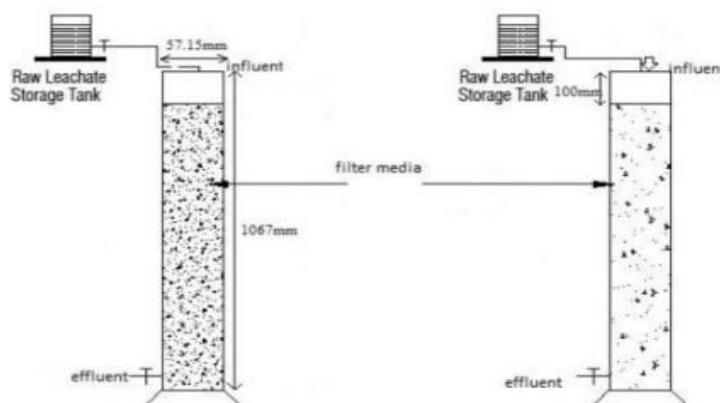
Laterite is both a soil and a rock type rich in iron and aluminum and is commonly considered to have formed in hot and wet tropical areas. Nearly all laterites are of rusty-red coloration, because of high iron oxide content. They develop by intensive and prolonged weathering of the underlying parent rock. Tropical weathering (laterization) is a prolonged process of chemical weathering which produces a wide variety in the thickness, grade, chemistry and ore mineralogy of the resulting soils. Laterites are a source of aluminum ore and the ore exists largely in clay minerals and the hydroxides, gibbsite, boehmite and diaspore, which resembles the composition of bauxite. In Northern Ireland they once provided a major source of iron and aluminum ores. Laterite ores also were the early major source of nickel.

4.3 BRICK BAT

Brick bats are defined as a cut portion of brick, generally the brick is cutted along the width and the length of brick piece is smaller than the original brick. Brickwork, a bat is a shorter and sometimes shaped section of a single brick to fit a specific need in the patter no bricklaying being performed and the required quantity of brick bats is taken as filter media for treating landfill leachate.

V. TREATMENT METHOD

5.1 EXPERIMENTAL SETUP The reactor R1 which is filled with laterite as filter media is more efficient than compare to other reactors in removal of both heavy metals and physico-chemical parameters. Sugar cane bagasse and brick bats filter medias which contains high amount of dissolved organic matter which increases the dissolved solid content and Electrical conductivity. The removal of heavy metals is observed in both laterite and other filter media. The



percentage of toxic content removed by laterite soil was 82% when compared to other filter medias. sugarcane bagasse can reduce the toxic content up to 60% which is higher when compared to brick bats 44%. Thus sugarcane bagasse, laterite soil are the best one to reduce toxic content in leachate. Leachate control is a very important step to receive the long-term functionality of the drainage system, to reduce treatment costs and to render possible high tech treatment systems. Now a days more than 100 leachete treatment plants are under operation in Germany, so there are many experiences concerning the technology, costs, the effluent quality and associated problems. In some cases the treatment of leachate resulted in increasing operation problems in opposite to the treatment of other wastewaters. The selection of the adaequate treatment process should not only include the compliance with the effluent limit values and maintenance but also the production of residuals which have to be further treated or disposed.



5.2 EXPERIMENTAL PROCEDURE

Landfill leachate is basically originated from infiltrated rainwater fraction in the cell of the landfill and water present in the mass grounded waste. Solid waste landfills may cause severe environmental impacts if leachate and gas emissions are not controlled. Leachate generated in municipal landfill contains large amounts of organic and inorganic contaminants. During treatment adsorbents will remove the heavy metals present in the leachate.

- Land fill leachate is collected from municipal solid waste landfill. Reactor body-Prefabricated PVC pipe and Material- Laterite soil, brick bats and sugarcane bagasse.
- PVC pipe having 57.15 mm internal diameter and 1067 mm height is used.
- Each reactor are provided with 100mm free board at the top and distance of 957 mm is maintained between inlet and outlet port which were kept Constant in all reactors.
- Flow reactors R1, R2, R3 are used for study purpose.
- R1-consisting of laterite soil as filter media, R2-consisting of brick bats, R3-consisting of sugarcane bagasse, combination of all filter media in layers.
- Reactors are completely filled with filter media with light compaction.

VI. RESULTS AND DISCUSSION

6.1 RESULT CALCULATION

➤ **P^H TEST RESULTS**

<u>Before treatment</u>	= 4.7
<u>After treatment using,</u>	
Sugarcane Bagasse	= 5.5
Laterite Soil	= 7.6
Brick Bats	= 6.0

➤ **TURBIDITY RESULTS**

<u>Before treatment</u>	= 0.57 mg/l
<u>After treatment using,</u>	
Sugarcane Bagasse	= 2mg/l
Laterite Soil	= 5mg/l
Brick Bats	= 2.5mg/l

➤ **TOTAL DISSOLVED SOLIDS**

<u>Before treatment</u>	
Suspended solids = Total solids – Dissolved solids = 2.8-1.3=1.5mg/l	
<u>After treatment using,</u>	
Sugarcane Bagasse	= 0.7mg/l
Laterite Soil	= 0.5mg/l
Brick Bats	= 0.8mg/l

➤ **BOD**

<u>Before treatment</u>	= 10,000mg/l
<u>After treatment using,</u>	
Sugarcane Bagasse	= 500mg/l
Laterite Soil	= 200mg/l
Brick Bats	= 800mg/l

➤ **COD**

<u>Before treatment</u>	=30,000mg/l
<u>After treatment using,</u>	
Sugarcane Bagasse	= 6000mg/l
Laterite Soil	= 1000mg/l

Brick Bats

= 2500mg/l

6.2 RESULT STUDIES

The leachate sample was collected from landfill site using cans. We have used sugarcane bagasse, laterite soil, brick bats as filter media for leachate treatment. The above calculation indicates that laterite soil removes more contaminants in the leachate when compared with other adsorbents. After treatment of landfill leachate using sugarcane bagasse, laterite soil, brick bats as filter media in PVC pipe, the effluent obtained from laterite soil as filter media contains less toxicity when compared with other adsorbents.

Laterite soil > Sugarcane bagasse > Brick bats

Hence laterite soil, sugarcane bagasse are easily available, the process can be done for the treatment of landfill leachate which has been proven successfully.

VII. CONCLUSION

The reactor R1 which is filled with laterite soil as filter media is more efficient than compare to other reactors in removal of both heavy metals and physico-chemical parameters. Sugarcane bagasse and Brick bats filter Medias which contains high amount of dissolved organic matter which increases the dissolved solid content and Electrical conductivity. The removal of heavy metals is observed in both laterite soil and other filter media.

The percentage of toxic content removed by laterite soil was 82% when compared to other filter Medias. sugarcane bagasse can reduce the toxic content up to 60% which is higher when compared to brick bats 44%. Thus sugarcane bagasse, laterite soil are the best one to reduce toxic content in leachate. Leachate control is a very important step to receive the long-term functionality of the drainage system, to reduce treatment costs and to render possible high technology treatment systems. Now a day's more than 100 leachete treatment plants are under operation in Germany, so there are many experiences concerning the technology, costs, the effluent quality and associated problems.

In some cases the treatment of leachate resulted in increasing operation problems in opposite to the treatment of other wastewaters. The selection of the adequate treatment process should not only include the compliance with the effluent limit values and maintenance but also the production of residuals which have to be further treated or disposed.

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