Treatment of Leachate Using Low Cost Material

Mr. A.N. Dahe[1], Mr. Palande S.M.[2], Ms.R.D.Dube[3], Mr.A.D.Baraikar[4], Mr. R.G.Kshirsagar[5], Mr.P.A.Varankar[6]
[1, 2] Lecturer, Dept of Civil Engineering
[3, 4, 5, 6]Dept of Civil Engineering
[1, 2, 3, 4, 5, 6] Bhivarabai Sawant Polytechnic, Wagholi, Pune, India

Abstract- *Solid waste is an important environmental problem in both developing and developed countries. Management of Municipal Solid Waste (MSW) is one of the main modern environmental issues in municipal areas because of both its huge amount and variety of constituents. Information on characteristics of MSW is important for the formulation of new waste management policy. Landfill leachate is defined as an aqueous effluent produced when water percolates through the waste in a landfill. The nature of landfill leachate depends on the type of MSW being dumped, landfill age, moisture content, seasonal weather variations, site hydrology, the stage of decomposition in the landfill and pH. Produced leachate could contain large amounts of contaminants measured as chemical oxygen demand (COD), five days biochemical oxygen demand (BOD5), ammonia-nitrogen (NH3–N), suspended solids, heavy metals, phenols, phosphorus etc. Obviously, as landfill age increases, the biodegradable fraction of organic pollutants in leachate decrease as an outcome of the anaerobic decomposition occurring in landfill site. Thus, mature or stabilized leachate contains much more refractory organics than young leachate.*

Keywords- Leachate treatment, Water pollution

I. INTRODUCTION

A leachate is any liquid that, in the course of passing through matter, extracts soluble or suspended solid or any other component of the material through which it has passed. Leachate is a widely used term in the environmental sciences where it has the specific meaning of a liquid that has dissolved or entrained environmentally harmful substances that may then enter the environment. It is most commonly used in the context of landfilling of putrescible or industrial waste. In the narrow environmental context leachate is therefore any liquid material that drains from land or stockpiled material and contains significantly elevated concentrations of undesirable material derived from the material that it has passed through. When water percolates through waste, it promotes and assists the process of decomposition by bacteria and fungi. These processes in turn release by-products of decomposition and rapidly use up any available oxygen, creating an anoxic environment. In actively decomposing waste, the temperature rises and the pH falls rapidly with the result that many metal ions that are relatively insoluble at neutral pH become dissolved in the developing leachate. The decomposition processes them release more water, which adds to the volume of leachate. Leachate also reacts with materials that are not prone to decomposition themselves, such as fire ash. Cement based building materials and gypsum-based materials changing the chemical composition. In sites with large volumes of building waste, especially those containing gypsum plaster, the reaction of leachate with the gypsum can generate large volumes of hydrogen sulfide, which may be released in the leachate and may also form a large component of the landfill gas. In a landfill that receives a mixture of municipal, commercial, and mixed industrial waste but excludes significant amounts of concentrated chemical waste, landfill leachate may be characterized as a water-based solution of four groups of contaminants: dissolved organic matter (alcohols, acids, aldehydes, short chain sugars etc.), inorganic macro components (common, cations and anions including sulfate, chloride, iron, aluminum, zinc and ammonia), heavy metals (Pb, Ni, Cu, Hg), and xenobiotic organic compounds such as halogenated organics, (PCBs,dioxins, etc.) The physical appearance of leachate when it emerges from a typical landfill site is a strongly odoured black-, yellow- or orange-coloured cloudy liquid. The smell is acidic and offensive and may very pervasive because of hydrogen-, nitrogen- and sulfur-rich organic species such as mercaptans.

II. AIM ANDOBJECTIVES

Aim-

To treat leachate material by mixing chemical reagents to control the PH & coagulatate & settle the solids and reduce the concentration of the hazardous materials using low costmaterials.

Objectives

- To understand the leachate formation and impurities in leachate.(seprate experiments for different values)
- Studying traditional leachate treatment methods and low cost treatment methods.(Sugarcane baggage and corn)

- To reduce the concentration of impurities in leachate to the permissible values with low cost treatment method.

III. PROBLEM STATEMENT

Today leachate generation is a major problem for municipal solid waste landfills and causes significant threat to surface water and groundwater. Leachate can be defined as a liquid that passes through landfill and has extracted dissolved and suspended matter from it, such water when mixed with groundwater can cause health problems.

A: COMPOSITION OF LANDFILL LEACHATE

This section presents data on the composition of landfill leachate, and further discusses the importance of the landfill phases presented in the previous section on compositional changes. Pollutants in MSW landfill leachate can be divided into four groups:

* Dissolved organic matter, quantified as Chemical Oxygen Demand (COD) or Total Organic Carbon (TOC), volatile fatty acids (that accumulate during the acid phase of the waste stabilization, Christensen and Kjeldsen, 1989) and more refractory compounds such as fulvic-like and humic-like compounds.
* Inorganic macrocomponents: calcium (Ca2+), magnesium (Mg2+), sodium(Na+), potassium (K+), ammonium (NH4+), iron (Fe2+), manganese (Mn2+),chloride (Cl-), sulfate (SO42-) and hydrogen carbonate (HCO3-).
* Heavy metals: cadmium (Cd2+), chromium (Cr3+), copper (Cu2+), lead (Pb2+),nickel (Ni 2+) and zinc (Zn2+).
* Xenobiotic organic compounds (XOCs) originating from household or in-dustrial chemicals and present in relatively low concentrations (usually lessthan I mg/l of individual compounds). These compounds include amongothers a variety of aromatic hydrocarbons, phenols, chlorinated aliphatics,pesticides, and plastizers.

Other compounds may be found in leachate from landfills: for example,borate, sulfide, arsenate, selenate, barium, lithium, mercury, and cobalt. However, in general, these compounds are found in very low concentrations and are only of secondary importance. Leachate composition may also be characterized by different toxicological tests, which provide indirect information on the content of pollutants that may be harmful to a class of organisms.

B: COMPONENTS IN LEACHATE TREATMENT

There are many components to a collection system including pumps, manholes, discharge lines and liquid level monitors. However, there are four main components which govern the overall efficiency of the system. These four elements are liners, filters, pumps and sumps.

Natural and synthetic liners may be utilized as both a collection device and as a means for isolating leachate within the fill to protect the soil and groundwater below. The chief concern is the ability of a liner to maintain integrity and impermeability over the life of the landfill. Subsurface water monitoring, leachate collection, and clay liners are commonly included in the design and construction of a waste landfill. To effectively serve the purpose of containing leachate in a landfill, a liner system must possess a number of physical properties. The liner must have high tensile strength, flexibility, and elongation without failure. It is also important that the liner resist abrasion, puncture, and chemical degradation by leachate. Lastly, the liner must withstand temperature variation and be black (to resist UV light), easily installed, and economical.

There are several types of liners used in leachate control and collection. These types include geomembranes, geosynthetic clay liners, geotextiles, geogrids, geonets, and geocomposites.Each style of liner has specific uses and abilities. Geomembranes are used to provide a barrier between mobile polluting substances released from wastes and the groundwater. In the closing of landfills, geomembranes are used to provide a low-permeability cover barrier to prevent the the intrusion of rain water. Geosynthetic clay liners (GCLs) are fabricated by distributing sodium bentonite in a uniform thickness between woven and non-woven geotextiles. Sodium bentonite has a low permeability, which makes GCLs a suitable alternative to clay liners in a composite liner system. Geotextiles are used as separation between two different types of soils to prevent contamination of the lower layer by the upper layer. Geotextiles also act as a cushion to protect synthetic layers against puncture from underlying and overlaying rocks. Geogrids are structural synthetic materials used in slope veneer stability to create stability for cover soils over synthetic liners or as soil reinforcement in steep slopes. Geonets are synthetic drainage materials that are often used in lieu of sand and gravel. Radz can take 12 in (30 cm) of drainage sand, thus increasing the landfill space for waste. Geocomposites are a combination of synthetic materials that are ordinarily used singly. A common type of geocomposite is a geonet that is heat-bonded to two layers of geotextile, one on each side. The geocomposite serves as a filter and drainage medium.

Leachate drainage system

The leachate drainage system is responsible for the collection and transport of the leachate collected inside the liner. The pipe dimensions, type, and layout must all be planned with the weight and pressure of waste, and transport vehicles in mind. The pipes are located on the floor of the cell. Above the network lies an enormous amount of weight and pressure. To support this, the pipes can either be flexible or rigid, but the joints to connect the pipes yield better results if the connections are flexible. An alternative to placing the collection system underneath the waste is to position the conduits in trenches or above grade.

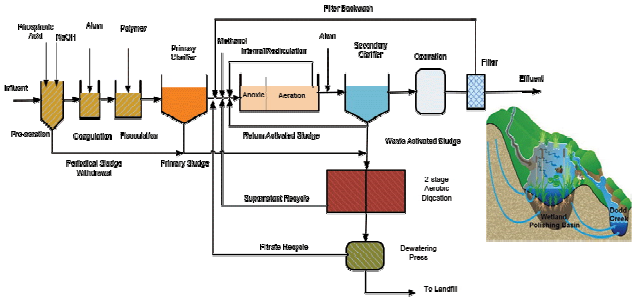
Filters

The filter layer is used above the drainage layer in leachate collection. There are two types of filtJers typically used in engineering practices: granular and geotextile. Granular filters consist of one or more soil layers or multiple layers having a coarser gradation in the direction of the seepage than the soil to be protected.

Re-injection into landfill

One method of leachate management that was more common in uncontained sites was leachate re-circulation, in which leachate was collected and re-injected into the waste mass. This process greatly accelerated decomposition and therefore gas production and had the impact of converting some leachate volume into landfill gas and reducing the overall volume of leachate for disposal. However, it also tended to increase substantially the concentrations of contaminant materials, making it a more difficult waste to treat.

C: ENVIRONMENTAL IMPACT



The risks from waste leachate are due to its high organic contaminant concentrations and high concentration of ammonia. Pathogenic microorganisms that might be present in it are often cited as the most important, but pathogenic organism counts reduce rapidly with time in the landfill, so this only applies to the freshest leachate. Toxic substances may, however, be present in variable concentrations, and their presence is related to the nature of the waste deposited.

D: EXPERIMENTAL IMPLEMENTATION AND RESULT

Classification of leachate treatment according to the composition change due to age factor;

Type of Leachate	Young	Intermediate	Stabilized
Age(Years)	<5	5-10	>10
Ph	<6.5	6.5-7.5	>7.5
COD	>10,000	4000-10000	<4000
BOD/COD	0.5-10	0.1-0.5	0.1
Organic Compounds	80% volatile fatty acid (VFA)	5-30%VFA+humic and fulvic acids	Humic and fulvic acids
Ammonia Nitrogen	<400	N.A	>400
TOC/COD	<0.3	0.3-0.5	>0.5
Heavy Metals	Low	Low to Medium	Low

IV. CONCEPTUALPHOTOGRAPH

Fig.1 Leachate Pond

Fig. 2 Pollutant Material

V. CONCLUSION

From the above –mentioned results we can see that the activated rice risk is a better coagulant than activated

sugarcane bagasse. The activated rise husk gives good results for BOD & TDS removal and also maintains the pH level within the standard limits. there is less sludge formatin when we use natural coagulants for wastewater treatment processes as compared to chemical coagulants. This cuts the large sludge handling costs. Natural coagulants can be regenerated again by acid bath and thermal regeneration process process which cuts down the cost of treatment process further.

VI. ACKNOWLEDGEMENT

It is not possible to express the things in words what we feel, but here we tried to express our thoughts in the form of acknowledgement. It has been privilege for us to be associated with Mr. A.N.Dahe our project guide. We are greatly benefited by his valuable suggestions and ideas. It is with great pleasure that we express our deep sense of gratitude to his for his guidance, constant encouragement, for his kindness, moral boosting support and patience throughout this work. We profoundly thank his for all this and owe much more than we could possibly express. We are thankful to Head of Civil Engineering Department Mrs. T. D. Sayyad and co-guide Mr. S. M. Palande for providing the required facilities to complete this report. We must say thanks to all the teaching and non-teaching staff of department for their valuable cooperation and support. I thank Dr. S. V. Admane Principal,Jayawant Shikshan Prasarak Mandal's Bhivarabai Sawant Polytechnic Wagholi, Pune 412207

REFRENCES

[1] Kai Wang *et.al,*"Treatment of landfill leachate using activated sludgetechnology"*HINDAWI,* "Characteristics of landfill leachate with different periods"

[2] S. Renou *et.al,* "Landfill leachate treatment:Review andopportunity"*ELSEVIER*, Journal of Hazardous Materials 150(2008) 468–493

[3] Safaa M. *et.al,* "Treatment if leachate from municipal solid waste landfill" HRBC Journal, "Treatment Of Leachate From Muncipal Solid WasteLandfill"

[4] Qi Wang *et.al*, "Research on leachate recirculation from different type oflandfills", *ELSEVIER*, Waste Management 26(2006) 815- 824.

[5] Habashi, F. The recovery of the lanthanides from Phosphate Rock. J. Chem. Technol. Biotechnol. Chem. Technol.1985, 35, 5–14

[6] Garamjav, D.; Jargalan, S. Introduction to REE metallogeny of the Mongolia. Mong. Geosci. 2009, 35, 73–76

[7] Enkhbayar, D.; Seo, J.; Choi, S.; Lee, Y.; Batmunkh, E. Mineral chemistry of REE-rich apatite and sulfur-richmonazite from the MushgaiKhudag, Alkaline Volcanic-Plutonic Complex, South Mongolia. Int. J. Geosci. 2016, 7, 20–31

[8] Peelman, S.; Sun, Z.H.I.; Sietsma, J.; Yang, Y. Hydrometallurgical extraction of rare earth elements from low grade mine tailings. In Rare Metal Technology 2016; Alan, S., Kim, H., Neelameggham, N.R., Ouchi, T.,Oosterhof, H., Eds.; John Wiley & Sons, Inc.: Hoboken, NJ, USA, 2016

[9] Azimi, G.; Papangelakis, V.G. The Solubility of gypsum and anhydrite in simulated laterite pressure acid leach solutions up to 250 ″C. Hydrometallurgy 2010, 102, 1–13

[10] Wang, L.; Long, Z.; Huang, X.; Yu, Y.; Cui, D.; Zhang, G. Recovery of rare earths from wet-process phosphoric acid. Hydrometallurgy 2010, 101, 41–47.