MANTECH Publications
International Journal of Advance Civil Engineering and Technology
Volume 2, Issue 2, May-August, 2017

Leach ate Treatment Processes: A Review

Himanshu Gupta
Assistant Professor
Department of Civil Engineering
ABES Engineering College, Ghaziabad (U.P.) India
Corresponding Author: *himanshu.gupta@abes.ac.in*

Abstract

Leachate is highly complex and polluted waste water that is produced by the introduction of percolation water through the body of landfill treatment. Leachate treatment is essential as it could threaten the surrounding ecosystem when discharge as it is and when it mixes with groundwater, it deteriorated water quality and become main source of water borne diseases. This paper is a review of landfill leachate treatment from Various leachate treatment technologies like coagulation flocculation, adsorption by activated carbon, biological treatment etc used across many countries like Sweden, Australia, Spain and find out other metals which also be treated out by these methods.

Key words: *Landfill, Leachate, Biological treatment, Activated carbon.*

INTRODUCTION

Leach ate is the liquid that drains or 'leaches' from a landfill. It varies widely in composition regarding the age of the landfill and the type of waste that it contains. It usually contains both dissolved and suspended material. Leach ate is highly complex and polluted waste water that is produced by the introduction of percolation water through the body of landfill treatment. Landfill leachate is a hazardous liquid emanates from municipal landfill sites [2]. It contains high level of biodegradable organics, inorganic heavy metals, non-degradable organic hydrocarbon, phenols and Xenobiotic compound including

Page 77-83 © MANTECH PUBLICATIONS 2017. All Rights Reserved

pesticides. A sizable research works are carried out by various scientists for assessing the quality of leachate for MSW landfill sites. They have mentioned that organic pollutant (high strength COD) is predominant over other pollutants. Limited amount of work have been done in Indian context to assess the potential of pollutant emanated from landfill sites.

Leachate Characteristics

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, aluminium, 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 be very pervasive because of hydrogen-, nitrogen- and sulfur-rich organic species such as mercaptans.

Table 1 Landfill leachate classification Vs age

Parameter	Young	Intermediate	Old
Age	<5	5-10	>10
pH	6.5	6.5-7.5	>7.5
COD(mg/L)	>10000	4000-10000	<4000
BOD_5/COD	>0.3	0.1-0.3	<0.1
Heavy metal	Low-medium	Low	Low
Biodegradability	Important	Medium	Low

Page 77-83 © MANTECH PUBLICATIONS 2017. All Rights Reserved

Leachate Treatment Technologies

i. Biological Treatment:

Biological treatment is worldwide the most common practice for leachate treatment.

a) Anaerobic biological treatment: - It can be treating either by anaerobic filter and anaerobic sludge bed reactor (UASB). This process have common practice in India.

b) Aerobic biological treatment:-it can be treated by Aerated lagoons, activated sludge plants, rotating biological contactors (RBC), trickling filter sequential batch plant and co-treatment with sewage.

ii. Reverse Osmosis Method:

It is dewy technology which stubborn the situation of membrane which is not so effective in India.

iii. Adsorption through Activated Carbon:

The adsorption process is used as a stage of integrated chemical-physical-biological process for Landfill leachate treatment, or simultaneously with a biological process. The most frequently used adsorbent is granular or Powdered Activated Carbon (PAC). Carbon adsorption permits 50-70% removal of both COD and ammonia nitrogen. Consequently, activated carbon adsorption aim is to (i) ensure final polishing level by removing toxic heavy metals or organics i.e., AOXs, PCB (ii) support microorganisms.

Other materials, tested as adsorbents, have given treatment performances close to those obtained with activated carbon. These are zeolite, vermiculite, illite, keolinite, activated alumina and municipal waste incinerator bottom ash.

iv. Fenton reaction:

Fenton's reagent was found to oxidize preferably biodegradable organic matter of leachate. In consequence, a decrease in the biodegradability of leachates was observed after Fenton treatment for both leachates. Nevertheless, Fenton reaction proved to be a feasible technique for the oxidation of the leachate in Spain.

v. Chemical oxidation:

Chemical oxidation is required for the treatment of wastewater containing soluble organic non-biodegradable and/or toxic substances as Amokrane and co-workers reviewed, commonly used oxidants such as

Page 77-83 © MANTECH PUBLICATIONS 2017. All Rights Reserved

chlorine, ozone, potassium permanganate and calcium hydrochloride for landfill leachate treatment resulted in COD removal of around 20-50%. The most processes based on direct reaction of oxidant (O_3-selective) with contaminates or via generated hydroxyl radicals (OH).

vi. Electrochemical treatment:

Electrochemical treatment such as membrane electro dialysis has also contributed to environmental protection in France and Brazil. In Rio Claro (Brazil), the electro degradation of stabilized landfill leachate was investigated by employing a flow electro-chemical reactor. Using a constant flow rate of 2000L h−1 for 180min and at a current density of1160A m−2, the maximum removal of COD and NH_3-Nwith initial concentrations of 1855 and 1060mg L−1 was found to be 73 and 49%, respectively. The result suggest that electro degradation was an alternative means to breakdown recalcitrant organic compounds in landfill leachate. Due to high energy consumption, however, this technology is more expensive than other treatment methods. As a result, this treatment technique has been investigated less extensively for the treatment of stabilized leachate.

vii. Membrane filtration:

Microfiltration (MF): Micro filtration is a low pressure cross-flow membrane process for separating colloidal and suspended particles in the range of 0.05-10 microns (i.e., Fat). MF was used as a pre-treatment for another membrane process (UF, NF or RO) or in partnership with chemical treatments. But, it cannot be used alone.

Ultrafiltration (UF): Ultra filtration is a selective fractionation process utilizing pressures up to 10 bar. It concentrates suspended solids and solutes of molecular weight greater than 1,000. The permeate contains low molecular-weight organic solutes and salts. UF is effective to eliminate the macromolecules and the particles.

viii. Rotating Biological Contractor (RBC)

In the first phase of the aerobic system study, a cyclic-batch RBC system was used to select perforated acetate discs among three different acetate discs. These discs were selected on the basis of high COD removal (65%) and biological stability. In the second phase, the RBC's (using four stages) was operated continuously at different hydraulic retention times (HRT), at

Page 77-83 © MANTECH PUBLICATIONS 2017. All Rights Reserved

different rotational speeds, and with vary inorganic concentrations of the influent leachate (2500-9000mg/L).

LEACH ATE TREATMENT: WORLD WIDE SCENARIO

This paper has analysed different leachate treatment process in world. Following table represented treatment technologies used by different countries along with their efficiency in removing other harmful chemicals**.**

Table 2 World Wide Scenario of Leachate treatment

S.No	Countries	Treatment Technologies used	Remarks (if any)	References
1.	**China**	RO, NF, Biological treatment, oxidation, coagulation etc	RO& NF are more reliable.	[1]
2.	**UK**	Membrane filtration technique	**-**	[7]
3.	**India**	Coagulation and Flocculation, Biological treatment, Rotating Biological Contactor (RBC)	**-**	[3]
4.	**Sweden**	Sequence batch rector	Remove ammonium, nitrate and nitrate	[5]
5.	**Italy**	Sequence batch rector	Removing phosphorus	[4]
6.	**Spain**	Fenton process	**-**	[6]

Page 77-83 © MANTECH PUBLICATIONS 2017. All Rights Reserved

REFERENCES

[1] Abdulhussain A. Abbas, Guo Jingsong, Liu Zhi Ping, Pan Ying Ya and Wisaam S. Al-Rekabi, "R**eview on Landfill Leachate Treatments",** American Journal of Applied Sciences 6 (4): 672-684, 2009ISSN 1546-9239 © 2009 Science Publications.

[2] http://leachate.co.uk/main/what-is-leachate/

[3] Sameer Kumar, Dhruv Katoria and Gaurav Singh**, "Leachate Treatment Technologies",** International Journal of Environmental Engineering and Management,ISSN 2231-1319, Volume 4, Number 5 (2013), pp. 439-444.

[4] A. Spagni, S. Marsili-Libelli and M. C. Lavagnolo, "**Optimisation of sanitary landfill leachate treatment in a sequencing batch reactor**", Water science and technology,2008.

[5] Cheng, N., Lo, K. V. & Yip, K. H**. "Swine wastewater treatment in a two stage sequencing batch reactor using real time control".** J. Environ. Sci. Health, 2000 , B35 (3), 379–398.

[6] Daniel Trujillo, Xavier Font, Antoni S´anchez, "**Use of Fenton reaction for the treatment of leachate from composting of different wastes"**, Journal of Hazardous Materials B138 (2006) 201–204.

[7] Erika Heander, "**Treatment of landfill leachate from a Swedish municipal waste landfill & potential of biological nitrogen removal with sequencing batch reactor technology"** , Journal of Hazardous Materials, 140:pp 316_324, 2006.

[8] Robinson AH, **"Landfill Leachate Treatment",** *The 5th International Conference on Membrane Bioreactors*", Cranfield University, 2005.

Page 77-83 © MANTECH PUBLICATIONS 2017. All Rights Reserved

[9] Peter Kjeldsen, Morton A. Barlaz, Alix P. Rooker, Anders Baun, Anna Ledin, and Thomas H. Christensen. "Present and Long-Term Composition of MSW Landfill Leachate: A Review".

Page 77-83 © MANTECH PUBLICATIONS 2017. All Rights Reserved