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Review on Leachate Generation and Characterization of Different Cities in India

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ABSTRACT: Due to urbanization and industrialization in India, threats for environmental degradation has increased. Environmental degradation results in frequent floods, change in durations of summer and winter, melting of ice from glaciers, etc. Also there is an increase in pollution due to deforestation and increase in industrial activities. Developing and under developing countries are facing crucial problems due to generation of leachate due to improper dumping of solid waste on a landfill area such as drinking unhygienic water, domestic and agricultural use and increase in health problems like typhoid, jaundice, gastro intestinal problems, bronchitis and many more. Aquatic and lithospheric systems are also affected to a great extent. This paper gives an idea about the importance of leachate collection, characterization and treatment.

KEYWORDS: Degradation, diseases, leachate, pollution, treatment.

INTRODUCTION

Disposal of solid waste in India is carried out by land filling methods, composting methods and by mechanical methods. Solid waste in India is dumped in large pits which is covered with soil layers to obtain a good quality end product. In India, degradable and non-degradable wastes are not segregated properly. Solid waste includes glass, papers, metals, ash, dead animals, paints, etc. Solid waste is classified as physical waste, chemical waste, biological waste and biomedical waste. Physical waste is the waste that is generated due to human activities. Chemical waste is a result of various reactions with metallic or non-metallic substances. Biological waste includes dead animals, excreta, dead plants, dry leaves, etc. Biomedical waste generated from clinics, hospitals, blood banks and pathological laboratories are disposed with municipal solid waste on the landfill. There is a significant increase in the generation rate in India per day. Leachate is harmful as it consists of high BOD content and heavy traces of metals like iron, nickel, zinc, nitrogen and manganese. Leachate is generated when solid waste is disposed off inappropriately on landfills, slurry water is developed in larger quantities and it meets the groundwater surface causing surface water pollution. This surface water then meets the water bodies and affects the quality of water and aquatic life. Leachate generation also leads to various diseases and breeding of insects. Leachate thus creates an imbalance in the environment and therefore in this paper, its characteristics and effects are emphasized.

II. PUBLISHED RESEARCH

This section presents review of published research on leachate generation and characterization of different cities in India. Presently most of the MSW in India is being disposed inappropriately leading to various ill effects. Generally, MSW is collected and deposited in landfills located away from the city area. Leachate is generated due to improper disposal of solid waste. Improper disposal of waste causes breeding of mosquitoes, pollution and create unhygienic conditions. The anaerobic decomposition by microorganisms is a method to degrade organic solid waste in the absence of oxygen. This results in the emission of toxic gases such as carbon dioxide (CO₂), methane (CH₄) which creates drastic effects on the environment. Methane gas production also leads to disastrous effects as it is a flammable gas and

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it displaces oxygen. These effects of leachate generation are stated by Amar M. Dhere and his team members in “Municipal solid waste disposal in Pune city – An analysis of air and groundwater pollution” paper.^[1]

In a paper “Leachate Characteristics and Evaluating Leachate Contamination Potential of Landfill Sites Using Leachate Pollution Index” by M.P.Krishnamurthy and his team members, Alevor landfill site which is located near Udupi, is studied and the aim is to determine the leachate characteristics and LPI values are calculated to determine the proper treatments required to treat the leachate and to reduce its impact on various factors. It also states that if the LPI values are high, then the site should be kept under observation continuously.^[3]

In a paper “Existing Situation of Solid Waste Management in Pune City, India” by Mane T.T and Hingane Hemalata N., it is stated that open dumping of solid waste affects the disposal site as well as the surrounding areas. Decomposition process leads to odour emission. During decomposition, various gases are released which leads to air pollution and global warming. All these gases e.g. SO₂, CH₄, CO₂ etc. are very harmful to human health and other living species. When these gases are released beyond its average limit, then it damages the human respiratory tract. Leachate formed from organic waste mixes with ground water and pollutes that water.^[4]

III.INFERENCES

The main objective of this paper is to study the importance of leachate collection and its harmful effects. Leachate is generated from the organic solid waste which consists of kitchen waste and food particles. Solid waste is not segregated properly in India. Methods used for treating solid waste are landfilling, incineration, open burning, composting, etc. But biological treatments are not carried out widely everywhere as they are very costly. Hence the current practices which are carried out for managing solid waste should be modified to reduce its harmful effects on the environment. Integrated Solid Waste Management should be practiced to reduce the evil effects of improper solid waste disposal. Reduce, reuse and recycle is the main objective of this system. This system mainly focuses on collection and sorting and then suggests the alternatives for treatment.

IV.LEACHATE GENERATION

Leachate is the slurry water that drains from solid waste containing highly suspended polluted particles. It is comprised of organic and inorganic pollutants and also consists particulates of heavy metals. It is produced due to physical, chemical, biochemical and microbiological reactions of organics within waste mass. As per data published by Amar M. Dhere and his team members in “Municipal solid waste disposal in Pune city – An analysis of air and groundwater pollution”, PMC disposes 1200-1300 metric tons of solid waste per day at Urali Devachi village which is 20kms away from Pune. About 43 ha land is provided for disposal, out of which 15 ha area is already land filled and is permanently sealed off.^[1]

In “Leachate characterization and identification of dominant pollutants using leachate pollution index for an uncontrolled landfill site” paper by S.K. Maiti and his team members, it is stated that Kolkata disposes its solid waste near Dhapa landfill site which is of 800 ha. A technique has been developed to qualify leachate contamination potential of different landfills in terms of LEACHATE POLLUTION INDEX (LPI). This paper presents leachate characteristics and also the problems arising due to these characteristics.^[2]

V.PROBLEMS ASSOCIATED WITH LEACHATE GENERATION

1. Threat to surface water and ground water.
2. Affects the aquatic life.
3. Helps in growth of sewage fungus.
4. Creates unhygienic conditions for local people.
5. Breeding of insects.
6. Affects the rivers and they appear in yellow colour.
7. Leads to ozone depletion due to improper disposal and treatments.

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VI.METHODOLGY

In this section, various methods are suggested for leachate treatment.

1. Biological Treatment -
 - Anaerobic biological treatment –
 - i.Upflow anaerobic sludge bed reactor (UASB)
 - Aerobic biological treatment –
 - i.Aerated lagoons,
 - ii.Activated sludge plants,
 - iii.Rotating biological contactors (RBC),
 - iv. Trickling filter.
2. Physiochemical treatment –
 - Air stripping,
 - pH adjustment,
 - Chemical precipitation,
 - Oxidation,
 - Reduction.
3. Coagulation –
 - Using lime,
 - Using alum.
4. Advanced techniques –
 - Carbon adsorption,
 - Ion exchange.^[5]

VII.CASE STUDY 1

- As per “Municipal solid waste disposal in Pune city – An analysis of air and groundwater pollution” by Amar M. Dhere and his team members, Urali Devachi Landfill Site is taken into consideration.

STUDY AREA: Urali Devachi Landfill Site

The three basic principles of solid waste management are REDUCE, REUSE and RECYCLE. These principles are taken into consideration at Urali Devachi Landfill Site where solid waste from the entire Pune city is dumped but due to lack of knowledge, solid waste is dumped without segregating wet waste, dry waste and garden waste. Dumping of waste without treatment has led to major problems like human health degradation, issues related to industrial, agricultural and domestic uses.

Urali Devachi site consists of total 43 ha area. Surrounding villages to this landfill site are getting affected by the improper management of solid waste. Well water is not safe for drinking purpose. Around 15 ha area of the total landfill site is permanently sealed off due to excessive waste disposal. Pune city generates around 600-800 metric tons of solid waste per day which needs to be treated otherwise the upcoming generations will have to face major consequences.

Various samples of leachate and groundwater were collected from locations such as percolation tanks, landfill storage tanks and distant wells. Based on the samples, characteristics such as conductivity, pH, COD and BOD are determined and conclusions are inferred. Feasibility of these samples are carried out to determine its suitability for various agricultural, domestic and industrial activities.^[1]

VIII.CASE STUDY 2

- As per “Leachate characterization and identification of dominant pollutants using leachate pollution index for an uncontrolled landfill site” by S.K. Maiti and his team members, research on Dhapa landfill site has been conducted.

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STUDY AREA: Dhapa Landfill Site

Metropolitan cities generate more amount of solid waste which is dumped without treatment. Dhapa, a site which is located on the eastern part of Kolkata has been allotted for solid waste disposal. Kolkata generates 1000-1200 metric tons of solid waste per day.

Dhapa site is of approximately 24.71 ha. It consists of two sites namely; eastern dumping area i.e. “Eastern Mound” and western dumping area i.e. “Western Mound”. Eastern Mound is also known as active dumping site whereas western mound is known as closed dumping site. Local residents are facing severe problems due to leachate generation. Improper disposal of waste is leading to groundwater and surface water pollution. It is also proving harmful for domestic, agricultural and industrial purposes.

Leachate sampling is carried out to determine its characteristics and pollution strength. Six samples from active and closed mound are collected and laboratory tests are carried out to determine physio-chemical and biological parameters. pH, COD, BOD, electrical conductivity, concentrations of iron, mercury, lead, nickel, zinc are estimated to measure the Leachate Pollution Index (LPI). The below figure depicts Dhapa landfill site.



Fig 1. Active and closed dumping grounds in Dhapa, Kolkata

Figure shows the active and closed dumping site of Dhapa landfill site. Dhapa is located on the eastern side of Kolkata. The figure shows that majority area is severely affected by improper disposal of solid waste which leads to leachate generation and air and ground water contamination of the landfill site.^[2]

IX.FUTURE SCOPE

1. Sampling – Methods should be determined for easy collection of samples. Leachate collection systems experience many problems including clogging with mud or silt.
2. Characterisation- Depending upon type of waste, the harmful metals present in leachate should be analysed properly
3. Based on content of leachate, proper treatment should be suggested.
4. Research can be conducted on controlling and maintaining the pH, COD, BOD, total dissolved solids and conductivity parameters to improve the efficiency of landfill and reduce the effects of leachate.
5. Landfill Design – It should be designed in such a way that it protects groundwater quality by eliminating leachate discharge and serves the disposal needs of a particular region.
6. Proper landfilling methods should be selected considering the topographical features, soil type, and moisture content of waste and hydrology of site.
- 7.

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