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CHARACTERISATION AND TREATMENT OF LEACHATE FROM MUNICIPAL SOLID WASTE OPEN DUMPING

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ABSTRACT:- Leachate is a concentrated liquid that originates from the solid waste at the dumping sites. Release of leachate to the environment without any treatment may pollute the soil, and both surface and ground water. The paper discusses the characteristics of leachate generated from municipal solid waste open dumping sites). Leachate samples were collected and analyzed for various physico -chemical parameters to estimate its pollution potential. This study aims to serve as a reference for the implementation of the most suitable treatment technique for reducing the negative environmental effects of discharge leachate. All the t land filling sites are non-engineered low lying open dumps. They have neither any bottom liner nor any leachate collection and treatment system. Therefore, all the leachate generated finds its paths into the surrounding environment. It has been found that leachate contains high concentrations of organic and inorganic constituents beyond the permissible limits. While, heavy metals concentration was in trace amount as the waste is domestic in nature. The data presented in this study indicated that the age of the landfill has a significant effect on leachate composition. In older landfills, the biodegradable fraction of organic pollutants in the leachate decreases as an outcome of the anaerobic decomposition occurring in the landfill. Indiscriminate dumping of municipal solid waste without proper solid waste management practices should be stopped or some remedial measures were required to be adopted to prevent contamination. In our project, we use coagulation process for leachate treatment. Coagulation studies were performed with lime and alum by varying parameters such as pH and coagulant dose.

1. INTRODUCTION

Solid waste is all kind of garbage, refuse, trash and other discarded solid materials which were generated from human activities especially from Residential, Commercial establishments (e.g., Restaurants, Banks) and Institutions (e.g., Hospitals, Schools) Usually wastes are managed by Municipal authorities. Nowadays, solid Waste disposal practices became a huge problem in every country with increasing concern for the environment. People generated solid wastes in the form of bottles, boxes, clothing, plastic bags and much more results in million tons of solid waste generated per year. If all of the trashes are not managed properly, they will pose a major threat to human, animals and the Environment.

Leachates from MSW landfill sites are often defined as heavily polluted wastewater. Leachate is a liquid formed primarily by the percolation of precipitation water through the open landfill or through the cap of the completed site. Some infiltration will evapotranspire, some may be stored within the landfill, and the balance becomes percolate and eventually leachate. Leachates may contain large amounts of organic contaminants which can be measured as chemical oxygen demand (COD) and biological oxygen demand (BOD), ammonia, halogenated hydrocarbons suspended solid, significant concentration of heavy metals and inorganic salt. If not treated and safely disposed, landfill leachate could be a potential source of surface and ground water contamination, as it may percolate through soils and sub soils, causing pollution to receiving waters.

The generation rate of leachate is estimated based on few factors as the rainfall, the amount of the rainfall infiltrating to the waste through the cover, the absorptive capacity of the waste, the weight of absorptive waste and any removal of the leakage via seepage or discharge. Because of the uncertainties involved in the leachate generation process from real sites, the estimated leachate generation rate would include varied inputs to provide a worse-case scenario for sizing the leachate output and getting discharge consent to allow the leachate into the sewer.

2. MUNICIPAL SOLID WASTES

2.1GENERAL

India is rapidly shifting from agricultural-based nation to industrial and services-oriented country. About 31.2% population is now living in urban areas. Over 377 million urban people are living in 7,935 towns/cities. India is a vast country divided into 29 States and 7 Union Territories (UTs). There are three mega cities—Greater Mumbai, Delhi, and Kolkata—having population of more than 10 million, 53 cities have more than 1 million population, and 415 cities having population 100,000 or more (Census, 2011a). The cities having population more than 10 million are basically State capitals, Union Territories, and other business/industrial-oriented centers. India has different geographic and climatic regions (tropical wet, tropical dry, subtropical humid climate, and mountain climate) and four seasons (winter, summer, rainy, and autumn) and accordingly residents living in these zones have different consumption and waste generation pattern. However, till date, no concrete steps had been taken to analyze regional and geographical-specific waste generation patterns for these urban towns and researchers have to rely on the limited data available based on the study conducted by Central Pollution Control Board (CPCB), New Delhi; National Engineering and Environmental Research Institute (NEERI), Nagpur; Central Institute of Plastics Engineering and Technology (CIPET), Chennai; and Federation of Indian Chambers of Commerce and Industry (FICCI, 2009), New Delhi.

2.2 COMPOSITION AND CHARACTERISTICS OF INDIAN MUNICIPAL SOLID WASTE

Following major categories of waste are generally found in MSW of India:

• Biodegradable Waste: Food and kitchen waste, green waste (vegetables, flowers, leaves, fruits)and paper.
• Recyclable Material: Paper, glass, bottles, cans, metals, certain plastics, etc.
• Inert Waste Matter: C&D, dirt, debris.
• Composite waste: Waste clothing, Tetra packs, waste plastics such as toys.
• Domestic Hazardous Waste (also called "household hazardous waste") and toxic waste:

Waste medicine, e-waste, paints, chemicals, light bulbs, fluorescent tubes, spray cans, fertilizerand pesticide containers, batteries, and shoe polish.MSW in India has approximate 40–60% compostable, 30–50% inert waste and 10% to 30% recyclable.Analysis carried out by NEERI reveals that in totality Indian waste consists of Nitrogen content(0.64 ± 0.8) %, Phosphorus (0.67 ± 0.15)%, Potassium (0.68 ± 0.15)%, and C/N ration (26 ± 5) %.

3. LEACHATE

One of the major pollution problems caused by the MSW landfill is landfill leachate, which is generated as a consequence of precipitation, surface run-off and infiltration or intrusion of groundwater percolating through a landfill, biochemical processes and the inherent water content of wastes themselves. Leachate is the liquid residue resulting from the various chemical, physical and biological processes taking place within the landfill. Landfill leachate is generated by excess rainwater percolating through the waste layers in a landfill. A combination of physical, chemical and microbial processes in the waste transfer pollutants from the waste material to the percolating water . After a landfill site is closed, a landfill will continue to produce contaminated leachate and this process could last for 30-50 years.

Generally, leachate may contain large amounts of organic matter (biodegradable, but also refractory to biodegradation), as well as ammonia-nitrogen, heavy metals, chlorinated organic and inorganic salts, which are a great threat to the surrounding soil, groundwater and even surface water . The compositions of leachate can be divided into four parts of pollutants. Organic matter such as: COD (chemical oxygen demand) and TOC (total organic carbon); specific organic compounds, inorganic compounds and heavy metals.

Three main groups of landfills are classified as young (less than five years), intermediate (5-10 years), and old or stabilized (more than 10 years). Table 2 summarizes the typical characteristics of leachate according to age of landfill . The typical chemical concentrations in young and old landfill leachates comparing with sewage and groundwater are also shown in Table 3.

Parameter	Young	Intermediate	Old
Age (years)	< 5	5-10	>10
Ph	6.5	6.5-7.5	>7.5
COD (mg/l)	> 10,000	4,000-10,000	<4,000
BOD5/COD	> 0.3	0.1-0.3	<0.1
Organic compounds	80% volatile fat acids (VFA)	5-30% VFA+ humic and fulvic acids	Humic and fulvicacids
Heavy metals	Low-medium	Low	Low
Biodegradability	Important	Medium	Low

Characteristics of leachate at different ages of landfill

Parameters*	Young leachate concentration	Old leachate concentration	Typical sewage concentration	Typical groundwater concentration
COD	20,000-40,000	500-3,000	350	20
BOD5	10,000-20,000	50-100	250	0
TOC	9,000-25,000	100-1,000	100	5
Volatile fatty acids	9,000-25,000	50-100	50	0

***ALL VALUES IN mg/l**

3.1 TREATMENT METHODS

Landfills are dump yards without top and bottom impermeable layers. All types of wastes viz., Hazardous, Industrial and even biomedical waste are dumped in these yards whereas Leachate is any liquid that, in passing through matter, extracts solutes, suspended solids or any other component of the material through which it has passed, generally through the landfills. In India, the leachate is disposed of on open lands or is allowed to mix with some water body thus leading to a drastic increase in pollution level of the surrounding. The high value of COD of 6000-20000 mg/l, total solids of 24000-50000mg/l and high concentration of heavy metals in leachate of India raise concern over its proper disposal and treatment system employed. This study is based on the currently used leachate treatment processes like biological treatment which involve treatment through aerobic and anaerobic bacteria, adsorption process on activated carbon, reverse osmosis and coagulation method with some modifications and their adaptability to Indian conditions.

3.2 RESULTS AND DISCUSSIONS

3.2.1 EFFECT OF pH ON THE COAGULATION OF LEACHATE USING CALCIUM HYDROXIDE AND ALUM

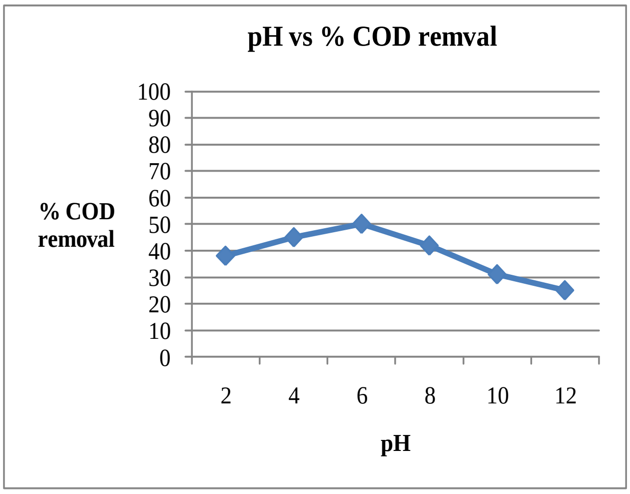

Chart 1:pH vs % COD removal (CaOH coagulant)

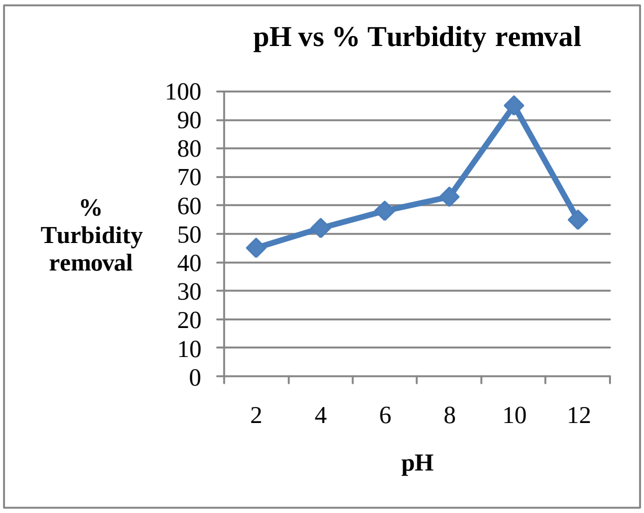

Chart 2: pH vs % Turbidity removal (CaOH coagulant)

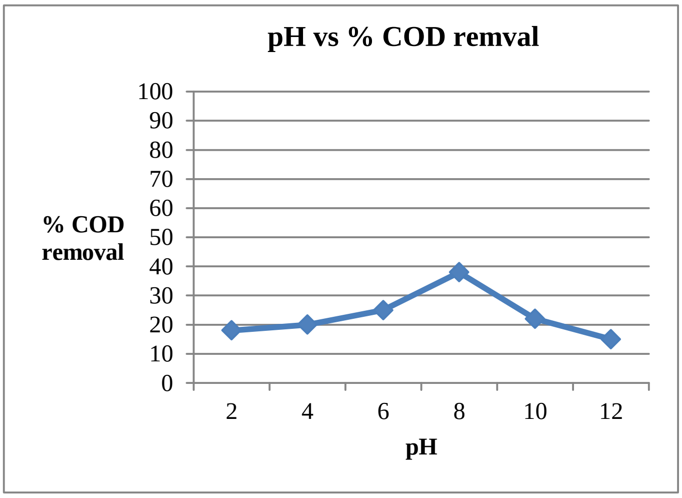

Chart 3: pH vs % COD removal (Alum coagulant)

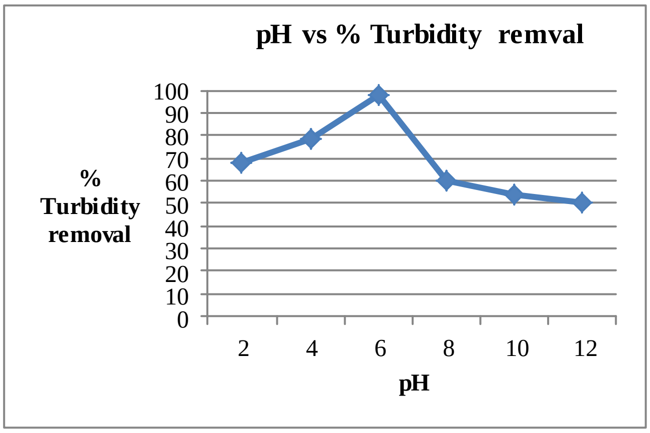

Chart 4: pH vs % Turbidity removal (Alumcoagulant)

3.2.2 EFFECT OF COAGULANT DOSE ON THECOAGULATION OF LEACHATEUSING CALCIUM HYDROXIDE

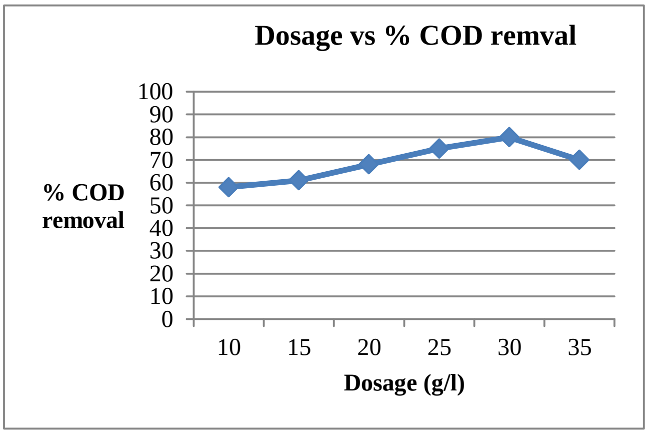

Chart 5: Dosagevs % COD removal (CaOH coagulant)

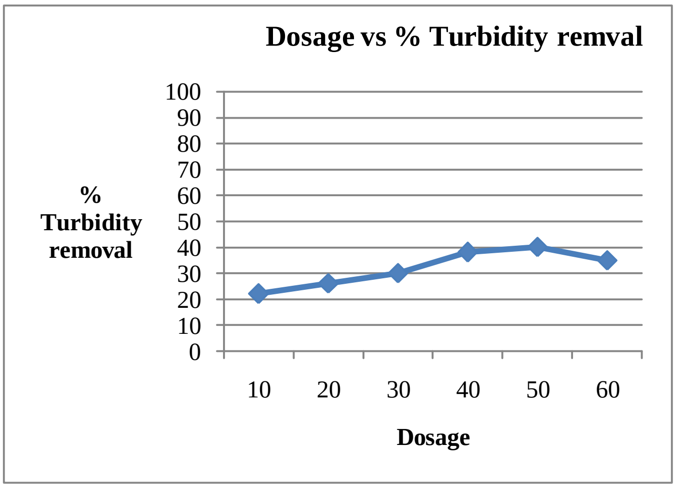

Chart 6: Dosagevs % Turbidity removal (CaOH coagulant)

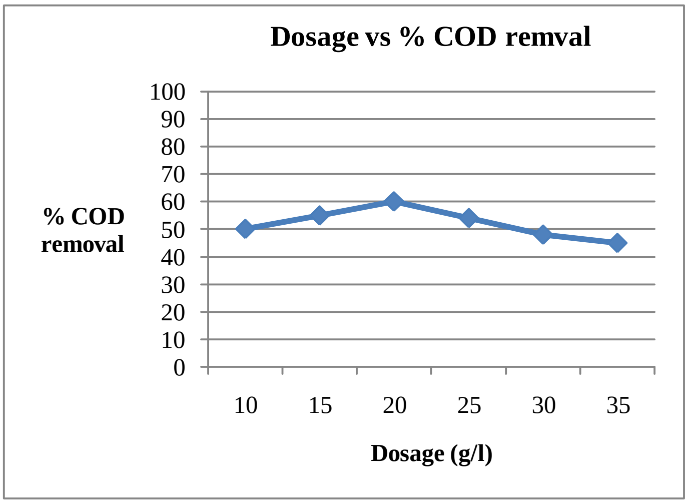

Chart 7: Dosagevs % COD removal (Alum coagulant)

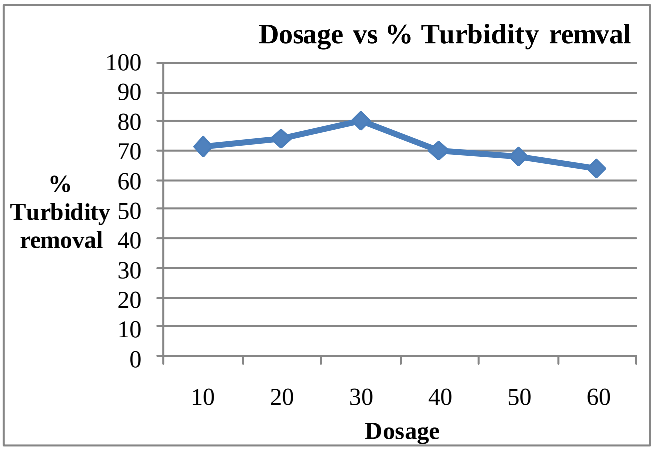

Chart 8: Dosagevs % Turbidity removal (Alum coagulant)

4. CONCLUSION

From the above study, the following conclusions were obtained.

CaOH coagulant:

1. It shows that the maximum COD removal at pH 6 and that resulted in a 50% reduction from the initial value.
2. It may be noted that maximum turbidity removal (95 %) occurred at pH 10
3. The COD removal was increased up to 80 % at 30 g/L coagulant dose, after this dose the COD removal was constant.
4. The maximum turbidity removal 40 % was also achieved at 50 g/L of coagulant dose

Alum Coagulant:

I. It shows that the maximum COD removal, 38% reduction from the initial value, at pH 8.

II. Here also, maximum turbidity removal (98%) occurred at pH 6

III. In case of alum, the maximum COD removal of 60% resulted at 20 g/L coagulant dose.

IV. The maximum turbidity removal (80%) achieved at 30 g/L dosage.

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