

Comparative Evaluation of Fuller's Earth & China Clay for the Control of leachate Generated From Municipal Solid Waste

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ABSTRACT:- Leachate generation is a major problem for municipal solid waste (MSW) landfills and causes significant threat to surface water and groundwater. Leachate is defined as a liquid, which passes through a landfill and has extracted dissolved and suspended matter from it. Leachate is the outcome from precipitation entering the landfill from moisture that exists in the waste when it is composed. A comparative evaluation between the china clay and fullers earth is performed to control the leachate, generated from the solid waste.

Permeability and type of bonding are the major factors, which are affecting the water movement from surface to below the clay liners. In this study the effect of china clay and fuller's earth clay are compared to control the leachate from MSW.

Keywords: Leachate, Fuller's Earth, China Clay, MSW, permeability

1. INTRODUCTION

Waste management is one of the major challenges faced by municipality officials, public health engineers and environmentalists in their quest to protect and preserve our environment. The wastes that generate in cities dispose their wastes in different ways. Historically waste is disposed of unscientifically leading to the development of many waste dumps around. These general natural anomalies in the ground where trash is disposed of with very little or no environmental regulations. One of the major pollution problems caused by the municipal solid waste landfill leachate can be defined as a liquid that is generated when water or another liquid comes in contact with solid waste. It contains number of dissolved and suspended materials. After municipal solid waste landfill site is closed, landfill will continue to produce contaminated leachate process could last for 30-50 years. Due to increase growth of population and development of the industry, the landfill leachate problem becomes increasingly serious. Leachate has potential to contaminate ground and surface water and threaten human health which migrating from the landfill and contaminates surrounding lands and water. Once the leachate enters the water bodies, it is very difficult and expensive to clean up the contaminated water.

In this, the performance of a landfill clay liner is generally evaluated; the design and maintenance of landfills for waste disposal are the concerns over the last few decades due to increasing awareness towards environment protection issues, such as ground and ground water protection. For last few decades, the landfill liner construction has developed and advanced technology has emerged such as the addition of engineered clays, synthetic lining material and designing of more sophisticated leachate collection systems etc. The main aim of these technology and methods are to improve the landfill liner performances as a hydraulic resistant and to minimize or prevent the migration of landfill leachate into surrounding environment. Clay minerals are available in bulk, these are inexpensive, and are safe materials for environmental applications. Because of their high porosity, surface charge, large specific surface area, and surface functional groups, clay minerals function as adsorbents, filters, flocculates, and carbon stabilizers.

Fullers earth (palygorskite) and china (kaolin) clay is taken for the clay liner. Fuller's earth is any clay material that has the capability to decolorize oil or other liquids without chemical treatment. Fuller's earth typically consists of palygorskite or bentonite. Palygorskite is hydrated Mg-Al silicate material. This mineral actually resembles the amphiboles more than it does clay minerals, but has a special property that smectite lacks - as a drilling fluid, it is stable in salt-water environments. When drilling for offshore oil, conventional drilling mud falls apart in the presence of salt water. Fuller's earth (palygorskite) consists primarily of hydrous aluminum silicates (clay minerals) of varying composition. Common components are montmorillonite, kaolinite and attapulgite. Small amounts of other minerals may be present in fuller's earth deposits, including calcite, dolomite, and quartz. In some localities fuller's earth refers to calcium bentonite, which is altered volcanic ash composed mostly of montmorillonite. Kaolinite is this clay mineral is the weathering product of feldspars. It has a white, powdery appearance. Kaolinite is named after a locality in China called Kaolin, which invented porcelain (known as china) using the local clay mineral. The ceramics industry uses it extensively. Because kaolinite is electrically balanced, its ability of adsorb ions is less than that of other clay minerals.

2. METHODOLOGY AND EXPERIMENTAL SETUP

The sources of wastage form household is around 40-45% in Lucknow, which is the maximum as compared to others as shown in the Fig 1

Source of waste	percentage
Households	40-45
Restaurants	28-30
Market	9-10
Shops & Workshops	7-8
Street Sweeping	7-8
Offices	5-6
Hospitals	3-2
Hotels	1-1.5

Fig 1. Percentage of sources of waste

The movement of leachate, generated from the landfilled solid wastes depends upon site circumstances and landfill design features. It is especially important to plan for leachate control during the development of the landfill rather than after the landfill is constructed, since the control techniques are usually employed beneath the waste. Interrelations between topographical, hydrological, and geological factors must be considered to select the site for maximum natural containment of leachate.

If a landfill site does not have suitable sub-surface hydrology for natural attenuation, the bottom of the landfill is lined with clay or silt, bentonite, kaolinite membrane liners, or other rather impermeable materials. It prevents the movement of leachate into the soil below the landfill. A prime consideration when installing a liner is its effectiveness in preventing leachate movement.

The bonding between the clay layers and permeability is paramount important and major factors affecting the flow of leachate.

The experimental setup is shown in fig. 2. The left side of the container is filled with soil, Middle container is filled with china clay and right container is filled with fuller's earth clay. Three trays are kept below the containers to collect the passing leachate.



Fig 2. Clay containers

Equal amount of water is poured into the containers and kept for two days, then add more water and kept for two more days. The water is absorbed by the soil and clays



Fig 3. Clay containers after five days

500 ml of leachate is added in each container and keep the containers for 2 days and Observations are recorded.

3. RESULTS

It is observed that the leachate is passed through the soil and collected in the tray below the soil container shown in the Fig. 4.



Fig 4. Clay containers after five days

A small amount of leachate is collected in the tray below the fuller's earth container. No leachate is passing through the container, filled with china clay.

There are two major reasons for best performance of china clay. One of them is the unit that is formed by stacking a gibbsite sheet on a silica sheet. These basic units are stacked on top of other to form a lattice structure. The units are bound together by hydrogen bonding. This bond is strong enough to prevent water to pass from the lattice. Thus, kaolinite minerals are stable. The fuller's earth clay units are

bond together with van der waals forces. These forces are weak and water easily enters into the lattice.

The second reason is the permeability of the china clay, which is lower than the fuller's earth. The typical average permeability of china clay is $4.439E-13$ m/s and that of fuller's earth is $2.845E-12$ m/s. Because of low permeability it is not easy to pass the water from the china clay.

4. CONCLUSION

Leachate means any liquid percolated through the deposited waste and emitted from or contained within a landfill. The leachate consists of many different organic and inorganic compounds that may be either dissolved or suspended. They will bring potential pollution issues for groundwater and surface waters in nature. The landfill leachate is a secondary contamination related to landfills. Clay liners are useful to prevent passing of water from ground surface to the inner surface of the earth. depending upon the physical and mechanical properties of the clay liners. China clay is better than the fuller's earth clay in terms of water contents. Mixture of both clays can be used with soil modification to reduce the permeability.

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