Utilization of Red Soil and Processed Fly ash as landfill Liner

Authors: Chetan Toke[1] Ritesh Chumbhale[2] Tanishq Nunse[3] Manish Singh[3] Shubham Bhadarge[5]
Prof. Atul Sonawane (Guide) Prof. Gaurav Ahire (Co-Guide)
Prof. Prashant chavan (HOD- Civil Engineering Department)
[12345] Student- GGSP

Abstract: Red soil was added to class F type of fly ash in the certain proportion to study for its suit-ability as a landfill liner material. Mixtures were compacted to their optimum moisture content (OMC) and maximum dry density (MDD). Landfills must be highly engineered containment systems, designed to minimize the impact of soiled waste on the environment and human health. The design of a liner, in the case of economically developing countries, will vary depending on a number of factors, including the potential of the landfill polluting the land and water environments, the local hydrogeology and meteorology, and the availability of suitable materials and monetary resources. In this paper, Flyash is used as a basic material; the properties of this material are altered by adding red soil to achieve the required properties of a competent material for landfill liners. Tests were conducted on fly ash. The main factor affecting the quality of compacted clay liners/covers is its permeability The appropriate flyash - Red soil mix and the range of compaction parameters was determined that would give the required hydraulic conductivity, strength characteristics and minimum desiccation crack for their use as liner material.

Keywords: landfill liners, flyash, red soil, hydrology and meteorology, hydraulic conducttivity

Introduction

The safe disposal of solid waste materials such as municipal, industrial and hazardous waste has been one of the major environmental problems in recent days. These waste materials are generally placed in a confinement termed as landfill. Landfills are usually provided with layers of nearly impermeable material, called as liner, to prevent contamination of the surrounding soil and under lying groundwater by the leachates generated from these wastes. Hydraulic conductivity is one of the most significant factors affecting the performance of a liner. Due to desiccation, the liner material may shrink and crack resulting in an increase in the hydraulic conductivity of the liner. Similarly, the liner material should have adequate bio diversity to prevent the material from failing the enjoinment to make hazardous waste

Due to their cost effectiveness and large capacity of contaminant attenuation, compacted clay is widely used as a liner at the waste disposal site. In the absence of impermeable natural soils, mixtures of compacted expansive soil, such as betonies, and a locally available soil, such as sand, is used as a landfill liner material. If suitable expansive soils are not available locally, the cost of the project can increase manifold as it has to be imported from elsewhere. In addition to this, sand has become an expensive construction material due to its limited availability. Therefore, it is of paramount importance to research new materials for landfill liner construction without compromising on the primary objective of efficient waste containment

Fly ash is a waste by-product of coal-fired power generating stations which is readily available and need to be disposed of safely. The installed 88 thermal power plants in India had produced around 131.1 million tons of fly ash in the year 2010–2011. Similarly, the power plants in the US produce more than 70 million tons of fly ash annually. Due to the large area of land required for its disposal, the disposal of fly ash is becoming expensive every year. One of the amicable solutions to this problem is the reuse of fly ash for some meaningful applications. The pozzolanic and self-hardening properties of fly ash have naturally made it a very attractive material for use in a variety of construction applications such as fills, concrete, pavements, grouts etc. However, not all the fly ash, which are generally divided into two types namely class C and F possess pozzolanic properties. The class C type of fly ash, which is produced from sub-bituminous coal sources, shows pozzolanic properties in the presence of water, whereas, class F type of fly ash, which is generally produced from bituminous coal, and also the property of red soil is Red soil contains a high percentage of iron content, which is responsible for its color. This soil is deficient in nitrogen, humus, phosphoric acid, magnesium, and lime but fairly rich in potash, with its pH ranging from neutral to acidic. Red soil has better drainage capacity compared to other soils and the soil is porous, fine grained and fertile in nature. Red soils also have higher iron, lime content and aluminum. Red soil is an important soil resource, which bears substantial implication for sustainable development of agriculture and healthy growth of economy. However, the red soil in China has been deteriorating in recent years and facing many threats, such as soil erosion, acidification, and pollution. Among these, contamination of heavy metals, particularly arsenic and cadmium pollution in paddy soils of the red soil regions, has become a major environmental concern. In this paper, we reviewed recent publications on iron redox cycling and its coupling to the fate of heavy metals and metalloids. The most exciting findings on the iron biogeochemistry processes include dissimulator iron reduction, Fe(II) oxidation, and Fe2+-catalyzed recrystallization of iron (hydro)oxides, all of which contribute to the immobilization of heavy metals. Although these findings are mainly based on laboratory experiments, they provide guidance for exploring innovative remediation strategies for controlling pollution of heavy metals in paddy soils of the red soil regions. We also summarized how the iron redox cycling may be affected by other biogeochemical processes or active constituents, such as the nitrogen cycling, the sulfur cycling and hemic substances. It appears that the mechanisms underlying the interactions among these multiple components and processes are not sufficiently understood and may require further studies. Finally, future research needs pertaining to iron redox cycling coupled to the fate of heavy metals are suggested. The results summarized in this review may provide insights for solving the heavy metal pollution of paddy soils in the red soil regions.

Objectives & Problem Statement of Proposed Work

1) Utilization of waste fly ash from thermal power plant

2) Preparing alternate liner for land filling

3) Checking effectiveness of red soil & fly ash and processed fly ash as land fill liner

4) The material that we are using are cost effective

Problem statements:

1) Due to decomposition of solid waste under aerobic and anaerobic condition waste such as leachate is produced which can contaminate the soil and ground water table

2) The liner material such as concrete, geosyntathic polymer, geo textile are expensive and requires skilled supervision

3) Hence to overcome the obove problems new economical liner materials is required

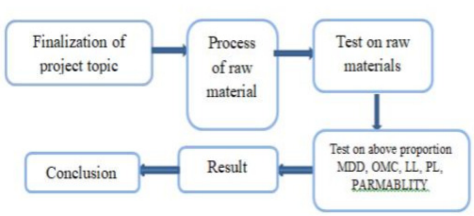
Property of Red soil:

Red soil contains a high percentage of iron content, which is responsible for its color. This soil is deficient in nitrogen, humus, phosphoric acid, magnesium, and lime but fairly rich in potash, with its pH ranging from neutral to acidic.

Property of processed fly ash:

Fly ash is a heterogeneous by-product material produced in the combustion process of coal used in power stations. It is a fine grey coloured powder having spherical glassy particles that rise with the flue gases. As fly ash contains pozzolanic materials components which reach with lime to form cementatious materials.

FLOW CHART OF PROPOSED WORK



Proportion	1	2	3	4
Red soil	100%	50%	70%	90%
fly ash	-	50%	30%	10%

Methodology

In this project we are conducting some test with some of the proportions of red soil and flyash that are mentioned above. [1]Test of (MDD) in this, The determination of maximum dry density and optimum moisture content of the soil is a measure of compaction level of soils. This can be measured by mainly two methods Standard Proctor Compaction Test and Modified Proctor Compaction Test. [2]Test of (OMC) in this, The Optimum moisture content (OMC) or Optimum Water Content (OWC) is the moisture content at which the soil attains maximum dry density. This OMC value is with respect to the specific amount of compaction energy applied to the soil.[3] Plastic limit test,in this the, Plastic Limit is determined by repeatedly remolding a small ball of moist plastic soil and manually rolling it out into a 1/8in thread. A plastic limit roller device can also be used to perform this test. The Plastic Limit is the moisture content at which the thread crumbles before being completely rolled out.[4] Liquid limit in this, The liquid limit is the moisture content at which the groove, formed by a standard tool into the sample of soil taken in the standard cup, closes for 10 mm on being given 25 blows in a standard manner.[5] Permeability test in this, Permeability tests can be performed with the sample from 0% to 100% relative density, as required. After compacting thin layers of the prepared granular soil sample in the permeameter, a special sliding-weight compaction hammer or vibrating tamper provides a higher relative density if required.

Conclusion: Based on the experiments done on red soil with flyash for liner material the test results is observed that when the percentage of flyash increases, consistency properties such as liquid limit, plastic limit and plasticity index are increasing. The Differential Free Swell of the mixture increased with the addition of flyash, resulting as a better sealant. Haudraulic conductivity of red soil- flyash mixture decreased linearly with increased amount of bentonite. Based on model of engineered landfill it is observed that red soil as liner material alone cannot be good material for engineered landfill whereas red soil and flyash mixture is good for liner material for engineered landfill.

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