International Journal of Advance Research in Science and Engineering
Volume No.06, Special Issue No.(01), December 2017
www.ijarse.com
IJARSE
ISSN: 2319-8354

Emerging Geo-Environmental Problems and Their Impact on Soil Behaviour

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I INTRODUCTION

Industrialization brought forth with it the associated problems. The industrial activities generated large quantities of wastes. Part of these wastes in different physical forms such as solids liquids and gases turn as pollutants in due course. Based on the safety level, these wastes can be hazardous or non hazardous.

Wastes can be controlled by different options such as waste reduction at source, resource recovery through separation and recycling, resources recovery through waste processing, waste transformation and environmentally sustainable disposal on land.

Despite all efforts, to minimize waste, and to neutralize it, the requirement for storage or disposal still exists. The most frequently used disposal option for solid waste in the land fill because of its low cost and efficiency. The landfill plays a vital role in the whole waste treatment/disposal process.

The basic philosophy of all engineered landfill should revolve around environmental protection through containment and controlled release, physical compatibility of the final landform to the surroundings, longevity for the design period, appropriateness to the type of waste and cost effectiveness.

The main components of an engineered landfill are a liner system at the base and sides of the landfill which prevent migration of leachate or gas to the surrounding soil, a leachate collection facility which collects and extracts the leachate from within and from the base of land fill and then treats the leachate, a gas control facility which collects and extracts gas from within and from the top of the landfill, a final cover system which enhances surface drainage intercepts infiltrating water and supports surface vegetation.

The final cover system can comprise of multiple layers of soils. Environmental protection Agency (EPA) has laid down norms for the selection of suitable standard liner materials. With regard to the long term satisfactory performance of land fills, the liners covers play a very vital role. The most common land fill liner materials are clayey soils of low permeability, since they satisfy the EPA standards.

Clayey soils pose numerous problems to geotechnical engineers because of their high compressibility and poor shear strength. The high compressibility of clays which leads to large scale volume changes is always a cause of concern to the field engineer. However there are occasions when clayey soils can be utilized such as control of permeability in clay liners, stabilization of bore holes etc. Here the geotechnical engineer is posed with the problem of suppressing the negative aspects of the clayey soils to the minimum while utilizing the positive aspects to the maximum.

II LITERATURE REVIEW

Abraham et al. (2012)[1] described that composite liners are in fact combination of flexible membrane liners (FML) and pure clay.

Acar et al. (2010)[2] pointed out that Leachate from top of the clay liner will percolate down through it at a rate controlled by the hydraulic conductivity of the liner, the head of the leachate on top of the liner and the liner"s total area.

Agarwal et al. (2013)[3] described that with the addition of FML placed directly on top of the clay and sealed up against its upper surface, leachate moving down through a hole or deflect
in the FML does not spread out between FML and the clay liner.

Aiban et al. (2014)[4] highlighted that the composite liner system allows much less leakage than a clay liner alone because the area of flow through the clay liner is much smaller. The lamellar arrangement of the liner materials prevent the direct permeation of the leachate from the top even in case of an accidental leakage.

Saglamer et al. (2012)[5] described that, even though, questions have been raised about clay waste interactions which may degrade clay soils and possibly increase their hydraulic conductivity, current EPA guidance allow single and double liners of compacted clays across sections to be installed at hazardous waste disposal sites.

Awad et al. (2012)[6] described that soil liners are preferred because of their low cost, large leachate attenuation capacity and resistance to damage and puncture.

Anand et al. (2010)[7] highlighted that clays also possess sorptive and or attenuative capacity and reduce the concentration of contaminants in leachate. This capacity relies on chemical composition and on mass of the liner.

Ansari et al. (2012)[8] described that soils generally have large capacity to sorbs materials of different types, but some soils do not provide an impermeable boundary. These properties can be enhanced by the use of soil additives.

Pepper et al. (2012)[9] described that of the two types of liners viz. soil and synthetic liners commonly used in waste disposal facilities, soil liners seems to be indicative of the extensive use of clay soils as pollution barriers.

Vipulanandan et al. (2011)[10] highlighted that for gravel contents less than 60%, it has the beneficial effects of slightly lowering the hydraulic conductivity of the kaolinite and simultaneous broadening of the range of molding water content by which minimal hydraulic conductivity was achieved.

Vipulanandan et al. (2013)[11] highlighted that the objective of compaction is to remould clods of the soil into a homogeneous mass that is free of large continuous inter-clod voids. The water content of the soil, method of compaction and compactive effort has major influence on the hydraulic conductivity of compacted soil liners.

Gustsfson et al. (2012)[12] described that soil liners have traditionally been compacted in the field to a minimum dry weight over a specified range in water content. With soil liners, hydraulic conductivity is usually paramount importance. Nazarian et al. (2012)[13] described that presented data to show that the water content – dry density criterion for compacted soil liners can be formulated in a manner that is different from the currently used approach in which the adequate strength and permissible compressibility is ensured. Selby et al. (2011)[14] described that the approach recommended by them is based on defining water content – dry density requirements for a broad, but representative, range of compactive energy and relating those requirements to hydraulic conductivity.

Hayden et al. (2013)[15] mentioned that grouting is very popular but at one time, it was supposed to be very mysterious task in civil engineering. For the grouting to be more effective, needs a lot of skill, understanding and perception.

Bussey et al. (2012)[16] described that the history of grouting is very old. It came into existence some 200 years ago. It was supposed to be an art for the improvement.

Chapuis et al. (2013)[17] described that soil method was used very limited. Then many research and investigations were performed and the concept of grouting came into existence very broadly. Now, this method is used very extensively. Most of the civil activities use this method.

Saha et al. (2010)[18] described that the properties of soil are increased by mixing grout in it. In fact, the grout is injected into the empty spares of the soil so that the improvement in the soil can be made to use it for the engineering purposes. Clarke et al. (2011)[19] described that grouting has many applications like it decreases the permeability of soil, controls the erosion of the soil, increases the strength of the material, fulfills the empty holes of the rock and soil, avoids the re existence of voids.

Clough et al. (2012)[20] highlighted that grout is inserted into the soil in that sufficient amount that it can easily fill the void space of the soil or until the maximum desired pressure is observed.

III OBJECTIVES OF THE STUDY

The objectives of the current research work are as follows:

1. To study the behavior of soil.
2. To study the geo-environmental problems.
3. To study the impact of geo-environmental problems on the behavior of soil.

IV RESEARCH METHODOLOGY

The grouting technique typically depends on the properties of materials used. Type of grout materials, medium, mix design and appropriate grouting method, these are some basic factors on which the success of grouting depends. Mechanical permeance, penetrability and strength are considered as some important mechanical properties that a grout should have. Geotechnical application also plays a very important part in the selection of the grout.

The technique of grouting has a wide range of application in real life as well as it is used to fill fissures in rock. The main objective of the current research work is to control the properties of grout materials and describe the methods to reduce the permeability of the sand so that it can be used for the construction work. Wide range of grouting materials is available in the field of grouting, ranging from suspension grouts to solution grouts.

In this current research work, we have concentrated on the suspension grouts. Granular was selected to be grouted. The details of the grouting materials, grouting medium, grouting procedure and testing methods are presented in the following sections.

The selection of proper grouting materials depends upon the type of granular medium and the purpose of grouting. There are many materials which can be used to grout a granular medium. Some of these materials used are lime, cement, bentonite and clay. In the present study sand was used as the grouting medium and cement (with or without admixtures), lime and clay were used as the grouting materials.

V TENTATIVE CHAPTER SCHEME

The tentative chapterization of the current research work is as follows:

Chapter I Introduction, in this chapter, we will describe about the soil problems.

Chapter II Review of Related Literature, in this chapter, we will highlight some main points of the previous work done on the related work. We will take help from several books and reports to highlight the objective of the research work.

Chapter III Research Methodology, in this chapter, we will describe about the techniques that will help us in getting the final aim of the research work.

Chapter IV Data Analysis, in this chapter, we will analyze the data obtained from the research work. It will be observed that how well the data obtained satisfies the objectives of the research work.

Chapter V Conclusion, in this chapter, we will summarize all the research work done and conclusion will be pointed out from the data gathered. Also, scope of the study in the future will be pointed out here.

VI . EXPECTED OUTCOMES OF THE RESEARCH WORK

In this research work, the observation got from the various tests like permeability test done on several sand fractions like fine, medium sand at a weight of 11.5 kN/m^3. It is observed that the size of soil particles and permeability are directly proportional to each other i.e. if the permeability goes on increasing as the grain size of

soil particle increases. Similarly, the permeability goes on decreasing as the grain size of soil particle decreases. Kenai et al.(2006) highlighted the impact of compaction methods on mechanical properties of the soil to be grouted. He described that the level of permeability decreases with the decrease in large voids by cement particles. Thus, it proves good for the soil to get some kind of treatment by the cement
particles as the mechanical properties of the soil tend to increase by using the cement.

Also, the other advantages of using cement is that the permeability of the soil reduces and hence, durability increases.

Other method of decreasing the permeability of the soil is to reduce the water-cement ratio of the grout and enhancing the time of curing and hence, the strength can also be increased by using this technique.

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