CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

"Bentonite" refers to any material that is primarily composed of the smectite group of minerals and whose physical properties are dictated by the smectite minerals (Grim and Guven, 1978). Characteristic of smectite minerals include large cation-exchange capacity, large specific surface area, high swelling potential, and low hydraulic conductivity to water. Bentonite is widely used for the following hydraulic containment applications: (1) as a soil amendment for compacted as a soil barriers in landfill liner and cover systems (Alther 1982, 1987; Garlanger et al., 1987; Cowland and Leung, 1991; Haug and Wong, 1992; Kenny et al., 1992; Chapuis et al, 1992; Daniel, 1993; O'Sadnick et al., 1995); (2) as a low-hydraulic-conductivity component in geosynthetics clay liners; and (3) in vertical cutoff walls that are backfilled with soil bentonite or cement bentonite.

Sand and Bentonite Mixtures was very advantage in impervious structure projects, such as, dam core, and landfill. Barriers with a low hydraulic conductivity are used as part of waste contaminant system to prevent ground water contamination. Sand-bentonite mixtures has been increasing interest in the use as the mineral impervious layer in both landfill liners and vertical cut-off walls, partly because they are less susceptible to frost damage and desiccation cracking than compacted clay. Amount of bentonite required for each project depend on its application and advantage (See details in Chapter 2). 5% to 25% of bentonite content has chosen to be mixing ratio.

However, many factors of mixture have investigated, such as hydraulic conductivity, maximum dry density, and swelling pressure to respect with design requirements. Homogeneous of mixtures and compaction process is important factors during construction, quality control at site must prepare. Hydraulic conductivity test in compacted mixture was used to checked ability of mixture and quality of construction

process. There are many methods to investigate in situ permeability such as infiltrometer box, porous piezometer (Wang and Benson, 1995; Kraus et al., 1997; Bjerrum et al., 1972).

For radionuclides waste site, tunnel, and slurry trenches there is hydraulic jet grouting during construction process (Russi and Cavalli, 1984; Gossow, 1985; Nilsson, 1985). High hydraulic pressure during hydraulic conductivity or hydraulic jet grout could cause hydraulic fracturing in impervious mixture layer.

In sand-clay mixture, detachment of fine particles, as well as hydraulic fracture, may occur. A great deal of researches has explored the mechanism of such erosion (Arulanandan et al., 1975, Sherard, 1976, Khilar et al., 1985, Sharma et al., 1992 and Reddi et al., 1997). It has been found that erosion is severe when the hydraulic pressure exceeds a certain level; the critical shear stress.

The hydraulic fracture in soil has been studied, because the problem is to prevent them from happening. However, they are useful in engineering projects such as injection, grout, permeability testing, deep-well injection, core dam construction. But little is known about the physical appearance and mechanical behaviour of a hydraulic fracture in soil.

This study aimed to explore the possibility of hydraulic fracture formation in the compacted sand-bentonite mixture. Studied of hydraulic fracturing in sand-bentonite mixture under controlled conditions in the laboratory were investigated. A laboratory model test was set up to examine the lateral pressure resistance of the sand bentonite mixture. The sand bentonite mixture was chosen due to its wide application to hydraulic barriers. A theoretical analysis based on observations from hydraulic fracture test was developed to predict breakthrough pressure in sand-bentonite mixture.

1.2 OBJECTIVES

Main objectives of this study, to know more about engineering properties of compacted sand – bentonite mixture by use Thailand Na bentonite product, and risk case about hydraulic fracture in sand-bentonite mixture which can occur by any engineering process such as field permeability test, hydraulic jet grouting. The objectives can list as following;

1. Determine the engineering properties of sand, bentonite, and sand-bentonite mixtures, such as, hydraulic conductivity, shear resistance, maximum dry density, optimum moisture content, unit weight, grain size distribution.
2. Determine the lateral hydraulic resistance of sand-bentonite mixtures on 2 planes (horizontal and vertical plane) beneath over burden stress of 100, 200, and 300kPa. Tested ratios are 5, 10, 15, and 20 percent by weight of sand.
3. Determine the effect of engineering properties of sand-bentonite mixtures caused from hydraulic fracture, such as, hydraulic conductivity, and lateral hydraulic resistance.
4. Make Mathematical modeled of fractured induced and effect of hydraulic fractured.

1.3 LIMITATIONS

Scope of this research, is to study mixtures ratio which ever used in compacted liner of landfill. Then the mixtures ratio has consider about useful properties and cost of mixtures. However, limitation of hydraulic fracture test apparatus controls scope of overburden stress.

1. Study the basic engineering properties of sand, bentonite, and Sand-Bentonite mixtures, such as, hydraulic conductivity, shear resistance, maximum dry density, optimum moisture content, unit weight, grain distribution.
2. Determine the lateral hydraulic resistance of Sand-Bentonite mixtures on 2 planes (horizontal and vertical plane) beneath over burden stress of 100, 200, and 300kPa. Tested ratios are 5, 10, 15, and 20 percent by weight of sand. Table 1.1 show list of samples.
3. Determine the differential of engineering properties of Sand-Bentonite mixtures caused from hydraulic fracture, such as, hydraulic conductivity property, and lateral hydraulic resistance property.

1.4 ADVANTAGES

Compacted impervious liner of landfill is important, leached in landfill can contaminant in subsoil and groundwater. Many risks of impervious mixture layer could occur from water pressure such as erosion, and hydraulic fracture. Study of hydraulic fracture resistance of mixture show the risk value of water pressure may operate in construction site. Advantage of this research can list as following;

1. Engineering properties of useable sand-bentonite mixtures can apply for compacted impervious layer of landfill.
2. Proportion of sand and bentonite will be known for good design of liner properties.
3. Apply of mixtures can be useful in impervious structure construction, and more interesting in Thailand.
4. To be guide of field hydraulic conductivity test of this compacted mixtures, must not use water pressure more than its breakthrough pressure resistance.
5. Control any other high pressure construction near compacted area.