CHAPTER 1

INTRODUCTION

1.1 Background of study

Soft clay soils are type of soil that composed of very fine particles and can impedes the flow of water. Clay soils are commonly stiff in dry state but heavy and sticky when saturated with water. As such, clay soil tends to swell when wet and tends to shrinks and settles when dry. Soft clays also characterized as low bearing capacity and high compressibility soil. The reduction in strength and stiffness of soft clays causes bearing capacity failure and excessive settlement, leading to severe damage to buildings and foundations (Sakr *et al*., 2008).

Soft clay soil normally distributed over the seaside. Especially very soft ground composed of marine clayey deposit which is mostly distributed over the west and south east coast part of Malaysia, is considerably affected by the numerous factors such as components of the deposit, particle size distribution, the shape of the particles, properties of the absorbed ion and pore water, tidal current, temperature and so on (Yoon *et al*., 2006).

The deep mixing method is today accepted world-wide as a ground improvement technology in order to improve the permeability, strength and deformation properties of the soil. This method mainly depends on increasing the stiffness of natural soil by adding a strengthening admixture material such as lime. The stabilized soil, often produced by using rotating mixing tools in column shapes having a higher strength than the virgin soil. Experiences have been positive and the method has a great development potential. The method is undergoing a rapid development, particularly about its applicability, cost effectiveness and export potential (Larsson, 2003).

Dry bottom ash is part of the unburned material in a furnace or incinerator. It is a porous, glassy, dark grey material with a grain size similar to that of sand or gravelly sand

Although similar to natural fine aggregate, bottom ash is lighter and more brittle and has a greater resemblance to cement clinker.

1.2 Problem statement

Soft clay soil is one of the problematic soils that face by many geotechnical engineers in the field. This is due to soft clay soils owe their characteristics to the presence of swelling clay minerals thus pose a significant hazard to foundations for light structures. Due to this characteristic, the soils will experience significant volume change associated with changes in water contents. As the clay particles can absorb and release water, therefore the soils tend to expand and contract. Soft clay soil then exerts uplift pressures that cause irregular inclination of superstructures and severe damage to infrastructures due to low shear strength and high compressibility of the soil. Building structures on soft clay soil can cause problems when it comes to land shifting and settlement, particularly where sunken foundations are concerned. Over time, this can lead to foundations that are cracked, lopsided or, in very bad cases, actually collapsed. Therefore, geotechnical engineers must consider various precautions to minimize the risk of construction on expansive soils. Next is about coal bottom ash (CBA) in Malaysia as it is classified under the Scheduled Waste (SW 104) Environmental Quality Act, consisting of all dust, slag or ash containing metallic elements such as mercury, arsenic, lead etc except for slag from iron and steel. If eaten, drunk or inhaled, these toxicants can cause cancer and nervous system impacts such as cognitive deficits, developmental delays and behavioral problems. Tanjung Bin power plant is a coal-fired thermal power plant which located in Mukim Serkat, Daerah Pontian, Johor, Malaysia. This power plant able to produce 180 tons of bottom ash and 1620 tons of fly ash per day from 18000 tons of coal burning. However, recycling of coal combustion byproducts has developed and evolved over the past few decades. As many geotechnical engineers realize that coal combustion product can be used as an alternative geotechnical material, this study performed series of composite discharge capacity tests to estimate applicability of coal combustion product as a replacement for the cement when construct lime bottom ash column.

1.3 Objective of study

This study is to determine the strength of soft clay reinforced with single encapsulated lime bottom ash column. Thus, the objectives of this study as follow;

1. To determine physical properties of kaolin clay, lime and bottom ash samples.

2. To determine undrained shear strength of soft clay reinforced with various dimension of single lime bottom ash column.

3. To establish correlations relating undrained shear strength with various dimensions.

1.4 Scope of study

The main objective of this research is to investigate soft soil improvement using single encapsulated lime bottom ash column. Lime and bottom ash are used as stabilizing agent in this study as they able to stabilize subgrades as well as improvement of bearing capacity of foundations in the form of lime bottom ash column. The use of lime and bottom ash for soft soils stabilization is not new and has been studied by many researches.

In this research, a batch of lime, bottom ash and kaolin grade S300 as a sample of soft clay are prepared in laboratory to study soil compressibility parameter after reinforced with single encapsulated lime bottom ash column. The experiments were carried out on soil after installed column with different diameter and different slenderness ratio. The column was surrounded by soft soil in cylindrical tanks of 100mm height, and diameter 50 mm. Hence, the tests were conducted with two different diameters of 10 mm and 16mm which corresponds to three different heights of 60mm, 80mm and 100mm.

The bottom ash and kaolin had been tested to determine their characteristics by laboratory tests in accordance with British Standard (BS) and/or the American Society of Testing Material (ASTM). For lime, many standard tests have been developed by the American Society for Testing and Materials (ASTM) (ASTM 2003a, 2003b. 2003c).

The physical, mechanical, and morphological properties of bottom ash were determined from the following laboratory tests:

For physical properties of kaolin and lime, the following tests will be conducted;

1. Atterberg limit test

2. Specific gravity test