

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

During the industrial process of titanium dioxide (TiO₂) production, a waste product Fe (OH)₂ is produced (Gazque *et al.*, 2009). The red colour from iron caused this waste product to be named as 'Red' Gypsum (RG) (Fauziah *et al.*, 1996). In Malaysia, RG produced is around 341000 tonnes per year, which is quite a large amount of volume (Pau, 2013). Almost all of the waste product, RG, will be disposed to the landfill. (Singh *et al.*, 2004). Recently, many researches have been done on RG and the researchers found that RG is a very useful waste in geotechnical field. By using RG in an effective way, landfill problem can be reduced as well as make benefit on RG. Hence, firstly, properties of RG were investigated. The properties of RG can be similar to that of clay, thus may be considered as a substitute material for geotechnical applications.

Soil suction characteristic curve (SWCC) is a fundamental property in soil physics and soil mechanics (Heshmati and Motahari, 2012). It defines the relationship between moisture content and soil suction. In fact, SWCC contains a lot of importance information as shear strength and permeability of soil are related to this curve. Hence, it also function as a tool to estimate the unsaturated soil properties such as diffusivity and shear strength of soil (Fredlund *et al.*, 2011). In this study, the desorption characteristic of RG was investigated and the drying suction-water content SWCC was established.

1.2 PROBLEM STATEMENT

In Malaysia, the annual production of titanium dioxide is around 61000 tonnes, while the RG produced is 341000 tonnes per year and this waste product will be disposed to a landfill with the area of approximately 11084 acres. It means that the production of the waste is more than 5 times of the titanium dioxide produced. This indicates that the waste problem is quite serious and cannot be neglected. Although the landfill tax in Malaysia is free, but the improper disposal of Red Gypsum will give an impacts to our environment. In fact, there are some heavy metals found in RG which may cause pollution. The iron compounds in RG may irritating to the respiratory tract and eyes, vomiting, diarrhoea, pink urine, liver damage and kidney damage. Other than that, the negative effect of landfill include hydrological effects which will affect the marine life. The iron compounds may have their effect to the wildlife that comes into contact with them. Therefore, it will cause the landfill problems in the future very soon not only due to its amount yet the pollution problems. In this case, red gypsum should be investigated in order to find out more applications of it to this world other than just dispose it at landfill. Other than that, the drying characteristic of Red Gypsum has not yet been explored by the researchers. So, this investigation about Red Gypsum is needed.

1.3 RESEARCH OBJECTIVES

The aim of this research is to investigate the water desorption ability of red gypsum.

1.3.1 To establish the drying suction-water content soil- water characteristic curve.

1.4 SCOPE OF STUDY

In this study, Red Gypsum from Tioxide (Malaysia) Sdn. Bhd. in Kemaman, Terengganu was considered. Samples were taken from the site and transported back to the laboratory in seal plastic containers. Several tests were carried out in Soil and Geotechnical Laboratory in University Malaysia Pahang. The variables involved in this study were gravimetric water content and soil suction. The soil-water characteristic curve that being drawn is only the drying curve and there are only 2 techniques were used in order to obtain the relevant data, which included vapour equilibrium technique and osmotic technique. For these 2 techniques, the initial water content of the soil samples is 1.2 times of its liquid limit. The suctions applied ranged from 0.23 to 111.77 MPa.

1.5 SIGNIFICANCE OF PROPOSED RESEARCH

This study enables people to understand RG much deeper hence it bring benefits to research purpose. Some estimations (for example, compressibility, permeability, shear strength and volume change behaviour of red gypsum) can be done from the drying SWCC and the result of this study can be used for future researches to give the researchers a clearer information about Red Gypsum.