CHAPTER 3
STABILISATION OF MARINE CLAY USING BIOMASS SILICA-RUBBER CHIPS MIXTURE

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3.1 INTRODUCTION

Marine clay can be found widely in the ocean bed and onshore as well. This situation differs in the properties of marine clay from moist soil and dry soil. Marine clay is microcrystalline in nature and clay minerals like chlorite, kaolinite and illite and non-clay minerals like quartz and feldspar are present in the soil (Basack & Purkayastha, 2009). Malaysian onshore is covered by large areas of marine clay, in particular, the currently undergoing West Coast Expressway project is aligned through a few types of soft soils where the major soil type is marine clay, it is one of the problematic soft soils and should be pre-treated to enhance the usability and serviceability of the constructed highway (Marto et al., 2015). Marine clay is characterised by low permeability and has the capability to attenuate inorganic contaminants (Rahman et al., 2013).

Among the methods used to improve soft soil is soil stabilisation. It is a process of enhancing the existing material properties to the requirement and specifications at the project site (Modarres & Yaser, 2015). The common method in the soft soil improvement process is to remove the soft soil and replace it with a stronger and good material. However, the high cost of replacement incurred alerted highway agencies to explore alternative methods of highway construction on soft subgrades (Senol et al., 2006). One considered economical soft soil stabilisation method is the chemically stabilised method (Amalina, 2016; Nicholson, 2015; Senol et al., 2006). Researchers such as Vichan et al. (2013) and Wang (2015) had studied the use of biomass as a stabilising chemical in enhancing marine clay properties. While other researchers (Mokhtar et al., 2007), had studied the combination of chemical and rubber chips in stabilising soft soil.

Rubber chips are waste products that could easily be obtained from the rubber industry. Figure 3.1 shows the consumption of rubber in the world. There are numerous researchers (Ayothiraman & Meena, 2011; Baleshwar & Valliapan, 2011; Das & Baleshwar, 2013) showed the possibility of utilisation of rubber chips in various different civil engineering applications.

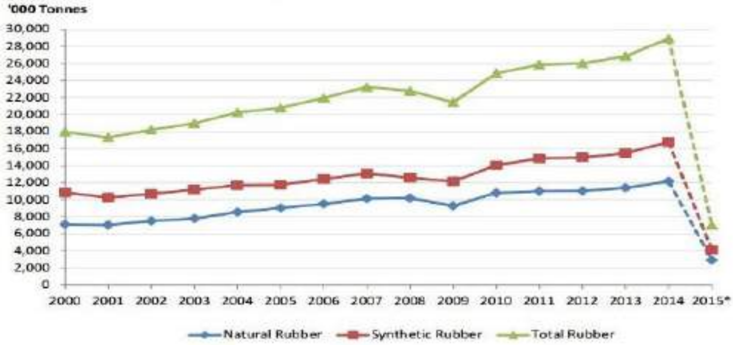

Figure 3.1 World rubber consumption, 2000–2015 (Source: Natural rubber statistics, 2015)

While based on the previous research carried out by Latifi et al. (2013), it was identified that the biomass silica chemical additives of SH85 could improve the soil characteristics of marine clay significantly. Hence, it was hypothesised that the combination of chemical-rubber chip mixtures is, therefore, a more effective soil stabilisation agent. Besides investigating the usability of chemical-rubber chips mixtures as the stabilising agent in improving the soil characteristics of marine clay from the two-engineering perspective of the strength and the compressibility, this chapter also aims to compare the results of unconfined compressive strength (UCS) for treated clay samples using two methods (SH85-RC and SH85 only). In this study, rubber had been cut into small pieces (passing 2 mm sieve size) to produce rubber chips, so that side effects could be prevented (Mokhtar et al., 2007).

3.2 PROBLEMS FORMULATION

This section explain study conducted on soil samples taken from Teluk Intan, Perak, Malaysia. The samples were characterised and further investigated through soil testing to assess the improvements achieved during the process.

3.2.1 Material Selection and Characterisation

The marine clay soils used in this study had been sampled and brought from Teluk Intan, Perak, which were taken at 1.2m to 1.5m depth. All tests had been carried out at the Geotechnical Laboratory, Faculty of Civil Engineering, Universiti Teknologi Malaysia. The results of the soil properties are shown in Table 3.1.

Table 3.1 The properties of marine clay of Teluk Intan, Perak

Properties	Amalina and Rahman (2016)	This Study
Liquid Limit	78%	78%
Plastic Limit	46%	47%
Plasticity Index	32%	31%
Specific Gravity	2.63%	2.5%
Loss of Ignition	1.2%	–
USCS Classification	OH	MH
Standard Proctor Compaction: Maximum dry density (MDD)	–	1.21
Optimum moisture content (OMC) (Mg/m^3)	–	40%