Journal of Engineering Science and Technology
Vol. 19, No. 1 (2024) 186 - 206

STABILIZING REINFORCED PEAT USING CALCIUM-BASED ADDITIVE (SH85)

NORAIDA RAZALI,
NORAZZLINA M. SA'DON*, ABDUL RAZAK ABDUL KARIM

Faculty of Engineering, Universiti Malaysia Sarawak (UNIMAS),
94300, Kota Samarahan, Sarawak, Malaysia
*Corresponding Author: msazzlin@unimas.my

Abstract

Due to its low shear strength, high compressibility, and bearing capacity, peat is classified as problematic soil and has become a major issue in construction development. This peaty soil presented geotechnical challenges due to its instability and rapid rate of settlement. In this study, shredded rubber crumb (RC) was added to peat (Pt) extract from Kota Samarahan, Sarawak, Malaysia, at regulated percentages of 5%, 10%, and 15%. Cement (C) that act as a binder added at a constant percentage of 5% with 3% to 6% powdered calcium-based resin (SH-85) that serve as an additive. The reinforced peat was prepared at the optimum moisture content for all design mix and cured for 7, 28, and 56 days at room temperature before tested for unconfined compressive strength (UCS) test. California bearing ratio (CBR) test specimens were cured for 7 and 28 days before the test was conducted. The findings indicate that UCS of 398.9 kPa was reached with the design mix of Pt+5%C+10%RC+3%SH-85 over a 7-days curing period. This was approximately 35 times higher than the strength of untreated soil. Whereas the maximum strength was 513.3 kPa for soil mixed with 5%C+15%RC+6%SH-85 after 56 days of curing. Results of the CBR test shows that the design mix of Pt+5%C+5%RC+3%SH-85, exhibit the highest strength of the reinforced peat which is 28.3% at 28-days curing period. It exceeds the minimum CBR value requirement between 5% and 12% stated by Public Works Department (PWD), Malaysia. This study also analysed the microstructure of the treated peat soil. Images taken by scanning electron microscopy (SEM) shows that the voids in treated peat have been significantly reduced and occupied by the new component formed by the interaction of peat with SH-85 and cement. This resulted in a continuous soil fabric, which produced denser and stronger soil. The results of the laboratory tests showed that the treated peat soil increases soil shear strength and load-bearing capacity. Therefore, it is recommended that the stabilized peat can be used as a subgrade layers, as the addition of SH-85 and shredded rubber crumb improve peat engineering properties.

Keywords: Peat stabilization, Powdered resin, Rubber crumb, Scrap tire, Strength enhancement

1. Introduction

Peat is categorized as one of the soft soils and its high-water content, high compressibility, and low shear strength are recognized by various researchers [1-3]. Research conducted by Khing [4] and Rahgozar and Saberian [5] also stated its high compressibility characteristic. Owing to these poor physical characteristics, various researchers agreed that peat soils are not suitable for the foundation of any engineering structure [6-9]. This is due to the soil's behaviour that also leads to significant failures, such as foundation instability and excessive settlement. As a result of the aforementioned issues, it was evident that peat soil requires significant improvement prior to construction.

In Malaysia, peat covers an important region, especially in the land of Sarawak. Peat soil covered about 8% of the organic soil which is about 3 million hectares in Malaysia making it one of the major soil groups in the country [10, 11]. Sarawak has the largest peat area in the country, constituting 13% of the state and covering approximately 16,500 km^2 of the total land area [12, 13]. A study conducted by M. Sa'don et al. [14] has reported that 90% of peat in Sarawak is categorized as deep peat that is more than 1.5 meters and can be found mostly in low-lying areas. The depth of peat is surprisingly exceeding 10 meters and the peat layer depth was found increases from the coast towards the inland. It is therefore a very challenging task for Geotechnical engineers when dealing with the existence of the deep peat in Sarawak.

Peat or highly organic soil is one of the biggest challenges in the infrastructure construction in Sarawak. With increased growth in population as well as industrialization, roads and other infrastructure on peat land have become vital. Previous case study by Khing [4] indicate that land sinking is a major issue in Sarawak. The problem requires a regular refilling and repairing to restore any platforms, infrastructure, and structures that infected.

Thus, alternative construction approaches can be used to improve the physical and mechanical geotechnical properties of the original soil through soil stabilization. The process of soil stabilization is to treat the soil in order to maintain construction materials and when the quality soil is unavailable from the project area. Soil stabilization is the process of enhancing a soil's physical and engineering properties such as increase bearing capacity, decrease settlement, and minimize lateral deformation in order to meet predetermined objectives and fulfil the design criteria. Therefore, soil stabilization may be a viable acceptable alternative for enhancing the geotechnical properties in such conditions [15]. In addition, the method is intended to be accessible and environmentally friendly, as it makes use of waste materials such as, fly ash, quarry dust, saw dust, rice husk ash and scrap tyres [16].

The use of a stabilizing agent on a subgrade with weak soil improves strength parameters such as cohesiveness, which results in the embankment being strengthened [17]. This statement was agreed by Khanday et al. [18] as he stated that stabilization of soil improves properties such as strength, permeability, and stiffness. As a result, it is capable of achieving predetermined performance and satisfactory results, particularly in terms of construction for a variety of civil engineering projects on peatland [5, 7]. Therefore, researchers have developed a series of peat stabilization techniques. Sapar et al. [19] reported that many researchers used numerous underlaying mechanisms of soil stability such as mechanical, chemical, biological, and electrical to improve the physical and engineering properties of soil. These methods are basically used to improve a soil's engineering properties. Researchers