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STRENGTH ENHANCEMENT OF REINFORCED PEAT WITH RUBBER WASTE AND MELAMINE UREA FORMALDEHYDE (MUF) RESIN

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Abstract

Peat is classified as a problematic soil due to its low shear strength, low bearing capacity and high compressibility characteristics, which has become a crucial problem in the construction development. The presence of this peaty soil caused difficulties due to its instability and high settlement rate. This paper presents the stabilization of local peat from Kota Samarahan, Sarawak, Malaysia by using two types of processed tire-waste disposal, namely shredded rubber powder (RP) and rubber crumb (RC) at a controlled percentage of 10% of the weight of peat. In this study, liquid Melamine Urea Formaldehyde (MUF) resin was used in different percentages (i.e., 10%, 20%, and 40%) and mixed along with 5% cement to act as a binder. All of the additives were added into the peat at its optimum moisture content. The samples were cured for 7 and 28 days at room temperature e and the Unconfined Compressive Strength (UCS) test and California Bearing Ratio (CBR) test are performed on the reinforced peat stabilized with MUF. Based on the findings, the results show that shredded rubber crumb, rubber powder and MUF polymer resin gradually improved the strength of the reinforced peat samples by increasing the effective contact area between the peat and the additive. The highest UCS strength recorded is 438 kPa with a composition of 10% rubber powder, 40% of MUF polymer resin and 5% cement. According to the CBR test findings, the peat increased strength as a result of the addition of 10% rubber crumb, 40% MUF and 5% cement which is 20.3%for soaked condition. Furthermore, the results show that peat soil may be used as a subgrade. The findings of this study indicate that the use of shredded rubber crumb and rubber powder with addition of MUF can improve the engineering properties of peat soil. Thus, these findings may be applied in the construction of subgrade layer.

Keywords: California bearing ratio (CBR) test, Melamine urea formaldehyde (MUF) resin, Rubber crumb, Rubber powder, Soil stabilization, Unconfined compressive strength (UCS) test.

1. Introduction

Peat is known as a soft soil that is prone to instability due to its high percentages of organic matter and high-water content. In Malaysia, peat covers a major area that is approximately 25,000-30,000 km^2 that roughly occupying 8% of the country total land area [1-3]. Zainorabidin and Wijeyesekera [4] and Melling [5] in their study has stated that Sarawak has the largest peat area in Malaysia that constituting about 13% of the state covering around 16,500 km^2 of the Sarawak land. According to Sa'don et al. [6], about 90% of peat in Sarawak is classified as deep peat which means the depth of the peat layer is more than 1.5 meters and it is increasing from the coastal area towards the inland. However, with population increase and growing urbanization, infrastructure facilities in soft and unstable soil areas, such as peat, are becoming increasingly required.

Most of the reduction in peat land is due to deforestation includes conversion of forestland to farms, ranches, or urban use, especially in Pahang and Sarawak including development for residential purposes in Malaysia. In general, Sarawak peat soil is black to dark brown in colour. The depth of the peat layers in Malaysia ranges from less than 1m to 25m depending on the region. Huat, [1] observed that the depths for peat deposits in Malaysia were varying from 1 m to 20 m. Unfortunately, in Sarawak, about 90% of the peat is classified as deep peat which the depth is more than 1.5 m [6, 7]. Studies by Sa'don et al. [8] stated that in some areas in Sarawak, the peat is exceeding 10 m in depth, and it is mainly in low-lying areas. The hot temperatures of the tropics that up to 32°C are one of the key reasons for the rapid decomposition in peat soil.

Moayedi and Nazir [3], in their study shows that Sarawak peat can be found in a swampy area, coastal area and steeply undulating inland hills. Deep peat and muck soils form the coastal plains, and some distance inland from the coastline occurs at different points along the coast. Peat occurs mostly between the low stretches of the main riverbeds (basin peat) and the poorly drained inner valleys (valley peat). Most of the Sarawak peat land is located in the central region of the state, which contributes about 70% of the division [9]. Samarahan division is also one of the biggest peat areas for deep peat in Sarawak as reported by Davies et al. [10] in Wetland International-Malaysia.

To strengthen the peat soil, soil stabilization is vital. Therefore, it is very important to stabilize the underlying soils to provide an optimum performance of the soil foundation for a better engineering property. Peat soil can be improved through a variety of methods. Several researchers has done researches on stabilizing soft soil [4, 8-10]. According to previous study by Sa'don et al. [6], mechanical improvement and chemical treatment are the two primary methods usually used to develop engineered soil. However, all of these procedures require the use of certain specialised equipment and a skilled worker in order to ensure that the project outcomes are sufficiently satisfactory. Mechanical improvement is a process of enhancing soil resistance by physical processes such as compaction, consolidation, external loading by surcharge, drainage or any other means. Chemical treatment implies inside-soil chemical reactions such as hydration or pozzolanic reactions to produce artificial binding between soil particles [11]. Chemical reactions between soil particles and additives can bind the particles of soil together to form a strong network, resulting in higher-quality soil compared to mechanical and physical methods thus increasing soil strength and durability [11,