9th INDES 2020

LIMITLESS MIND:

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The 9th International Innovation, Invention & Design Competition
INDES2020

17th May – 10th October 2020

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Published by: Department of Research, Industrial Linkages, Community & Alumni Networking (PJIM&A)
Universiti Teknologi MARA, Perak Branch
Bandar Seri Iskandar, 32610, Seri Iskandar
Perak Darul Ridzuan, Malaysia

Perpustakaan Negara Malaysia

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WasTic: FUTURE SOIL STABILISER

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ABSTRACT

Problems of excessive settlement due to consolidation process in compressible soil is inevitable at some construction sites in Malaysia. For earthworks, soil with good bearing capacity and strength is required to support the structural loads. Sometimes, locally available soil is not eligible for construction works. Soil stabilization method is needed to make sure the stability and control of soil settlement of the embankment. Hence, WasTic has been innovated to fulfill the requirement as soil stabilizer compliance. WasTic comprises of waste plastic as the main reinforcement agent for the soil. Several series of experimental works have been carried out to investigate the potential of waste plastic to stabilize the soil consolidation behavior by using Unconfined Compression Test (UCT). WasTic is mixed and compacted with the soil samples at different moisture content. Each moisture level is mixed with different percentage of the plastic waste. Results showed that the required amount of plastic waste is 1.5 % in order to be increase the shear strength of the soil. Utilisation of WasTic as soil stabilizer promotes environmentally friendly approach to the construction industry, thus helps in creating a sustainable development in the scope of civil engineering practices.

Keywords: soil stabilizer, soil settlement, waste plastic, fly ash

1. INTRODUCTION

Compressible soil is defined as low in shear strength and susceptible to severe settlement problems. Soil improvement is usually carried out to resist shear stresses, by enhancing the soil interparticle friction at the contact surface. In current practices, three soil improvement techniques methods are available; which are physical, mechanical and chemical methods. The physical method is widely used and very practical with high-level technology however they require a very high construction cost. The mechanical method by using discrete fibrous material could alter the mechanical characteristics of the soil. The chemical method utilizes chemical additive to improve the soil strength by altering the bonding properties between the particles, however extra care needs to be considered whenever environmental issue is under consideration.

Mechanical means by using discrete fiber reinforcement such as plastic waste offers several advantages because it is simple, versatile and safe [1-3]. The plastic waste is simply added and mixed with soil in random distribution planes. Randomly distributed fibers will constrain the potential failure planes that can develop in the parallel direction like in the conventional technique. This technique is based on the principle of friction, in which the soil-fiber composite will be compacted thus the strength will increase as the contact surface between soil-fiber increases [4]. From previous reports, there is very few or none of them reporting on the effect of moisture condition with respect to the optimum moisture condition (OMC) of the soil. OMC reflects the moisture level that will be made as reference for field application. Therefore, this paper aims to investigate the effect variation of moisture condition with different percentage of waste plastic (WasTic) to the shear strength of the soil.

2. MATERIAL AND METHOD

The soil sample used in this study was collected at Simpang Empat, Kedah, Malaysia from a depth of 1 to 1.5 meters below the ground surface. The waste plastic was easily obtained and penny less. The plastic waste (WasTic) was cut into 25 mm to ease mixing and standardisation process so that friction at the surface contact can be developed well. The physical property tests were carried out to identify the basic soil properties. The Standard Proctor test was conducted to determine the maximum dry density (MDD) and optimum moisture content (OMC). Three different moisture conditions are used i.e. optimum moisture (20.75%), dry of optimum (18.75%) and wet of optimum (22.75%). The percentage of waste plastic fiber used was 0.5%, 1.0%, 1.5% and 2.0%. The Unconfined Compressive test (UCT) was carried out after the prepared sample reached the homogenisation in moisture at about 24 hours. The samples are placed in load frame machine driven strain rate controlled at 1.2 mm/min until failure take part.

3. RESULTS AND DISCUSSION

Herewith, the observed Unconfined Compressive Stress (UCS) is thought to be the maximum shear stress necessary to break the bonds between soil particles along the failure plane. As depicted in Figure 1 (a-c), the peak strength increased as the amount of plastic waste added. At dry of optimum moisture, the maximum strength is reached when the amount of plastic waste (WasTic) is 1.0%. At optimum of moisture, the required amount to mobilise the shear strength is 1.5%. At wet of optimum moisture, 1.5% of the plastic fibre is needed to attain the highest shear strength. The development of interfacial force and interlock between soil and fibres in the compacted soil specimens give an improvement in the friction resistance to force application and consequently, the strength of the fibre reinforced soil increased.

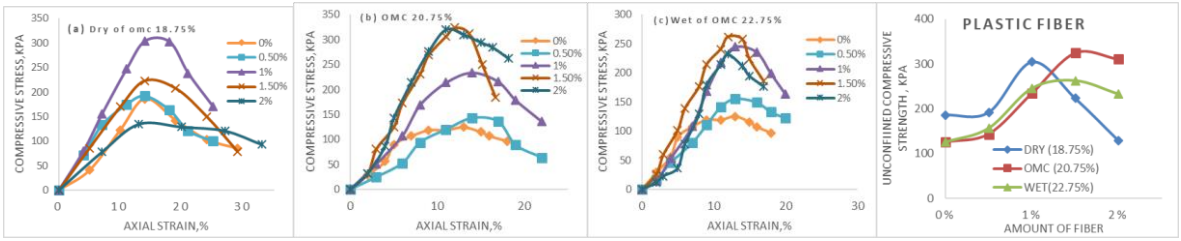

Figure 1. Stress-Strain behavior of soil samples stabilized with plastic

4. CONCLUSION AND RECOMMENDATION

The effect of waste plastic (WasTic) i.e. 1.5% to the strength of the weak soil has been successfully proven by using Unconfined Compressive Strength Test. As the quantity of the fiber increased, the strength was also greater. Soil moisture content directly influenced the performance of the reinforced soil. At dry condition, the suction and cohesion force governed the interfacial force of the soil-fiber matrix. As the soil getting wetter, the development of pore water pressure cause reduction of the interfacial force, hence reducing the shear strength.

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