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Stabilization of Batu Pahat Soft Clay by Combination between TX-85 and SH-85 Stabilizers

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Abstract – *Soft clay often causes difficulty in construction operations with strength and low hardness properties. Soil stabilization is very important in construction to ensure the stability of the strength and stiffness of soil for each building to be built. This study uses chemical stabilization to treat of soft clay in Batu Pahat. This research carried out to study the stabilization of clay in Batu Pahat using additional materials TX-85(liquid) and SH-85(powder). This study aims to determine stabilization of soft clay soil with combination of SH-85 and TH-85 Probase Stabilizers. Soft clay samples were collected from the Research Centre for Soft Soils (RECESS) of UTHM. The result shows that the liquid limit of the soil decreases while plastic limits increase with an increasing of SH-85 and TX-85. As a result, the Plastic Index (PI) reduces with the increment of SH-85(powder) content. The strength gain increase at early 3 days after stabilization and constant increase from 7 to 28 days curing period. The results indicated that the SH-85 is stabilizing agent. Overall, the addition stabilizer of 3%L+ 6%P to 3%L+ 9%P were increase significant and 3%L + 12%P was slight increase for probase stabilizer content. The results of unconfined compressive strength test (UCS) showed that 3%L + 9%P was the optimum amount of this stabilization process for this soil sample. The results data of the basic soil properties and shear strength could also allow a quick and economic alternative in order to design for construction on soft clay soil.*

Keywords: Clay stabilizer, Unconfined compressive strength, Liquid stabilizers

1.0 INTRODUCTION

Development in the construction industry and the rate of increase the human population nowadays requires additional soil surface for construction purposes. Geotechnical engineer it plays an important role in determining like the quality of pore water pressure, soil bearing capacity, soil pressure, either horizontal or vertical, soil sediment and water from the soil. Each execution of the building load carried must have good soil bearing capacity and good physical to secure the strength of the bearing capacity of the soil.

Stabilization of the soil is very important in the construction to ensure the stability of the strength and stiffness of soil for each building to be constructed. The soil stabilizers are

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categorized as traditional and non-traditional [1]. Traditional additives include cement, lime, fly ash, and bituminous materials, while non-traditional additives consist of various combinations such as enzymes, liquid polymers, resins, acids, silicates, Ions, and lignin derivatives.

Nowadays, a variety of supplier and manufactures was developed a new agent to stabilize soil to increase their strength. The new product namely commercial name SH-85 (powder form) and TX-85 (liquid form) was introduced to increase strength of soils. Previous research show that the stabilization using SH-85 increase strength of soil [2-5]. While the TX-85 was also increase strength when used to stabilize soil [4, 6-8].

This study was made to determine the mechanisms of the enhancement of treated clay when stabilize with combination of both stabilizers. The engineering properties of untreated and treated soil, i.e., atterberg limits and Unconfined Compression Strength (UCS) with curing time were monitored.

2.0 METHODOLOGY

2.1 Material

The soil sample is a soft soil collected from the Research Centre of Soft Soil (RECESS) Universiti Tun Hussein Onn Malaysia campus in Johor, Malaysia at a depth of 3 meter. Table 1 shows the physical properties of this soil. The both of stabilizers, SH-85 (powder stabilizer) and TX-85 (liquid stabilizer) was sold by the Probase Manufacture Sdn. Bhd. a local company in Malaysia

Table 1: Physical Properties of Soft Clay [9]

Physical Properties	Values
Liquid Limit, LL (%)	73
Plastic Limit, PL (%)	29.12
Plastic Index, PI (%)	43.88
Maximum Dry Density, MDD (kg/m3)	1343
Optimum Moisture Content, OMC (%)	30

2.2 Preparation of Samples

The physical properties tests were carried out in accordance with (BS 1377: Part 2: 1990: 4) [10]. A Standard proctor compaction test is the process by which the solid particles are packed more closely together, usually by mechanical means, thereby increasing the dry density of the soil. The dry density which can be achieved depends on the degree of compaction applied and on the amount of water present in the soil. Compaction test was used to determine the optimum moisture content (OMC) and maximum dry density (MDD) for the preparation of specimens. All preparation samples were done by controlling the bulk density and moisture content to avoid influences of these variables at the strength of stabilization soil. The samples were prepared by 90% OMC (wet side) and 90% of MDD of natural soils. The method of preparation of samples for these tests, with the quantity of soil and one sample only is required for test and

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it can be used several times after progressively increasing the amount of water. In order to get accurate result, 3 specimens have been prepared for same mixture to get an average data. All specimens at different curing period (0, 3, 7, 14 and 28 days) with different percentages of TX-85 (liquid) with SH-85(powder) probase stabilizer were made. All samples that was enough time period curing were tested using LoadTrac II is defined as the maximum unit axial compressive stress at failure or at 20% strain [11].

The Atterberg limit test have done for classification to recognize the clay is to investigate the influence of moisture content of the behavior soil, especially fine-grained soil after addition of stabilizers. The consistency limit tests were carried out to determine the influence of the stabilizer on the Atterberg limits of the treated and untreated soils. The samples was dried, crushed and sieved passing 425 μm (in accordance with BS) and containing various contents of different stabilizer to establish the influence of the stabilizer on the Atterberg limits.

3.0 RESULTS AND DISCUSSION

Table 2 and Figure 1 shows the Atterberg Limit of Batu Pahat Soft Clay soils after addition of both of stabilizers. The addition of SH-85 and TX-85 stabilizer on the soil affect the properties and strength of the soil. The liquid limit of the soft clay is declined with addition stabilizer of 3% L is 59.79% and began increased gradually is 60.06% after addition stabilizer 3% L + 3%P. As we know, the significant reduction of liquid limit immediately after the addition of SH-85 (powder) is due to the depression of double layer, resulting from the crowding of calcium ion Ca^{2+} concentration on soft clay surface. While, the plastic limit is upward and the higher when reached 44.81% after addition stabilizer 3%L + 3%P compared the liquid limit decreased dramatically after addition stabilizer 3%L and plastic limit begin to decline slowly when reached 41.61% after addition stabilizer 3%L + 6%P.

Table 2: Results for Atterberg limit test with addition of both stabilizers (TX-85 and SH-85)

Soil Samples	PL	LL	PI	Plasticity chart	Remarks
Untreated Soils	29.12	73.00	43.88	High	UT
3%L	34.31	59.79	25.48	High	3L
3%L + 3%P	44.81	60.06	15.25	High	3L3P
3%L + 6%P	41.61	63.08	21.50	High	3L6P
3%L + 9%P	38.82	66.03	27.21	High	3L9P
3%L + 12%P	37.41	68.30	30.89	High	3L12P

*UT= Untreated soils, P=SH-85, L=TX-85

The reduction in liquid limit along with the increased in plastic limit produced a considerable decreased in the plastic index (PI) of soils. The quantity of SH-85 (powder) required to bring changes in plasticity. This shows plasticity chart mixed with TX-85 and SH-85 were high plasticity. The effects of stabilizer on the plasticity of soft clay are due to the calcium ions from stabilizer causing a reduction in plasticity and improve soil friability. This is because of the increase of coagulation and aggregation of the clay mineral particles under the influence of the

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calcium ions. The increase of the optimum moisture content is because of the increased void volume of the specific surface area. This result is the same as the finding previous research.

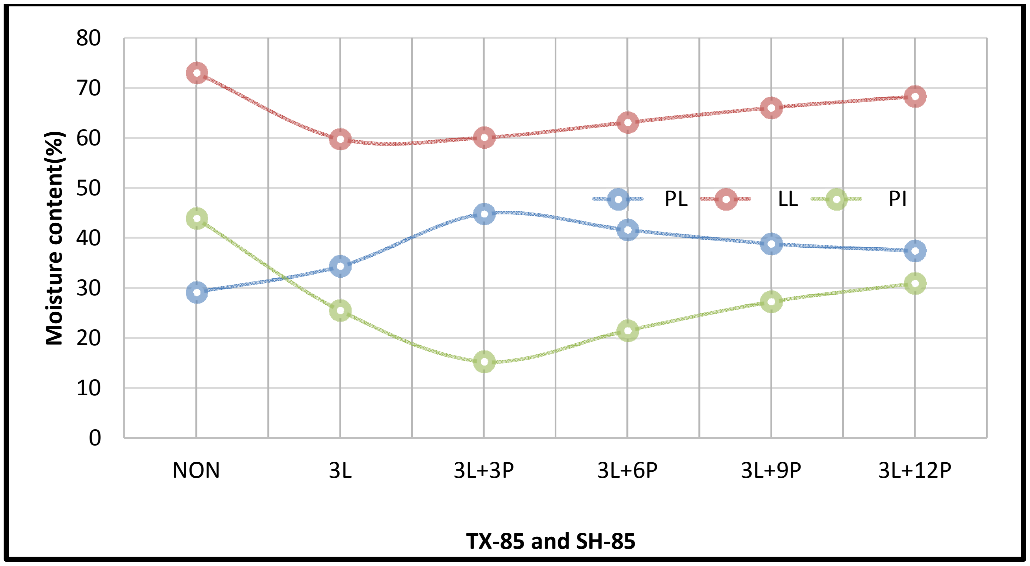

Figure 1: Atterberg Limits of Batu Pahat Soft Clay soils after addition of Probase Stabilizer

Figure 2 shows the effect of the mixture TX-85 (liquid) and SH-85 (powder) different percentages of soft clay. The shear strength values of the specimens were determined by the peak pressure respectively. It can be seen that increased strength in unconfined compressive strength (UCS) leads to the percentage increase in the content of SH-85. The strength value increase gradually at SH-85 content of 3%L for all specimens at different percentages.

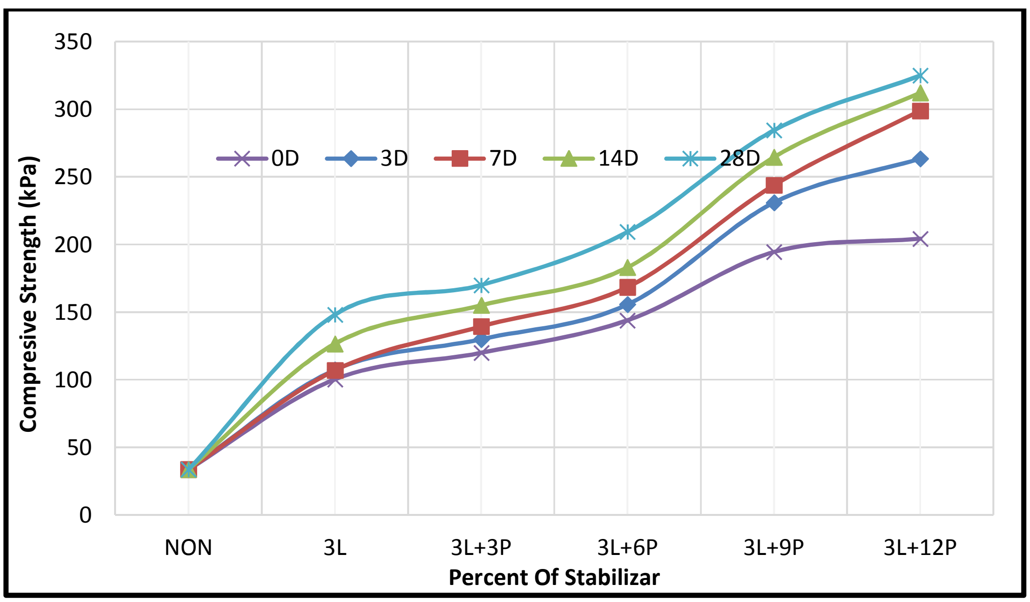

Figure 2: UCS versus Probase Stabilizer content at different curing time period

For instance, the optimum content of combination between TX-85 with SH-85 Probase Stabilizer obtained by addition of 3%L+12%P on soft clay was 364.895 kPa as compared to only 33.625 kPa achieved on untreated soft clay. It was suggested that the ion calcium in SH-85 only sufficient for flocculation and coagulation process. It can be improve the strength of soil to support load of structure and to decrease the settlement problem on construction over soft clay.

Figure 3 shows the effect of curing time on combination of TX-85 (liquid) and SH-85 (powder) treated soft clay at different stabilizer contents. All the soil samples were cured for 3, 7, 14 and 28 days. The strength value increased slowly on content of 3%L up to 3%L + 12%P were 100.3 kpa and 204.27 kPa of the soil that has been treated with no curing period.

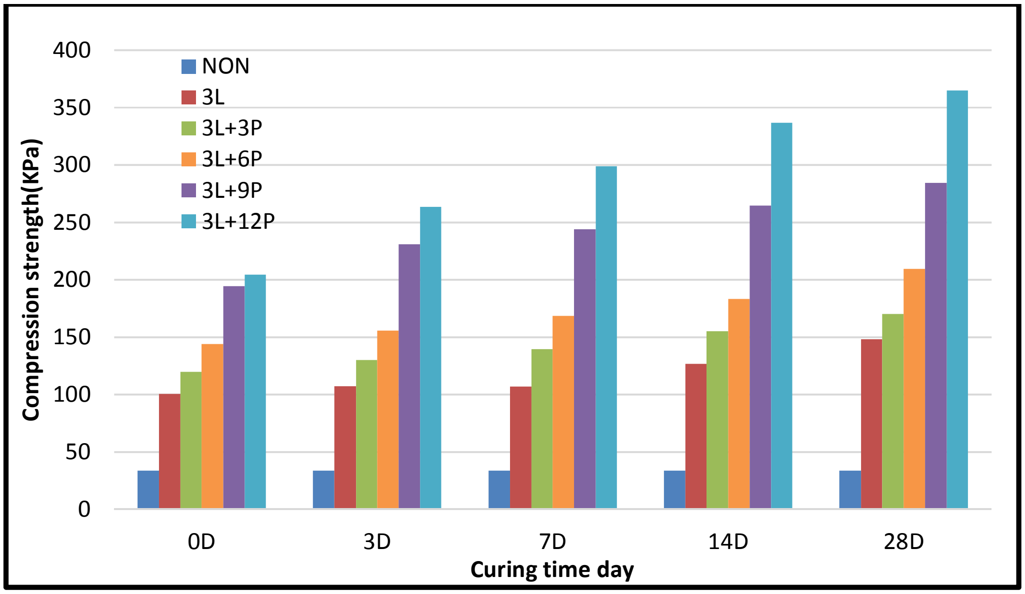

Figure 3: UCS of Batu Pahat Soft Clay Soils with curing time

It can be seen that the 3%L+ 6%P treated samples after 7 days curing gained a compressive strength of 168.47 kPa, started to increase which was approximately 4 times greater than the strength of untreated soil. However further increased slowly in strength was achieved with addition higher content of 3%L+ 6%P. Overall, we can see that the addition stabilizer of 3%L+ 6%P to 3%L+ 9%P were increase significant and 3%L + 12%P was slight increase for probase stabilizer content. It can be concluded that the 14 days of combination TX-85 and SH-85 are the optimum amount of this type soil clay of additive stabilizer for soil clay.

4.0 CONCLUSSION

From the result of this study it can be concluded that the addition of the TX-85(Liquid) and SH-85(Powder) on the soil can affect the properties and strength of the soil.

1) The liquid limit of the soil decreases while plastic limits increase with an increasing of TX-85 and SH-85. As a result, the Plastic Index (PI) reduces with the increment of SH-85(powder) contents.
2) The results of the atterberg limit test shows that soft clay with content of combination between TX-85 with SH-85 Probase stabilizer were contain high plasticity. In other words, it able to reducing the moisture content of soil clay in Batu Pahat.

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3) Overall, the addition of stabilizer of 3%L+ 6%P to 3%L+ 9%P were increase significant and 3%L + 12%P was slightly increase for probase stabilizer content. The results indicated that the SH-85 is stabilizing agent.
4) The results of unconfined compressive strength test (UCS) showed that 3%L + 9%P was the optimum amount of this stabilization process for soft clay.

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