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THE EFFECT OF CURING PERIOD AND THICKNESS OF THE STABILIZED PEAT LAYER TO THE BEARING CAPACITY AND COMPRESSION BEHAVIOR OF FIBROUS PEAT

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ABSTRACT

Peat is soil that known as a very soft soil with high organic content, low bearing capacity, and very high compression. Soil improvement using stabilization method has been developed because it is cheaper and environmentally friendly. This paper presents the effect of curing period and thickness of the stabilized peat layer to the bearing capacity and compression behavior of the fibrous peat. This study was carried out by using physical model of the stabilized peat placed in box size of 100 x 60 x 70 cm^3. Thickness of the stabilized peat layer varies: 1/3H, 1/2H and H (H=peat layer thickness). Step loading was adopted for consolidation test and each load was applied for 3 days. The results show that bearing capacity of the stabilized peat is higher than the original peat but it is slightly affected by the stabilized peat layer thickness. This bearing capacity, however, drops drastically when curing period reach 30-45 days and then keep decreasing with the increase of the curing period until it is about the same with the initial value. The compression of loaded stabilized peat layer is not only caused by the applied load but also due to the fiber decomposition. Thickness of the stabilized peat layer affects its compression where the thicker the stabilized layer, the larger the peat layer compression caused by fibers decomposition. It also shows that large compression due to bearing capacity failure occurs when the stabilized peat layer is very thin compared to the peat layer thickness.

Keywords: $C_aS_iO_3$ gel, curing period, fibrous peat, fly ash, rice husk ash, stabilization.

1. INTRODUCTION

The use of environmentally friendly admixture to stabilize fibrous peat was carried out in the laboratory by Yulianto, F.E and Mochtar, N.E. [1] and also by Harwadi, F dan Mochtar, N.E [2]. The result showed that the stabilized peat parameters improved significantly. In 2014, Mochtar, N.E, *et al* [3] developed laboratory model with bigger size of the stabilized peat; the stabilized peat was cured until 90 days. It showed that the physical characteristics of peat stabilized with two different admixtures increased when the curing periods reach 60 days. Afterwards, the water content was decreasing and other physical parameters of the stabilized peat also decreased. It can be caused by peat decomposition or by the $CaSiO_3$ gel formation became slower.

These peat parameters change also causes the change of bearing capacity and compressibility behaviors of the peat. By knowing the effect of decomposition process to the physical behavior of the stabilized peat, this research was continued to study the effect of stabilized peat thickness to its compressibility and bearing capacity behavior.

2. RESEARCH METHODOLOGY

Peat studied was fibrous peat taken from Bareng Bengkel, Palangkaraya, Central Kalimantan. It was classified as Hemic with low ash content and high acidity (Yulianto, FE and Mochtar, NE [4]). Peat was stabilized with 10% admixture material. There were two admixtures chosen: admixture-1 ($CaCO_3$ and rice husk ash) and admixture-2 (CaCO3 and fly ash). The bearing capacity of the stabilized peat was determined at curing period of 20, 30, 45, 60, and 90 days.

The effect of stabilized peat layer thickness to its compression behavior was performed by using physical model of the stabilized peat placed in box size of 100 x 60 x 70 cm^3 as shown in Figure-1. Thickness of the

Figurer-1. Laboratory model of stabilized peat.

stabilized peat prepared was varies: 1/3H, 1/2H and H (H=total sample thickness); so that the total laboratory models were 6 boxes (3 boxes of samples with Admixture-1 and 3 boxes of samples with Admixture-2). Step loading was carried out for consolidation test: 2.5, 5.0, 10, 20, 40, and 50 kPa, where each load was applied in 3 days; the loaded area was 10x40 cm^2. Settlement under each load was recorded in order to see the effect of stabilized thickness and type of admixture to settlement behavior of

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the stabilized peat. Its bearing capacity of peat stabilized with different thickness was predicted using formula introduced by Meyerhof and Hanna [5].

3. THE EFFECT OF CURING PERIOD TO THE BEARING CAPACITY OF THE STABILIZED PEAT

Figure-2 shows bearing capacity curves of peat stabilized with 10% admixture-1. All curves show that

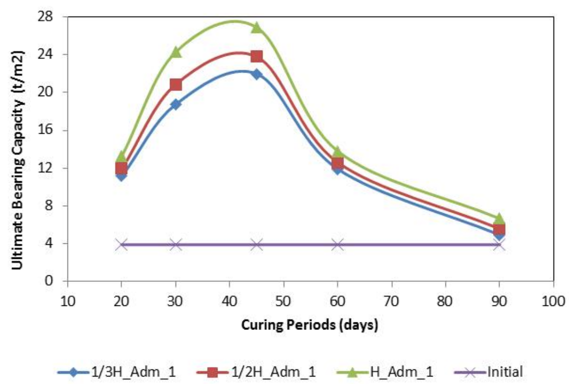

Figure-2. Bearing capacity behavior of peat stabilized with admixture-1 ($CaCO_3$+RHA).

bearing capacity of the stabilized peat increases with the increase of the stabilization age until it reaches 45 days; afterwards it decreases. It shows that the $CaSiO_3$ gel formation takes place smoothly when water in the soil pores is still available (until 45 days). When water in the pores decreases, the gel formation is slowing down and the gels are not enough to wrap the peat fibers. Consequently, the unwrapped peat fibers undergone decomposition process (Mochtar, NE, [2]). Besides, all the curves show similar shape except peat with thicker stabilized peat layer shows slightly higher bearing capacity.

Similar behavior shown by peat stabilized with admixture-2 as seen in Figure-3. Its bearing capacity reaches the highest value at 30 days of the stabilization age. Afterwards, however, the bearing capacity decreases and it becomes constant after 60 days of the stabilization age. In addition, peat with thicker stabilized peat has slightly higher bearing capacity. Bearing capacity curves of the fibrous peat stabilized with admixture-1 and admixture-2 are shown in Figure-4. All the curves

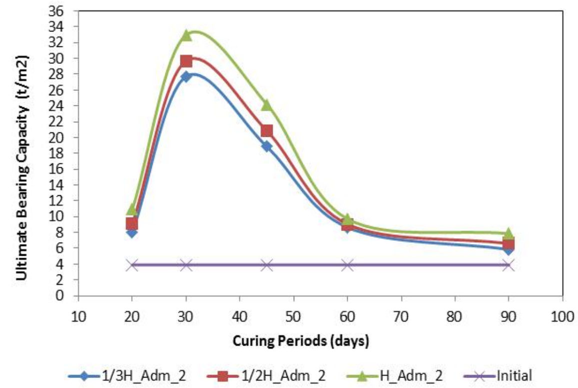

Figure-3. Bearing capacity behavior of peat stabilized with admixture-2 ($CaCO_3$+ FA).

show similar shape but peak of the bearing capacity curves of peat stabilized with admixture-2 is higher and occur earlier (at 30 days). It means that peat stabilized with admixture-2 gives higher bearing capacity and faster formation of $CaSiO_3$ gel than peat stabilized with admixture-1. It is because fly ash has better water absorption capacity so that formation of $CaSiO_3$ gel occurs earlier in admixture-2 than in admixture-1 (Mochtar, NE, dkk, [2]).

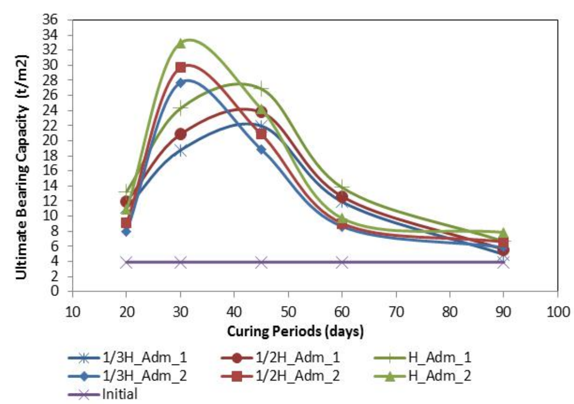

Figure-4. Bearing capacity behavior of peat stabilized with admixture-1 and admixture-2

When water availability in the pores is limited, however, the bearing capacity of peat stabilized with admixture-2 drops earlier than the one stabilized with admixture-1. It is due to formation of the $CaSiO_3$ gel was disrupted when no more water available in the pores. Consequently, not all fibers can be wrapped by $CaSiO_3$ gel so that those fibers undergone decomposition (Mochtar, NE, [2]).

4. THE EFFECT OF STABILIZED LAYER THICKNESS TO THE COMPRESSION BEHAVIOR OF PEAT

Step loading until maximum load of 50 kPa (200 kg) was applied on peat samples that stabilized in 3 (three)

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different layer thickness 1/3H, 1/2H and H (H=total peat sample thickness). The compression behavior of peat stabilized with admixture-1 and admixture-2 are given in Figure-5 and Figure-6, respectively. In general, the compression behavior for all samples are similar that is about constant after 20.000 minutes (14 days) of load application It shows that pores of peat soil become smaller after total load was applied for long period of time; besides, $CaSiO_3$ gel that filled of the peat start changing becoming crystal.

Figure-5 shows that the compression of peat stabilized in 1/3 of peat layer thickness (AS-1) has strange behavior in which the compression is very large at the beginning and then decreasing and finally about constant after 14 days of load application. It shows that large compression at the beginning is due to bearing capacity failure of peat layer loaded that can be caused by very thin stabilized layer (1/3 of peat layer) or due to the $CaSiO_3$ gel has not yet been developed perfectly.

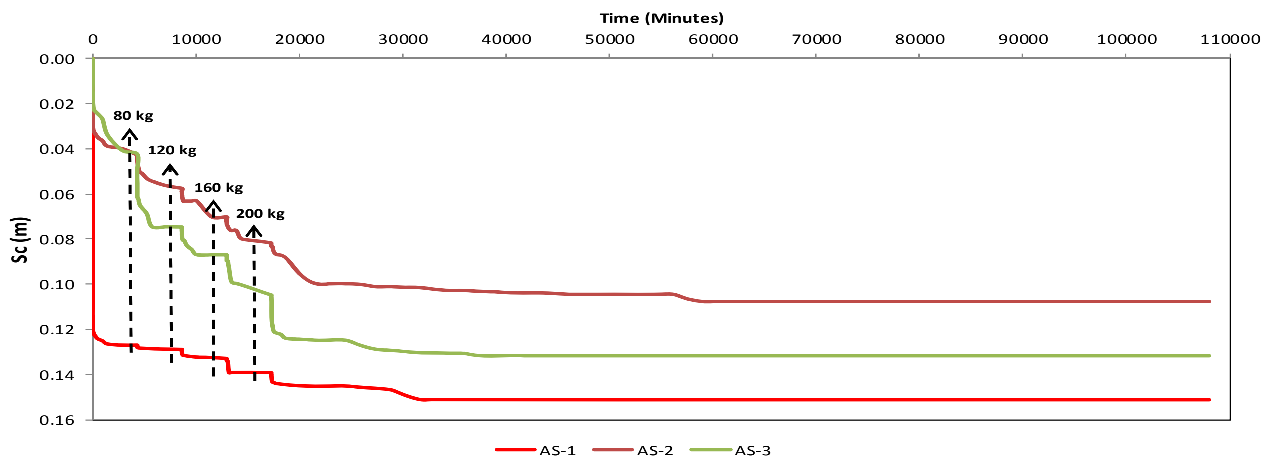

Figure-5. Compression behavior of fibrous peat stabilized with admixture-1 ($CaCO_3$+RHA) in three different layer thicknesses 1/3H, 1/2H and H (H=total peat sample thickness) under step loading.

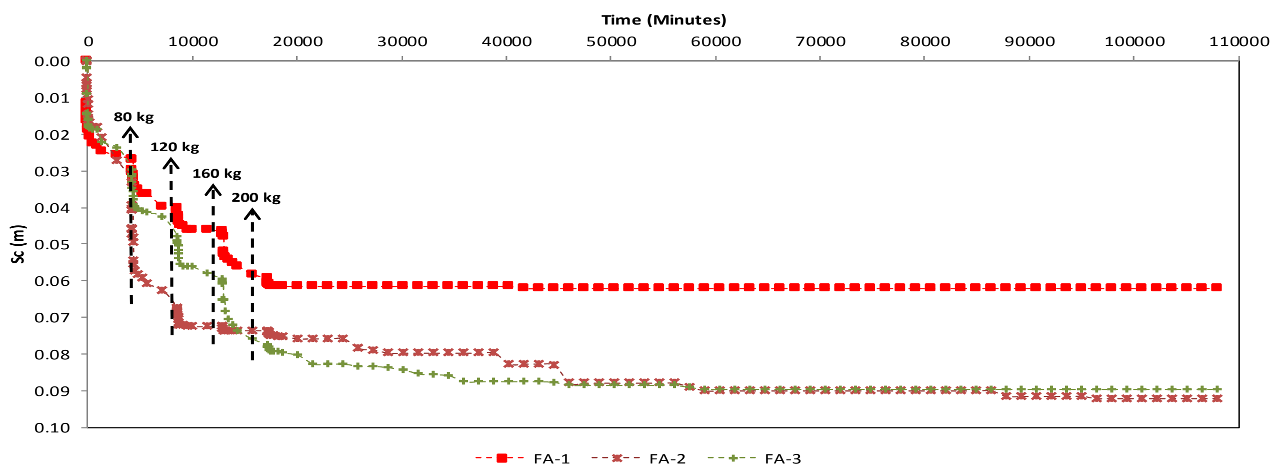

Figure-6. Compression behaviour of fibrous peat stabilized with admixture-2 ($CaCO_3$+FA) in three different layer thicknesses 1/3H, 1/2H and H (H=total peat sample thickness) under step loading.

The compression behavior of samples AS-2 (stabilized half layer) and AS-3 (stabilized total layer) is different with the one of sample AS-1. Compression of sample AS-2 is smaller than that of sample AS-3, but the compression of those samples is still smaller than that of sample AS-1. It shows that sample AS-3 where the whole layer is stabilized needs more water than sample AS-2 to develop $CaSiO_3$ gel. This water content reduction causes the $CaSiO_3$ gel formation was disturbed so that not all of fibers wrapped perfectly. As a result, those unwrapped fibers undergo decomposition process. This is in agreement with the one studied by Mochtar, NE., *et al.* [3] about the change behavior of the stabilized peat.

Figure-6 shows that compression behavior of sample FA-1 different with the one of sample AS-1 although they have the same stabilized layer thickness (1/3 of peat layer). It shows that fine granular of fly ash used in admixture-2 can be easily filled up the pores; besides high absorbent capacity of the fly ash causes the $CaSiO_3$ gel formation takes place in very short time. As a result the bearing capacity develops perfectly in sample FA-1 although the stabilized layer is thin (only 1/3 of peat layer) so that no bearing capacity failure occurs. In Figure-6 can also be seen that Sample FA-1 has smaller compression compared to that of sample FA-2 and FA-3; the thicker the stabilized peat layer, the higher the peat compression. This condition confirmed finding that the thicker the stabilized peat layer, the higher the compression take place due to decomposition process of peat fibers.

5. CONCLUSIONS

From analysis given above, it can be concluded as follows:

a) Bearing capacity of the stabilized fibrous peat increases significantly at curing period of 45 days (stabilized with admixture-1) and 30 days (stabilized with admixture-2); afterwards, the bearing capacity decreases.

b) Bearing capacity of peat stabilized with admixture-2 ($CaCO_3$ and fly ash) is higher than the one stabilized with admixture-1 ($CaCO_3$ and rice husk ash).

c) Bearing capacity of the stabilized fibrous peat increases with the increases of the stabilized peat layer thickness.

d) Large compression due to bearing capacity failure is able to occur at the stabilized peat layer if it is not thick enough and the curing period is too short to develop $CaSiO_3$ gel.

e) Compression of the loaded stabilized peat layer is not only due to pore size reduction but also due to decomposition of the fibers that are not wrapped properly by the $CaSiO_3$ crystal.

f) Compression of peat layer is affected by the thickness of the stabilized peat; the thicker the stabilized layer, the larger the peat layer compression due to peat fiber decomposition.

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