Parameters changes of Fibrous Peat Stabilized with [$C_a(Oh)_2$+Flyash] and [C_aco_3+ Flyash]

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ABSTRACT

Lime materials [C_aCO_3 and $C_a(OH)_2$] had been used since years ago as stabilization materials for clay soil. For peat soil, however, was only recently developed and it was found that the lime material had to be mixed with pozolon such as Fly Ash (FA) or Rice Hush Ash (RHA) as silica material; it was because peat had no silica content. This paper presents the use of two different types of lime [C_aCO_3 and $C_a(OH)_2$] mixed with Fly Ash (FA) as admixture materials, those were, Admixture-1 [30% C_aCO_3 dan 70% FA] and Admixture-2 [10% $C_a(OH)_2$ dan 90% FA]. Fibrous peat soil taken from Palangkaraya, Central Kalimantan, Indonesia, was stabilized with Admixture-1 and Admixture-2 separately, and then cured in different period of time in order to see the effect of each admixture to the peat behaviour. The result shows that both admixtures absorb water in soil pores to produce silica gell ($C_aS_iO_3$); Admixture-2 produces silica gell faster than the Admixture-1 because Admixture-2 is able to absorb water faster than the other one. As a result, the increament of soil perameters (unit weight, specific gravity, and soil strength) of peat stabilized with Admixture-2 faster than the one stabilized with Admixture-1; those parameters, however, then decreases caused by no more water available in the soil pores. Decreament of the stabilized peat compression is really significant, especially for peat stabilized with Admixture-2. In addition, it can be concluded that development of silica gell $C_aS_iO_3$ is really depending on the availability of water in the soil pores.

Keywords: *Curing period, Fibrous peat soil, Fly ash (FA), Lime, Stabilization*

INTRODUCTION

Peat is organic soil with very low bearing capacity about 5-7 kPa[1] and high compressibility. In order to improve its bearing capacity, many types of soil reinforcements have been tried to increase its bearing capacity. All of those methods, however, are very expensive and have bad impact on the environment [2]. When the stabilization method was adopted for fibrous peat, the results was not as good as for clay soils. It is because fibrous peat has no silica content.

Based on that condition, Yulianto, F.E and Mochtar, N.E.[3], [4],Harwadi, F. and Mochtar, N.E.[5] and Febrianti, M.[6] created a stabilizing agent (admixture) for fibrous peat that environmentally friendly. It was lime mixed with pozolon such as Fly Ash (FA) or Rice Hush Ash (RHA); this pozolon was added as silica materials. By stabilizing the fibrous peat with that admixture, the physical and engineering properties of the stabilized peats improved significantly. This paper presents the effect of lime types [C_aCO_3 and $C_a(OH)_2$] used as a stabilizing agent (mixed with fly ash) to the behavior improvement of the stabilized fibrous peat.

ISSN: 2223-9944, e ISSN: 2223-9553
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PEAT SOIL STUDIED

Peat soil sample was taken from BarengBengkel, Palangkaraya, Central Kalimantan. Types of sample used were disturbed and undisturbed samples. Tests carried out in two places, field and laboratory. Field test consist of the acidity (pH) test, vane shear test, and sand cone test for unit weight (γt). The Laboratory testing was conducted based on the Peat Testing Manual [7]. The test results of peat soil studied in initial condition is shown in Table 1.

Table1.Physical and Engineering Properties of InitialFibrousPeatSoil.

Parameter		*Peat Studied*	*Peat Studied by Other Researcher*
Specific Gravity (Gs)	-	1.51	1.4 – 1.7
Water Content (Wc)	%	511.27	450 1500
Unit Weight (γt)	gr/cm^3	0.981	0.9 – 1.25
Void Ratio (e)	-	7.5	6.89 – 11.09
Acidity (pH)	-	4	3 – 7
Organic Content (Oc)	%	98	62.5 – 98
Fibrous Content (Fc)	%	50.92	39.5 – 61.3
Shear Strength (τ); (σv = 50 kPa)	kPa	24.38	-
Compression (Δh)	mm	5.8	-

From the data given inTable1, it is known that parameters of peatsoil studied are still in the range of peat parameters from other researchers(Hanrahan, [8], MacFarlaneandRadforth[9], MacFarlane, [10], Mochtar, NE. Etal., [11], [12], [13], [14], Pasmar, [15]andJelisic, [1].

Specific gravity (Gs) of peat studied is 1.51; it shows that the peat has high organic content (98%). This is in accordance with the MacFarlane statement [10] that the Gs value of peat is in the range of 1.4-1.7. The organic content of peat soil also affects its acidity; it shows that pH of the peat studied is 4. It means that it is not safe for building materials especially for concrete and steel.

The unit weight (γ_t) of peat studied is 0981 gr/cm^3. Its water content is very high 511.27%; it indicates that water dominates the peat,that is about 5 times the amount of solid. It is also corresponding to its very big void ratio, that is 7.5, and very small shear strength, that is 24.38 kPa. From those soil parameters it can be concluded that the peat studied has very low bearing capacity and very high compressibility.

STABILIZTION MATERIALS

Materials used for peat stabilization wereC_aCO_3 lime as a side product soffertilizer industry, the common lime, $C_a(OH)_2$, and flyash taken from electricity power plant, PLTU Paiton, East Java, Indonesia. Lime$C_aCO_3$contains of about 70% C_aCO_3(Harwadi, F&Mochtar, NE, [5]), andlime$C_a(OH)_2$ is dominated by CaO that is68% (Wiqoyah, Q.[16]).

BEHAVIOR OF PEAT SOIL STUDIED

In this studi, there are 2 (two) types of admixtures used for peat stabilization: Admixture-1 that contains of 30% lime $C_aCO_3$and70% flyash, and Admixture-2 that consists of 10% $C_a(OH)_2$ and90% flyash. According to Harwadi, F and Mochtar, NE, [5], the use of 10%

Admixture-1 can improve the physical and engineering properties of the initial peat. It needs 15% of Admixture-2 in order to make the fibrous peat studied improved (Febrianti, [6]).

Reduction of water content(w_c) of the stabilizedpeatsoil studied can be seen in Figure1. In general, addition of the admixture make w_c decreases significantly. It is because water in the pores is absorbed by the admixtureto form the $C_aS_iO_3$ gel(YuliantoFE&Mochtar, NE, [3][4]). When curing period reaches 30days, its water content is relatively constant; this is due tothe availability of water in the soil pores is very limited so that the gel formation is obstructed. Besides, w_c reduction of the peat stabilized with Admixture-2 is bigger than the one stabilized with Admixture-1. It is because $C_a(OH)_2$ has capacity to absorbe more water thanC_aCO_3 to form the $C_aS_iO_3$ gel (Wiqoyah, [16]).

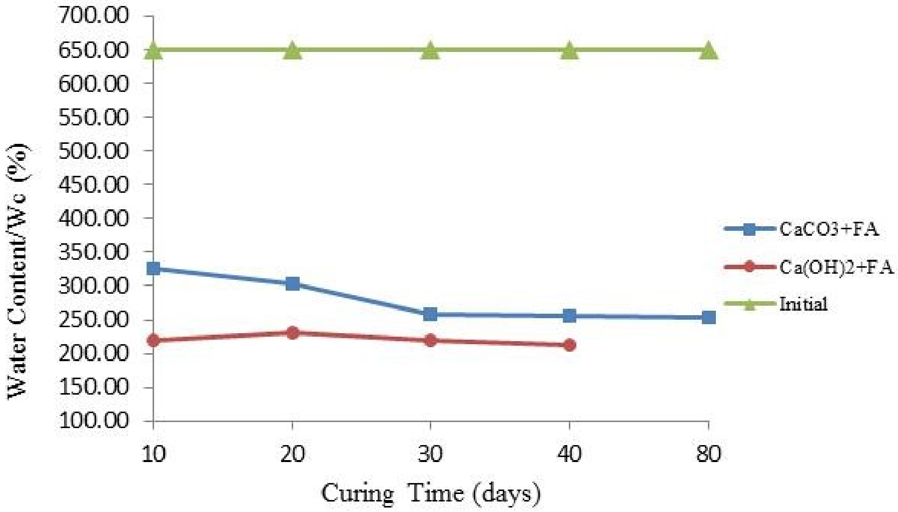

Figure1. Water content(wc) of peatsoilstabilized withAdmixture-1 and Admixture -2.

Figure 2 shows that unit weight (γ_t) of the stabilized peat increases with the increase of curing period. The highest value of the γ_t occurs when the curing period reaches 30 days and 20 days for Admixture-1 and Admixture-2, subsequently; after that, the γ_t decreases.

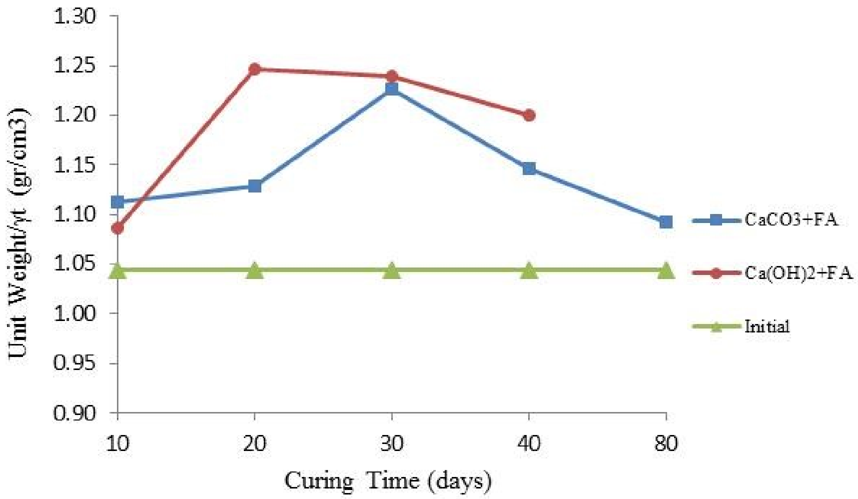

Figure2. Theunit weight(γt) of peatsoilstabilized withAdmixture-1 and Admixture -2.

This condition indicates that due to the process of the $C_aS_iO_3$ gel formation, the γ_t increases. When the pore water decreases and becomes limited, however, the gel formation process is

ISSN: 2223-9944, e ISSN: 2223-9553

obstructed and getting slower; it causes decrement of the unit weight. The curves in Figure 2 also presents that at the same curing periods, the γ_t of peat soil stabilized with Admixture-2 is slightly higher than the one stabilized with Admixture-1. This caused by higher absorption capacity of Admixture-2 so that it is able to produce gel in shorter curing period than Admixture-1.

Specific gravity, Gs,of the stabilizedpeat(Figure 3) increases with the increase of curing period until it reaches30 days. Afterwords, the Gs of peatstabilized withAdmixture-2 decreases butthe onestabilized with Admixture-1tends to be constant. It shows that the gel formed by Admixture-1 is still able to continue to produce $C_aS_iO_3$ crystal although it is very slow because the water available in the soil pore is limited. On the other hand, theAdmixture-2 is not successful to form $C_aS_iO_3$ crystal because no more water available in the soil pores. As a result, $\gamma_t$produced by Admixture-2 decreases with the increase of the curing periods.

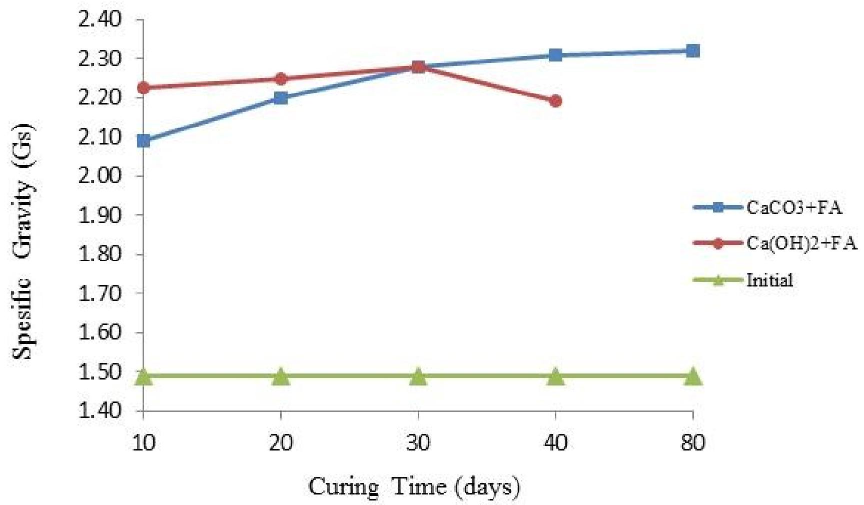

Figure3. Specific gravity(Gs) of peatsoilstabilized withAdmixture-1 and Admixture-2.

The $C_aS_iO_3$gel formed by the admixtures fills the soil pores and wrap the peat fiber. This condition causes void ratio reduction of the stabilized peat (Figure 4). The compression is much smaller for peat stabilized with Admixture-2; decomposition process started at 30days of curing period and it causes slight increment of the peat compression.

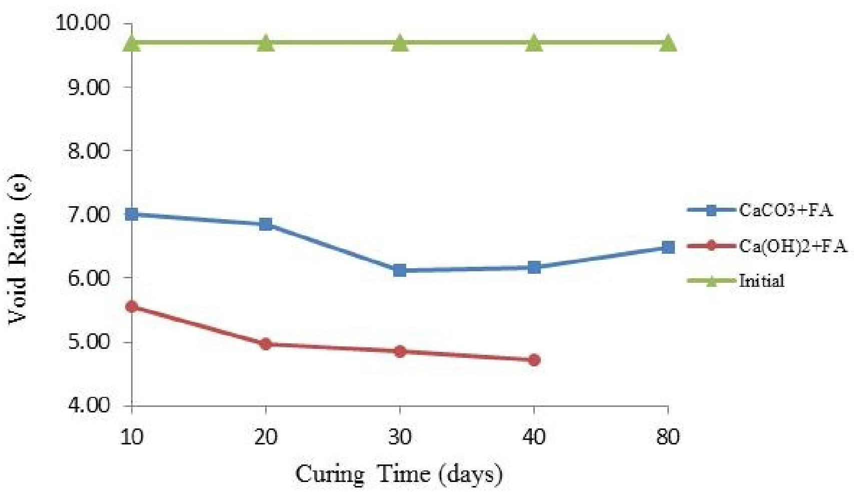

Figure 4.Void Ratio (e) of peatsoilstabilized withAdmixture-1 and Admixture-2.

The compression of peat stabilized with Admixture-1 shows different behavior in which the compression is still significant. This condition is corresponding to the void ratio of the peat stabilized with Admixture-1.However, void ratio of peat stabilized with Admixture-1 is still larger compared to the one stabilized with Admixture-2. This condition supports the previous argumentation where $C_a(OH)_2$ has capacity to absorb more water thanC_aCO_3 to form the $C_aS_iO_3$ gel.

Void ratio of the stabilized peat soil affects its shear strength (τ); it can be seen in Figure 5 where the stabilized peat has greater τ than the initial conditions. At the curing period 20 days, the shear strength (τ) of peat stabilized with Admixture-2 is the highest; after that, it decreases significantly.

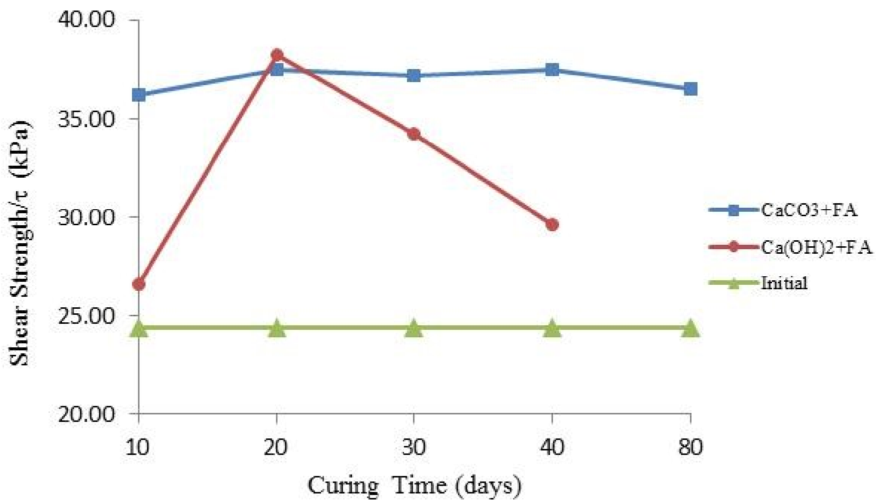

Figure 5.Shear Strength(τ) of peatsoilstabilized withAdmixture-1 and Admixture-2.

This may be caused by the decomposition process due to no more water available in the soil pores. This situation corresponds to the specific gravity and unit weight of peat stabilized with Admixture-2. Different condition occurs for peat stabilized withAdmixture-1 where its shear strength tends tobe constant and slightly decreasesafter40days curing period. It shows that decomposition process has not occurred yet for peat stabilized withAdmixture-1 because water is still available in its soilpores. This condition confirmed the water content of peat stabilized with Admixture-1 that is still high (Figure 1).

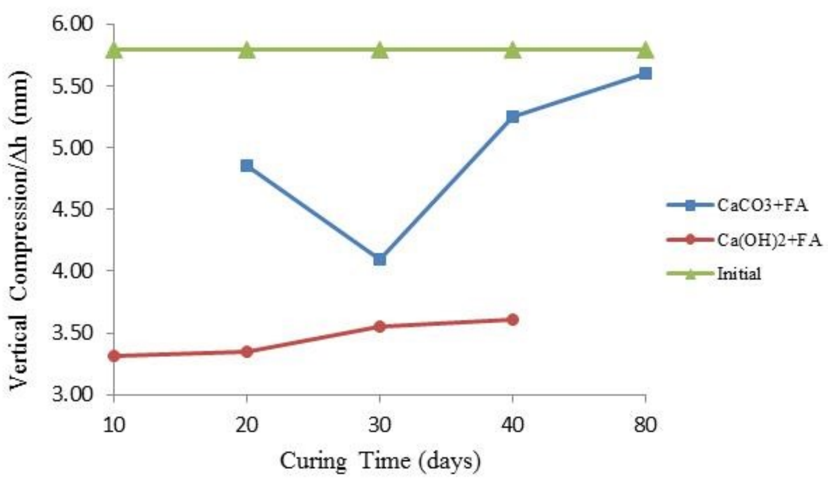

Figure 6.Compression(Δh) of peatsoil stabilizedwithAdmixture-1 and Admixture-2.

The void ratio change of the stabilized pest is also influence its compressibility behavior(Figure 6). From the explanation above, it known that the formation of$C_aS_iO_3$gel that affect the physical and engineering parameters of the stabilized peat is depending on the availability of pore water of the stabilized peat.

CONCLUSION

From the discussion given above, it is concluded that:

1. The gel formation process occurs faster in peat stabilized with Admixture-2 [10% $C_a(OH)_2$ and90% flyash] because it has higher water absorption capability than Admixture-1 [30% $C_aCO_3$and70% ash to fly].
2. The unit weight, specific gravity, and shear strength of peat stabilized with Admixture-2 increases and then decreases faster than the one stabilized with Admixture-1; it caused by decomposition process occurs earlier in the one stabilized with Admixture-2.
3. Peat stabilized withAdmixture-2 has smaller compression behavior than the one stabilized withAdmixture-1; it is corresponding to the other parameters of the stabilized peat.
4. Process of $C_aS_iO_3$gelformationneeds availability of water in the soil pores.

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ISSN: 2223-9944, e ISSN: 2223-9553

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ISSN: 2223-9944, e ISSN: 2223-9553
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