REVIEW STRENGTH SUPPORT SUKODONO SOIL CLAY WITH ADDITION STABILIZATION MATERIAL CHARCOAL WOOD POWDER

To fulfill part requirements

reached a degree of Bachelor of S - 1 Civil Engineering

Submitted by:

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Surakarta, July 24 ,2017

Writter,

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Abstrak

Berdasarkan hasil uji pendahuluan menunjukkan bahwa tanah di Sukodono, Sragen adalah tanah liat anorganik plastik tinggi, dengan LL = 85,73%, PL = 24,69%, PI = 61,04% (Prasetyo, 2016). Dalam uji kimia kimia tanah yang dilakukan di Laboratorium Kimia Analitik Kimia UGM Yogyakarta, tanah Sukodono mengandung unsur kimia tanah Al2O3 = 16,86%, CaO = 0,92%, Fe2O3 = 10,81%, MgO = 1,35% Dan SiO2 = 63,25% (Sangeoris, 2016). Berdasarkan nilai PI = 61,04% (lebih dari 17%) maka tanah ini diperlukan untuk tindakan perbaikan tanah. Perbaikan tanah dilakukan dengan stabilisasi tanah kimia menggunakan serbuk arang dengan persentase 10%, 15%, dan 20% berat sampel. Pengujian meliputi uji sifat fisik dan sifat mekanik tanah asli dan tanah campuran. Hasil sifat fisik tanah asli dan campuran nilai batas plastisnya meningkat, sedangkan kadar air, kerapatan (berat jenis), batas cair, indeks plastisitas, batas susut, dan penurunan saringan 200 persen. Klasifikasi campuran tanah serbuk arang 10% dan 15% termasuk kelompok A-7-6, 20% A-7-5. Campuran tanah serbuk kayu arang 10%, 15% dan 20% sesuai dengan sistem USCS termasuk kelompok CH. Hasil uji sifat mekanik dari uji Standar Proctor campuran tanah serbuk kayu arang 10%, 15%, dan 20% menurunkan nilai berat volume dan kenaikan kadar air optimum. Nilai bobot maksimum volume adalah 1,182 gr / cm3 dan kadar air optimum tertinggi adalah 38% pada penambahan serbuk kayu arang 20%. Nilai CBR Unsoaked meningkat sebesar 13% pada kenaikan 10% pada persentase bubuk kayu arang. Namun, turunnya penambahan 15% serbuk kayu arang dengan nilai 11%. Nilai CBR Unsoaked terkecil adalah persentase 20% serbuk kayu arang sebesar 10%.

Kata kunci: tanah liatkuat dukung tanah, serbuk kayu arang, stabilisasi

Abstract

Based on the preliminary test results shows the soil in Sukodono, Sragen is a high plastic inorganic clay, with LL = 85.73%, PL = 24.69%, PI = 61.04% (Prasetyo, 2016). In soil chemical chemistry test conducted at UGM Chemical Analytical Chemistry Laboratory Yogyakarta, Sukodono soil contains chemical element of soil Al2O3 = 16,86%, CaO = 0,92%, Fe2O3 = 10,81%, MgO = 1,35% And SiO2 = 63.25% (Sangeoris, 2016). Based on the value of PI = 61.04% (more than 17%) then this soil is necessary for soil improvement action. Soil improvement is carried out by chemical soil stabilization using charcoal powder with a percentage of 10%, 15%, and 20% by weight of the sample. The tests include physical properties test and mechanical properties of original soil and mixed soil. The result of the physical properties of the native soil and the mixture obtained plastic limit value has increased, while the water content, density (specific gravity), liquid limit, plasticity index, shrinkage limit, and a sieve 200 percent decline. The soil mixture classification of 10% and 15% charcoal powder included the A-7-6, 20% group A-7-5. Soil mixture of charcoal wood powder 10%, 15% and 20% according to USCS system

including CH group. The result of test of mechanical properties from Standard Proctor test of soil mixture of charcoal wood powder 10%, 15%, and 20% decreased value of volume weight and increase of optimum water content. The maximum weight value of the volume is 1.182 gr / cm3 and the highest optimum water content is 38% in the addition of 20% charcoal wood powder. The CBR Unsoaked value increased by 13% on the 10% increase in the percentage of charcoal wood powder. However, the decrease in the addition of 15% charcoal wood powder with a value of 11%. The smallest Unsoaked CBR value is the percentage of 20% charcoal wood powder by 10%.

Keywords: ***clay, stabilization, charcoal wood powder, strenght support***

1. INTRODUCTION

1.1 Background

- Soil is the foundation of a construction, be it the construction of road and building construction. There are soil types that have poor properties, and usually they often cause problems such as soils with high plasticity values, low shear strength, and large shrinkage.
- Currently, many roads were damaged in Java, for example road in District Sukodono, Sragen. Road conditions in this area suffered many damages, among others, roads, bumpy and long life of the road is relatively short, thus becoming a major problem in this area. Can be seen by the invisible curve of the road due to the local soil structure has a weak carrying capacity, during the rainy season arise water puddles on the road with holes, and the surrounding land becomes very plastic and sticky. In the dry season the soil around the road becomes cracked and hard. In order to overcomes the problems existingsoil condition in the area Sukodono, it is necessary to study soil improvement that is stabilizing the soil.

1.2 Problem Formulation

Based on the background, the following problems can be formulated:

1. How are the physical and mechanical properties of the original soil from Sukodono, Sragen?
2. How are the soil physical and mechanical properties of Sukodono, Sragen that have been stabilized using charcoal wood powder?
3. What is the value of CBR Unsoaked land from Sukodono, Sragen with the addition of charcoal wood powder?

1.3 Objective and Benefit

1. Research Objective

1) To know the physical and mechanical properties of the original soil from Sukodono, Sragen.

2) To know the physical and mechanical properties of the soil from Sukodono, Sragen that has been stabilized using charcoal wood powder.
3) Knowing the value of soil CBR from District Sukodono, Sragen Regency with the addition of charcoal wood powder.

2. Benefit Research

1) Improving the land of Sukodono Sub-district, Sragen Regency which is stabilized using charcoal wood powder.
2) Provide solutions and alternative added materials for the stabilization of clay soil in the form of charcoal powder, thereby complementing pre-existing research.
3) As input for relevant agencies on local soil conditions, so as to plan a safe construction.

1.4 Scope of Problem

In order to avoid expanding the discussion of this Final Project, then in this study need the scope as follows:

1. The research was conducted in the laboratory of Civil Engineering University of Muhammadiyah Surakarta.
2. Sample is clay with disturbed condition (disturbed) taken from District Sukodono, Sragen regency with depth of land approximately 50 cm.
3. Variation of charcoal wood powder mixture as stabilization material that is equal to 10%; 15%; 20% by weight of sample with optimum moisture (w_{opt}) and maximum dry soil volume (γ_d max).
4. The powder using charcoal wood powder originating from the city of Surakarta, then made to pass the filter number 30 (0,590 mm).
5. The use of secondary data for the nature of the original soil physical properties is taken from Sangeoris (2016).
6. Test taken include:
    a) (ASTM D2216-71), atterberg boundaries (ASTM D423-66), and grain size analysis (ASTM D421 -58).

b) Soil density testing with Standard Proctor (ASTM D 698) on original soil and mixed soil.
c) Strenght soil support testing with unsoaked CBR (California Bearing Ratio) (ASTM D1883-87) with original soil samples and mixed soil samples. This test is carried out with optimum moisture (w_{opt}) and maximum dry soil volume (γ_d max).

1.5 Authenticity of Research

Research with characteristics of clay from Sukodono, Sragen which stabilized using chemical method with wood charcoal with title " Review Strength Support Soil Clay Sukodono with Addition Stabilitation Material Charcoal Wood Powder " previously had never done research at Faculty of Engineering Department of Civil Engineering University of Muhammadiyah Surakarta.

2. RESEARCH METHODS

2.1 General Review

In this study to determine soil characteristics to be studied need to do some testing. Tests performed include testing the water content, specific graphite (Gs), the limits of Atterberg (liquid limit, plastic limit and shrinkage limit), the analysis of grain size (hydrometer and sieve analysis), standard proctor, and test CBR (California Bearing Ratio).

2.2 Research Material

Materials made as test object as follows:

1. Soil samples derived from the Sukodono, Sragen with disturbed conditions, soil acquisition is done at a depth of approximately 50 cm.
2. The water used comes from the Civil Engineering Laboratory of the University of Muhammadiyah Surakarta.
3. Charcoal powder wood used comes from the city of Surakarta with sieve size No. 30 (0,590 mm)

2.3 Stages Research

This study consists of several stages, among others:

1. Stages I: An initial phase of research begins with the study of literature and pre-testing the soil physical properties. Preparing materials research is a soil sample and charcoal wood powder. To test the specific gravity in charcoal wood powder. Soil sampling by drying and filtering with sieve No. 4.
2. Stages II: Doing this is the physical nature of the native soil and soil mix with the addition of powdered charcoal percentage of 10%, 15%, and 20%. This testing includes moisture content, density, limits of Atterberg, and grain size analysis. Then do a test proctor compaction standards in order to get the maximum soil density and optimum moisture content. The optimum moisture content is used for the manufacture of the test sample CBR.
3. Stages III: Making test specimen native soil samples and soil mix with the addition of powdered charcoal percentage of 10%, 15%, and 20%for testing CBR. Then do CBR test conducted on native soil and soil mix.
4. Stages IV: This stage is a discussion of the test results that have been obtained from the phase II and III. From this stage can be made a conclusion as to the results obtained and providing advice if necessary.

3. RESULTS AND DISCUSSION

3.1 Physical Properties Test

1. Specific Gravity Test of Charcoal Wood Powder

According to research conducted by Soemeinaboedhy and Tejowulan (2004) entitled "The Use of Charcoal as a Source of Nutrient P and K Element and Soil Enhancement" is produced by heavy of various kinds of charcoal is as follows.

Table V.3. The test results of various chemical elements of charcoal powder (Soemeinaboedhy and Tejowulan, 2004)

Kind of Charcoal	Specific gravity
Wood	1,11

Coconut shell	1,15
Rice Husk	1,23
Sawdust	1,53

2. Physical Properties Test of Native Soil

The native soil physical properties test conducted in this study include water content, specific gravity, Atterberg Limits, filter analysis. Analysis and results can be seen in appendix and Table V.4.

Table V.4. Physical properties of native soil

Water Content (%)	Specific Gravity	Liquid Limit (%)	Plastic Limit (%)	Shrinkage Susut (%)	Plastisity Indeks (%)	Through Sieve No.200	Soil Classification	
							AASHTO	USCS
18,323	2,621	91,5	27,04	11,30	64,46	91,00	A-7-6	CH

3. Physical Properties Test of Soil Mixture

Physical properties of mixed soil tests were performed on all variations of mixed percentages of 10%, 15%, and 20% of charcoal wood powder. The result of soil physical properties test can be seen in Table V.5.

Table V.5. Physical properties of the soil mixture

Addition Charcoal Wood Powder (%)	Specific gravity	Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Shrinkage Limit (%)	Plastisity Indeks (%)	Loose Sieve No.200	Group Indeks (GI)	Classification	
									AASHTO	USCS
10	2,468	25,493	62,20	25,95	9,65	36,25	91	43,420	A-7-6	CH
15	2,428	23,273	56,70	28,31	6,35	28,39	90	41,711	A-7-6	CH
20	2,409	21,188	53,35	31,66	4,49	21,89	89	38,505	A-7-5	CH

3.2 Mechanical Properties Test

1. Standard Proctor

Standard proctor compaction test aims to obtain the value of the maximum dry content weight and the optimum moisture value to be used for subsequent tests, ie to calculate the addition of water to the CBR test.

Proctor standard test results on native soil and mixed pass filter No. 4 can be seen in Table V.6.

Table V.6. Proctor standard test results on native soil and soil mixture pass filter No. 4

Sample	Variation	W_{opt} (%)	γd maks (gr/cm^3)
1	Soil + Charcoal Wood Powder 10%	34,58	1,257
2	Soil + Charcoal Wood Powder 15%	35,70	1,198
3	Soil + Charcoal Wood Powder 20%	38,00	1,182

The above occurs because the native soil mixed with wood charcoal powder is lighter in weight than the native soil type so that W_{opt} increases as much as for the maximum γ_d decreases in each percentage increase.

2. CBR Test (California Bearing Ratio*)*

In this study CBR test used is CBR Unsoaked. Unsoaked CBR test results for mixed soil can be seen in Table V.9.

Table V.9. Unsoaked CBR test results (without soaking) on the soilthrough sieve No. 4

No	Soil Sample	CBR (%)
1	Native Soil + 10% Charcoal Wood Powder	13
2	Native Soil + 15% Charcoal Wood Powder	11
3	Native Soil + 20% Charcoal Wood Powder	10

Based on Sangeoris's (2016) study on increasing the percentage of 5% wood charcoal powder getting 12% CBR value and 7.5% wood charcoal enhancement get CBR value of 23%.

If the result of Sangeoris research is combined with the results of this study then it can be made graph of CBR Unsoaked value relationship with the percentage of wood charcoal powder as in Figure V.12.

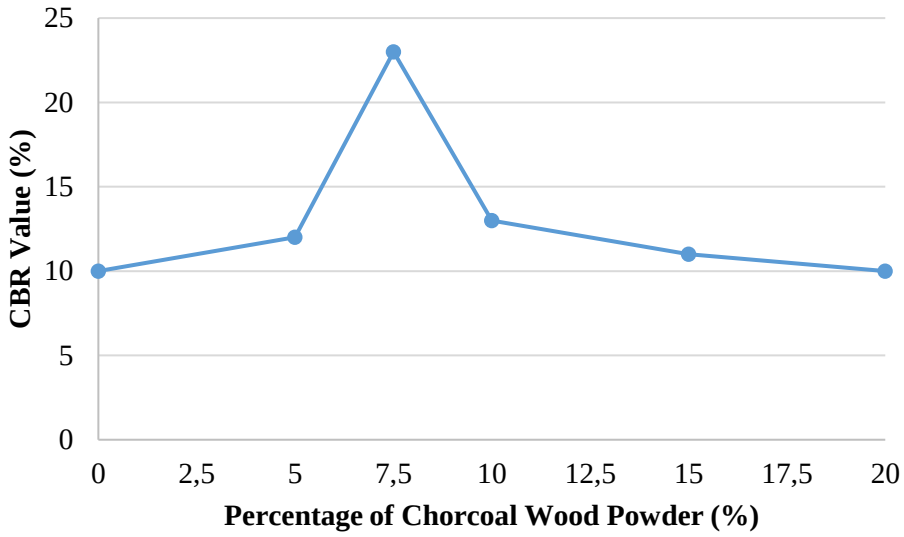

Figure V.12. Relation of CBR Unsoaked value with percentage of wood charcoal powder

Figure V.12. Showed that the CBR value tended to increase from 5% to 7.5% after subsequent decrease in subsequent percentage increase. The optimum percentage of the optimum charcoal powder mixture is 7.5% of the weight of the soil.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusion

Based on the results of research in the laboratory of Civil Engineering University of Muhammadiyah Surakarta and the results of data analysis it can be concluded as follows:

1. The native soil physical test result shows that Sukodono soil is included in clay soil with high plasticity which is cohesive with PI value equal to 64,46%. Sukodono soil classification according to AASHTO shows that this soil belongs to group A-7-6 which means clay soil is bad and not well used as plywood and building pavement foundation. Soil classification according to USCS, Sukodono soil belongs to CH group which means clay soil with high plasticity.

2. Physical soil test results of 10%, 15%, and 20% mixed yields for Gs 2,468 in mixture 10% and 2,409 in mixture 20%, for water content obtained 25.493% yield on 10% mixture and 21,188% on mixture 20 %, For LL, the result is 62.2% in the mixture of 10% and 53.35% in the mixture of 20%, for the PL obtained 25.95% in the mixture of 10% and 31.66% in the mixture 20%, for SL obtained results 9.65% in the mixture of 10% and 4.49% in the mixture of 20%, for the PI value obtained 36.25% results in the 10% mixture in AASHTO entering groups A-7-6 and USCS entering group CH, 28.39% In the AASHTO 15% mixture entering the A-7-6 and USCS groups belonging to CH, and 21.89% in the 20% mixture in AASHTO entering the A-7-5 and USCS groups belonging to the CH group
3. The result of soil compaction test using Proctor standard on mixed soil 10%, 15%, and 20% wood charcoal powder has decreased dry volume weight and optimum water content. The value of CBR Unsoaked decreased as the percentage increase of wood charcoal powder. The highest CBR value is 13% in the percentage increase of 10% wood charcoal powder. Based on physical and mechanical properties test on indigenous soil and stabilized mixture with charcoal powder, it was found that the greater percentage of wood charcoal powder mixture would result in the weight value of dry volume and strong soil support decreasing, the optimum percentage of optimum powder 7.5% mixture of soil weight.

4.2 Recommendation

1. For CBR testing to get more accurate results and maximum required more samples (minimum more than 2) on each variation.
2. Make sure the native soil is correct in the dry air conditions in order to get better results and correct.

3. Before performing any tests, it is better to check the water content of the soil, so that each sample has the same water content and condition.
4. Use a crusher tool to facilitate the breakdown of soil and stabilization materials in order to get the most results in this study I use the tool Los Angles Machine.

BIBLIOGRAPHY

ASTM. 1981. *Annual Book of ASTM*. Philadelpia, PA.

Bowles, J.E. 1991. *Sifat-Sifat Fisis Tanah dan Geoteknis Tanah*. Jakarta: Erlangga.

Hardiyatmo, H.C. 2010. *Mekanika Tanah I edisi ke V*. Yogyakarta: Gadjah Mada University Press.

Hardiyatmo, H.C. 2007. *Mekanika Tanah II edisi ke IV*. Yogyakarta: Gadjah Mada University Press.

https://id.m.wikipedia.org/wiki/Arang).

Murhandani, U. W. 2015. *Stabilisasi Kapur Terhadap Kuat Dukung Tanah Lempung dengan Perawatan 3 Hari (Studi Kasus Subgrade Jalan Raya Tanon, Sragen)*, Tugas Akhir, S1 Teknik Sipil, UMS.

Wesley, L.D. 1994. *Mekanika Tanah (Cetakan ke VI)*, Jakarta: Badan penerbit Pekerjaan umum.

Wiqoyah, Q. 2007. *Pengaruh Tras Terhadap Parameter Kuat Geser Tanah lempung*. Jurnal Teknik Sipil, Vol.7 No. 2 Juli 2007: 147-153.

Sangeoris, M. 2016. *Pemanfaatan Bubuk Arang Kayu Sebagai Bahan Stabilisasi Terhadap Kuat Dukung Tanah Lempung Sukodono dengan Variasi Perawatan*, Tugas Akhir, S1 Teknik Sipil, UMS.