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Stabilization of Laterite Soil with Several Types of Kalimantan Sand View From The Physical And Mechanical Properties Of Soil

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ABSTRACT

Laterite soils contain relatively high clay minerals especially illite and montmorilonite, so the potential for damage is relatively large. One way to strengthen the soil that can be used is to stabilize it by using sand. Research is needed on the characteristics of the physis and mechanical properties of laterite soils before and after stabilization using several types of Kalimantan sand, namely barito river sand, Palangka sand and Liang Anggang sand after being squeezed for 3 days and 7 days. Mechanical testing carried out is Unaxial Compressive Strength Testing and Vane Shear Testing. Soil samples tested in this study were types of inorganic clay with high plasticity taken from Mount Raja, Tanah Laut Regency, South Kalimantan. Based on unaxial compressive strength testing the 7day immersion time variation shows a significant increase in *qu* value in each mixed variation, especially native soil + 10% palm sand variation 7 days of immersion time which gets the greatest q_u value of 0.512 kg/cm2. In the vane shear test results a 7day immersion time variation showed a significant decrease in vane shear value in each mixed variation to a 3 day squeeze variation. Making variations of the original soil mixture + 10% barito river sand 3 days of splitting time get the highest vane shear value of 118 Kpa.

KEYWORDS
Laterite Soil
Vane Shear
Unaxial Compressive Strength
Stabilization

1. Introduction

Soil is an aggregate (aggregate) of natural mineral grains which can be separated by mechanical means when the aggregate is stirred in water (Terzaghi & Peck, 1987). Soil has a variety of uses, including as a basis for road pavement and embankment construction, so that in using it as a basis for constructing construction, one must consider the condition of the land to be used. Soil has various uses, including as a basis for road pavement and embankment construction, so that in using it as a basis for constructing construction, one must consider the condition of the land to be used. Soil is the most important part in a construction such as buildings, roads, and traffic loads because the soil has a function as a construction support or in other words on this soil a construction rests on aggregates (grains) of cemented solid minerals (chemically bonded) to each other. other and from decayed organic matter (solid particles) accompanied by liquids and gases that fill the empty spaces between the solid particles (Das et al., 1995)

Laterite soil or red soil is soil that has a red to brown color that is formed in a humid, cold environment, and also due to puddles. Laterite soils in South Kalimantan are often found in mountainous areas, these areas often experience high rainfall intensity, so that laterite soils or red soils are formed. During the rainy season, laterite soil becomes more muddy and has a strong stickiness.

According to the USDA soil classification (United States Department of Agriculture) Scientifique, laterite soils are formed in tropical or sub-tropical areas with high weathering levels in alkaline rocks to ultramafic rocks dominated by iron metal content. This soil contains relatively high clay minerals, especially illite and montmorillonite, so the potential for damage is relatively large if construction work is carried out on laterite soils.

Laterite soil stabilized using several types of Kalimantan sand has never been included in a study. However, there have been applications for materials to improve soil bearing capacity or stabilize lateritic soils.

This study uses various kinds of sand in Kalimantan, such as Barito River sand, Palangka sand and Liang Anggang sand. Barito sand has a very low silt content, medium grain variations are finer, slightly yellowish white in color. This sand is often found in the Barito River area which is located downstream. The results of Dewi Rosalinda's research (2016) Sand Liang Anggang has a uniformity of 2.30, an effective diameter of about 0.07 mm - 0.15 mm, media resistance is not good and has a morphology that looks lumpy with a rough surface and irregular grain shape equally. Meanwhile, Palangka sand has the characteristics of clear white or other colors depending on the impurity compound. In industrial activities, the use of Palangka sand has developed widely, both directly as the main raw material

In the results of analytical research that has been carried out previously by several authors such as (Syahdi & Suhaimi, 2017) which discusses the addition of white sand, it greatly affects the improvement of soil properties that will be used for stabilization materials. In addition, according to (Hafizh et al., 2017) , the effect of sandy clay gradation on the free compression strength and CBR value, it is known that stabilization materials using various mixtures, especially sand have a significant effect and change effect.

In this research, the laterite soil which has been stabilized with Barito sand, Palangka sand and Liang Anggang sand, is cured for 3 days and 7 days, the physical properties of the soil and the mechanical properties of the soil will be tested which includes free compressive strength testing and vane shear testing so that the compressive strength value is obtained. free (without any horizontal pressure from the side) original or artificial and the value of the vane shear of the laterite soil.

2. Method

The implementation of the research was carried out in several stages, namely preparatory work, field work, laboratory work and analysis of research results. Preparatory activities include preparing materials in the form of soil and sand, as well as preparing the tools used. Field work is taking soil samples at the site in the form of soil samples disturbed. Further testing is carried out in the laboratory, namely testing the physical and mechanical properties of the stabilized soil. The data from the laboratory tests were then analyzed so that several conclusions were obtained. In this study, two variations of the experiment were carried out, namely curing for 3 days and 7 days.

2.1. Data Collection

The tests carried out in this research include:

- Water content
  The water content (ω) is the ratio between the weight of water (Ww) and the weight of the grains (Ws) of the soil expressed in percent. The testing standard used is SNI 1965:2008
- Specific gravity
  The specific gravity of the soil (Gs) is the ratio between the weight of the grain volume (γs) and the volume of water (γw) at a certain temperature. The testing standard used is SNI 1964:2008. The test is carried out on disturbed soil.
- Uniaxial compressive strength test
  This strength test measures how strongly the soil receives a given compressive strength until the soil is separated from its grains and also measures the strain of the soil due to the pressure.
- Vane shear test
  To determine the vane shear value of a soil. Vane shear capacity can reach up to 200 kPa in shear strength in saturated soft soils.

2.2. Manufacture of Soil Test Objects

The cycle of making specimens in this study was divided into two, namely, specimens that were cured for 3 days and specimens that were cured for 7 days. The weight of the test object (%) in this study is divided into two, namely, first weighing 250 grams or 5% and 500 grams or 10% of the weight of the original soil sample to be mixed, which is 5000 grams. The following is a table of the composition of the mixture that will be used in the manufacture of test objects. In the mixture, the weight of the original soil sample used in this study was 5000 . The composition of the mixture can be seen in Table 2 and Table 3.

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Table 1. Composition of the Mixed Test Object

Number	Variation	Curing Time	Sample
1.	Original soil + 5% Barito river sand	3 day	3
2.	Original soil + 5% Barito river sand	7 day	3
3.	Original soil + 10% Barito river sand	3 day	3
4.	Original soil + 10% Barito river sand	7 day	3
5.	Original soil + 5% Palangka Sand	3 day	3
6.	Original soil + 5% Palangka Sand	7 day	3
7.	Original soil + 10% Palangka Sand	3 day	3
8.	Tanah asli + 10% Palangka Sand	7 day	3
9.	Tanah asli + 5% Liang Anggang sand	3 day	3
10.	Tanah asli + 5% Liang Anggang sand	7 day	3
11.	Tanah asli + 10% Liang Anggang sand	3 day	3
12.	Tanah asli + 10% Liang Anggang sand	7 day	3

Table 2. Preparation of original soil and sand mixture, with 3 days of curing time

Number	Original soil		Sand		Mixed total weight (gr)	Curing time
	Percentage (%)	Weight (gr)	Percentage (%)	Weight (gr)		
1.	95%	4750	5%	250	5000	3 days
2.	90%	4500	10%	500	5000	

Table 3. Preparation of original soil and sand mixture, with 7 days of curing time

Number	Original soil		Sand		Mixed total weight (gr)	Curing time
	Percentage (%)	Weight (gr)	Percentage (%)	Weight (gr)		
1.	95%	4750	5%	250	5000	7 days
2.	90%	4500	10%	500	5000	

3. Results and Discussion

3.1 Water Content Text

This water content test is intended to determine the moisture content of the soil sample, namely the ratio of the weight of water contained in the soil to the dry weight of the soil. The results of the water content test (Wc) showed that the original soil water content value was 33.66%. The results of testing the original soil moisture content with several types of Kalimantan sand in this study include the following.

Table 4. value of water content of mixed variation

Mixed Variation	Curing Time 3 days	Curing Time 7 days
Original soil + 5% Palangka sand	34,97%	33,85%
Original soil + 10% Palangka sand	32,75%	31,09%
Original soil + 5% Barito river sand	28,74%	25,31%
Original soil + 10% Barito river sand	26,68%	24,06%
Original soil + 5% Liang Anggang sand	30,22%	25,99%
Original soil + 10% Liang Anggang sand	26,15%	24,09%

From testing the original soil moisture content mixed with several types of sand, it can be seen that the longer the ripening period of the test object, the lower the value of the soil water content. From the results of testing the original soil moisture content, the value of 33.66% was obtained, and the highest water content value was obtained, namely the original soil + 5% sand of Palangka (curring time 3 days) which was 34.97%.

3.2 Specific Gravity

This specific gravity test is intended to determine the specific gravity of the soil that passes the No. sieve. 40 using a measuring flask (Picnometer). The results of the specific gravity test (Gs) show that the

value of the original soil density is 2.64. The results of testing the original soil density with several types of Kalimantan sand in this study include the following.

Table 5. Value of specific gravity of mixed variation

Mixed Variation	Curing Time 3 days	Curing Time 7 days
Original soil + 5% Palangka sand	2,52	2,55
Original soil + 10% Palangka sand	2,54	2,57
Original soil + 5% Barito river sand	2,50	2,52
Original soil + 10% Barito river sand	2,51	2,53
Original soil + 5% Liang Anggang sand	2,50	2,53
Original soil + 10% Liang Anggang sand	2,52	2,54

From testing the density of the original soil mixed with several types of sand, it can be seen that the longer the ripening period of the test object, the higher the value of the specific gravity of the soil. The highest soil density value is in the original soil mixture with 10% sand Palangka, which is 2.57

3.3 Uniaxial Compressive Strenght Test

The results of the original Uniaxial Compressive Strength test showed that the strain value was 4.12% and the stress was 0.696 kg/cm^2. The results of testing the original soil density with several types of Kalimantan sand in this research include the following:

Table 6. value of uniaxial compressive strenght of mixed variation

Mixed Variation	Curing Time 3 days	Curing Time 7 days
Original soil + 5% Palangka sand	0,304 kg/cm^2	0,405 kg/cm^2
Original soil + 10% Palangka sand	0,322 kg/cm^2	0,512kg/cm^2
Original soil + 5% Barito river sand	0,198 kg/cm^2	0,323 kg/cm^2
Original soil + 10% Barito river sand	0,216 kg/cm^2	0,433kg/cm^2
Original soil + 5% Liang Anggang sand	0,179 kg/cm^2	0,234kg/cm^2
Original soil + 10% Liang Anggang sand	0,267 kg/cm^2	0,463 kg/cm^2

From the uniaxial compressive strength test, it can be seen that the addition of a mixture of several types of sand to the laterite soil will reduce the value of the soil stress. This makes laterite soil stabilization with sand unable to increase the value of uniaxial compressive strength.

3.4 Vane Shear Test

Based on the results of the Vane Shear test on the original soil, the value of 82 Kpa. The results of testing the original soil density with several types of Kalimantan sand in this research include the following. From the vane shear test of the original soil mixed with several types of sand, it can be seen that the addition of sand can increase the value of the shear strength of the soil. However, the longer the curing time of the soil, the value of the shear strength of the soil will decrease.

Table 7. value of vane shear test of mixed variation

Mixed Variation	Curing Time 3 days	Curing Time 7 days
Original soil + 5% Palangka sand	112 kPa	58 kPa
Original soil + 10% Palangka sand	110 kPa	52 kPa
Original soil + 5% Barito river sand	114 kPa	73 kPa
Original soil + 10% Barito river sand	118 kPa	92 kPa
Original soil + 5% Liang Anggang sand	102 kPa	90 kPa
Original soil + 10% Liang Anggang sand	95 kPa	88 kPa

4. Conclusion

From the results of testing the original soil moisture content, the value of 33.66% was obtained, and the highest water content value was obtained, namely the original soil + 5% sand of Palangka (peram 3

days) which was 34.97%. Meanwhile, from the results of the original soil specific gravity test, the value was 2.64, and the average density value based on 12 test samples was 2.53, the results did not meet the specific gravity values of various types of soil in the specific gravity table. From the results of the Uniaxial Compressive Strength test, the original soil obtained a stress value of 0.696 kg/cm^2, and a significant value of uniaxial compressive strength (qu) in every variation of the mixture, especially the original soil + 10% sand palangka getting a value of uniaxial compressive strength (qu) the largest is 0.512 kg/cm^2. From the vane shear results, the original soil obtained a value of 82 KPa, while the variation of the original soil mixture + 10% barito river sand got the largest vane shear value, which was 118 KPa.

References

[1] Amu, O.O., et. al., 2011, Geotechnical properties of lateritic soil stabilized with sugarcane straw Ash, American Journal Of Scientific And Industrial Research

[2] A., P. A., Iswan, & Jafri, M. (2016). Pengaruh Variasi Waktu Pemeraman Terhadap Nilai Uji Kuat Tekan Bebas pada Tanah Lempung dan Lanau yang Distabilisasi Menggunakan Kapur pada Kondisi Rendaman. JRSDD Edisi Juni 2016, Vol. 4, No. 2, 4, 237 - 255.

[3] Al Hafizh, M. S., Wibisono, G., & Nugroho, S. A. (2017). Stabilisasi Tanah Lempung Dengan Pasir Bermacam Gradasi Dan Campuran Kapur. Jom FTEKNIK Volume 4 No. 2 Oktober 2017, 1 – 9

[4] Bowles, Joseph E. 1989. Sifat-sifat Fisik & Geoteknis Tanah. Jakarta : Erlangga

[5] Das, B. M., Endah, & Mochtar, I. B. (1995). Mekanika Tanah (Prinsip - Prinsip Rekayasa Geoteknis). In B. M. Endah, & I. B. Mochtar, Mekanika Tanah (Prinsip - Prinsip Rekayasa Geoteknis) (pp. 1 - 291). Ciracas, Jakarta: Penerbit Erlangga

[6] Febriani,F., Dkk, 2014. Perilaku Kuat Tekan Tanah Laterit Dengan Stabilisasi Kapur Dan Semen. Departemen Teknik Sipil: Universitas Hasanuddin : Makasar

[7] Hakam, A., Yuliet, R., & Donal, R., (2010). Studi pengaruh penambahan tanah lempung pada tanah pasir pantai terhadap kekuatan geser tanah. Rekayasa Sipil, 6(1), 11–22.

[8] Hardiyatmo, H. C. (2002). *Mekanika Tanah I.* Yogyakarta: Gadjah Mada University Press.

[9] Hardiyatmo, H. C. (2003). *Mekanika Tanah II.* Yogyakarta: Gadjah Mada University Press.

[10] Kara, E. M., et al. (2013). Contribution of Particles Size Ranges to Sand Friction. Engineering, Technology & Applied Science Research (ETASR), 3(4), 497– 501.

[11] Lasino, Sugiharto B, Cahyadi D. 2011. Pemanfaatan Pasir dan Debu Merapi Sebagai Bahan Konstruksi Dalam Mendukung Pembangunan Infrastruktur dan Meningkatkan Nilai Guna Lahar Vulkanik. Prosiding PPI Standardisasi 2011. p. 20-36. Yogyakarta

[12] Salonten, Untung, T., & Kurnia, B. A. (2018). Analisis Perbandingan Pasir Kuning Desa Gohong Kabupaten Pulang Pisau Dengan Pasir Putih Desa Petuk Berunai Kecamatan Rakumpit Kota Palangka Raya Sebagai Campuran Pada Hot Rolled Sheet – Base (Hrsbase). *Jurnal Teknika*, 160 - 168.

[13] Saeed, H. S.-A. (2009). Geotechnical Properties of Clayey Sand. University of Khartoum: Building and Road Research Institute (BRRI).

[14] Setiawan, I., Muzaidi, I., & FItriansyah, M. (2019). Laterite Soil Behavior - Geotextile (Study of Laterite Soil, Tanah Laut District). 2019 3rd International Conference on Engineering and Applied Technology (ICEAT), 1 - 5.

[15] Siska, H. N., & Yakin, Y. A. (2016). Karakterisasi Sifat Fisis dan Mekanis Tanah Lunak di Gedebage. Reka Racana Jurnal Online Institut Teknologi Nasional, 44 - 55.

[16] Syahdi, & Suhaimi, M. (2019). Pengaruh Penggunaan Bahan Tambah Pasir Putih Untuk Stabilisasi Tanah Desa Bangkuang. JURNAL GRADASI TEKNIK SIPIL, 1 - 7.

[17] Tangkeallo.M.M,Samang L, A.R. Djmaluddin and Muhiddin, A.B . 2018. “Experimental Study Of Laterite Soil Stabilized With Zeolite” ”The 4th International Symposium on infrastruktur Development. Manado Indonesia October 12, 2018

[18] Terzaghi, K., & Pack, R. B. (1987). Mekanika Tanah dalam Praktek Rekayasa. In K. Terzaghi, & R. B. Peck, Mekanika Tanah dalam Praktek Rekayasa (pp. 1 - 383). Jakarta: Penerbit Erlangga

[19] Wardana, I. Gusti. Ngurah, 2009. Kelakuan Tanah dengan Sifat Kembang - Susut yang Tinggi pada Stabilisasi Tanah dengan Bahan Serbuk marmer dan Bahan Stabilia. Jurnal ilmiah teknik sipil, (Online), Vol.13(2): 161-172

[20] Yeimo, D. 2014. Kajian Stabilisasi Tanah Lempung Menggunakan Pasir dan Kapur Sebagai Subgrade Pada Ruas Jalan Enarotali Madi Kabupaten Paniai Provinsi Papua. Tesis. Univesitas Gadjah Mada. Yogyakarta.