Original Article
ISSN (Online): 2454-1907

International Journal of Engineering Technologies and Management Research
January 2023 10(1), 79–84

IMPROVING CLAY SOIL STABILITY WITH THE ADDITION OF RICE HUSKS THROUGH CHEMICAL METHODS

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Received 08 December 2022
Accepted 09 January 2023
Published 26 January 2023

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DOI
10.29121/ijetmr.v10.i1.2023.1290

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

Soil stability is a mixture of soil with a certain material, the aim is to improve the technical properties of the soil so that it can technically meet certain requirements. Soil stability is a mixture of soil and other materials, for the purpose of achieving the correct gradation, so that the technical properties of the soil are better. Chemical stability is the addition of chemical elements to the clay with the addition of other ingredients, namely rice husk ash (ASP), so that a physical change is achieved and a change in the physical properties of the soil occurs, with an increase in the size of the soil load capacity (CBR). This study aims to obtain the appropriate variable for adding rice husk ash to the stability of clay as a stabilizer seen from the unconfined compressive strength test to obtain a capacity value of high load. The research method was carried out by testing the properties of soil index, soil compaction tests (standard proctor) and unconfined compression strength tests (Unconfined Compression Strength) in the laboratory. 200 with variations of 5%, 10% and 15%. Index property tests such as water content tests refer to ASTM D2216:2010, Sieve Analysis (ASTM D-422), Atterberg Limit, Liquid Limit (LL) (ASTM D-4318), and Specific Gravity (Gs) (ASTM D-854). Soil mechanical properties test (proctor standard) (ASTM D 698), free compression resistance test (ASTM D 2166). The conclusive results show that the free compressive strength value increased in the mass without hardening with a 10% husk ash percentage of 1.0005 kg/cm2 and a Cu value of 0.502 kg/cm3. While the results of the free compression strength test with curing for 24 hours, the highest bearing value occurred, in the original soil variation of 1.000 kg/cm3 and a Cu value of 0.500 kg/ cm3. For the value of the free compressive strength, there is a decrease, namely at variations of 5%, 10% and 15% with a time of 24 hours.

Keywords: Rice Husk Ash, Soil Stability, ASTM, Bearing Capacity Value

1. INTRODUCTION

Soil is the base layer as a layer of building structures which have good properties and load-bearing capacity. The strength of the structure is strongly influenced by the ability of the foundation soil to support the workload. In a sector, not all types of soil have good properties and good bearing capacity, because in general some are heterogeneous and anisotropic Das (1991). Clay soils are soils that exhibit the characteristics of fine-grained soils and have a specific surface area with larger grain sizes, more pores, and lower permeability than coarse-grained soils. Where clay is very easy to expand and shrink due to changes in water content. It is this shrinkage factor that can interfere with the strength of a construction building such that the construction suffers unpredictable physical damage, where the pavement layer above the basement cracks and causes the road to ripple of construction. Seeing this condition, special treatment is required to improve the properties of clay soil by increasing the carrying capacity of the soil by increasing the parameters, soil density and soil inclination angle Bowles (1991). This study aims to obtain the right variable in adding rice husk ash to the stability of clay as a stabilizer seen from the uncofined compressive strength test to obtain a capacity value of high load. This research was carried out by a chemical method with the addition of rice husk ash to clay soil because rice husk ash contains elements of the chemical compound silica and when added to pozzlan material containing elements of free lime compounds, it hardens by itself, in addition to that the husk ash contains aluminum dioxide which reacts easily with lime Widhiarto et al. (2015).

2. METHODOLOGY

Soil samples were taken from Jalan Mutual Cooperation, Sukodadi, Sukarami District, South Sumatra. Soil property index test, soil compaction test (standard proctor) and independent compressive strength test were performed. 200 with variations of 5%, 10% and 15%. Index property tests such as water content tests refer to ASTM D2216:2010, Sieve Analysis (ASTM D-422), Atterberg Limit, Liquid Limit (LL) (ASTM D-4318) and Specific Gravity (Gs) (ASTM D-854). Soil Mechanical Properties Test (Proctor Standard) (ASTM D 698), Free Compressive Strength Test (ASTM D 2166)

Table 1

Table 1 Mixed Regime

Variation	Mixture (kg)		Period Ripening		Number of Sample
	TA	ASP	0	1	
T+ASP 0%	2	0	1	1	2
T+ASP 5%	1,9	0,1	1	1	2
T+ASP 10%	1,8	0,2	1	1	2
T+ASP 15%	1,7	0,3	1	1	2
Number of Sample					8

Information:

T+ ASP 0% = Native Land + 0% Rish Husk Ash

T+ASP 5% = Native Land + 5% Rish Husk Ash

T+ASP 10% = Native Land + 10% Rish Husk Ash

T+ASP 15% = Native land + 15% Rish Husk Ash

3. RESULTS AND DISCUSSION

Based on the results of data analysis performed from soil physical property tests including soil water content, particle size analysis (sieve analysis), Atterberg limits (plastic limit and liquid limit) and specific gravity (soil density). A test of the mechanical properties of the soil was carried out with several parameters, namely: soil compaction (Standard Ptoctor) and resistance to free compression (Uncofined Compression Streght).

3.1. SOIL PHYSICAL PROPERTIES TEST (INDEX PROPERTIES)

This property index test is a test of the physical characteristics of the original soil. The results of the property index test can be seen in Table 2 below.

Table 2

Table 2 Physical and Mechanical Properties of Parent Soil and Soil Classification

No	Soil Indentification (%)	Test Result
1.	Water Content	36,53
2.	Soil passes the sieve no.200	53,16
3.	Liquit Limit (LL)	78,17
4.	Plasticity Indeks	38,38
5.	Plastic Limit	39,79
6.	Spesifik grafity (Gs)	2,60
7.	Soil Classification (AASHTO)	A-7-5
8.	Soil Classification (USCS)	OH
9.	Optimum water content	22,084
10.	Specific Gravity (kg/cm2)	0,435

3.2. TEST RESULTS FOR SPECIFIC GRAVITY AND ATTERBERG LIMITS OF MIXED SOIL

The Atterberg limit test (plastic limit and liquid limit) was also carried out on a mixture of rice husk ash with a percentage of 5%, 10% and 15%. The test results can be viewed in Table 3.

Table 3

Table 3 Atterberg Limits Test Results

Mixed Variation	Spesifi Gravity	Atteberg Limit		
		LL (%)	PL (%)	IP (%)
Native Land	2,60	78,17	38,38	39,79
Native Land + 5% ASP	2,59	72,25	40,48	31,77
Native Land + 10% ASP	2,49	67,19	44,77	22,42
Native Land + 15% ASP	2,21	66,97	45,19	21,78

From the test results of Atterberg limit (plastic limit and liquid limit) on soil, it was found that soil liquid limit (LL) was 78.17% with d value plastic index (IP) of 39.79% and a plastic limit (PL) of 38.38%. Clay soil that had been mixed with a 5% to 15% rice husk ash mixture experienced a significant decrease (IP), from the initial value (IP) of 39.79% to 21.78%. However, the plastic limit value (PL) with increasing variations in the rice husk ash mixture showed an increase with the value (PL) being from 38.38 to 45.19%. The specific gravity (Gs) test results obtained from the original soil sample yielded a result of 2.60. Although the soil specific gravity (Gs) test results obtained from the original soil sample and the soil mixed with rice husk ash can be seen in Table 3, knows that the specific gravity (Gs) of adding rice husk ash decreased in each percentage of the mixture from the original soil of the value of specific gravity (Gs). The greater the variation of adding rice husk ash to the soil, the lower the value of its specific gravity (Gs). In native soil, the value of specific gravity (Gs) is 2.60. In the variation of adding 15% rice husk ash which is the lowest specific gravity (Gs) value of 2.21.

3.3. MIXED SOIL COMPACTION TEST (STANDARD PROCTOR).

This compaction test was performed on native soil and soil mixed with rice husk ash with percentage of 5%, 10% and 15% where each sample was performed at least five times with moisture content different to obtain the maximum dry unit weight (γd).) and the optimal water content (Wopt). Table 4 shows the dry unit weight (γd) and optimum water content (Wopt) of each percent blend.

Table 4

Table 4 Compaction Test Results

Mixed Variation	Maximum Dry Volume Weight (gr/cm3)	Optimum Moisture Content (%)
Native Land	1,385	22,084
Native Land + 5% ASP	1,371	26,707
Native Land + 10% ASP	1,403	21,278
Native Land + 15% ASP	1,357	28,655

Standard Proctor soil compaction test results obtained from the original soil sample gave an optimum water content value (Wopt) of 22.084% and a maximum dry density value (ɣ*d* max) of 1.385 gr/cm3. While the standard soil compaction test results were obtained from the original soil sample and the soil mixed with rice husk ash, there was a significant decrease in the percentage of addition of 10% rice husk ash, it was found that the soil compaction value of adding the rice husk ash gave an optimum water content (Wopt) value of 21.278% and the value maximum dry density (ɣ*d* max) is 1.403 gr/cm3.

4. FREE COMPRESSIVE STRENGTH TESTING

From the free compressive strength test, bearing capacity (qu) and cohesive values (qu) can be produced on native soils as well as on clay soils with various variations of rice husk ash mixtures. Free compression strength tests were also carried out on soil mixed with rice husk ash with a mixture percentage of 0%, 5%, 10% and 15%, with preservative-free conditions and 24-hour cure. Thus, the results are obtained as in Table 5.

Table 5

Table 5 Bearing Capacity (qu) And Cu Values of Original Soil and Mixed Soil

Mixed Variation	Value qu (kg/cm2)		Value Cu (kg/cm2)	
	Conditions Without Aging	Ripening Condition 24 Hour	Conditions Without Aging	Ripening Condition 24 Hour
T.L + 0% A.S. P	0,435	1,000	0,217	0,500
T.L + 5% A.S. P	0,702	0,584	0,351	0,292
T.L + 10% A.S. P	1.005	0,764	0,502	0,382
T.L + 15% A.S. P	0,752	0,636	0,376	0,318

In Table 5, it shows that the highest load capacity value in the native soil increased during the 24-hour drying, which is 1000 kg/cm2, which is different from that without drying, while the load capacity value for the variations of the addition of rice husk ash is 5%, 10% and 15% at curing 24 hours decreased. From Table 3, it can be seen that the highest carrying capacity value was in the 10% variation of rice husk ash mixture of 1.005 kg/cm2, but the carrying capacity value decreased in the rice husk ash mixture percentage, namely at 15% variation. The conclusive results show that the free compressive strength value increased in the mass without hardening with a 10% husk ash percentage of 1.0005 kg/cm2 and a Cu value of 0.502 kg/cm3. While the results of the free compression strength test with curing for 24 hours, the highest bearing value occurred, in the original soil variation of 1000 kg/cm3 and a Cu value of 0.500 kg /cm3. For the value of the free compressive strength, there is a decrease, namely at variations of 5%, 10% and 15% with a time of 24 hours. This is because if the rice husk ash is mixed with the soil, a soil flocculation process will occur, and the size of the clay grains will become large. Apart from this, fluctuation process and soil stability occur if there is an addition of pozzolana process and hydration process Arima Sefta and Rustam (2021). Seeing the above statement, the higher the addition of rice husk ash, the lower the carrying capacity of the soil. According to Abdurrozak and Mufti (2017), the high addition of husk ash will cause the adhesion between soil particles and water to decrease, and the soil will break easily when vertical pressure is applied.

5. CONCLUSION

The conclusive results show that the free compressive strength value increased in the mass without hardening with a 10% husk ash percentage of 1.0005 kg/cm2 and a Cu value of 0.502 kg/cm3. While the results of the free compression strength test with curing for 24 hours, the highest bearing value occurred, in the original soil variation of 1000 kg/cm3 and a Cu value of 0.500 kg /cm3. For the value of the free compressive strength, there is a decrease, namely at variations of 5%, 10% and 15% with a time of 24 hours. And the high addition of rice husk ash will affect the decrease in compressive strength and breakability.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

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