EXPANSIVE SOIL STABILIZATION USING MUD (LAPINDO) AND ASPHALT EMULSION

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ABSTRACT

Most of Gedebage area consist of expansive soil and always greatly induce disturbance to structure of foundation. Nature properties of expansive soil is a high plasticity value, low soil shear strength, high swelling, and large potential for shrinkage. One solution for soil improvement is to use an additional material to stabilize this soil. Additional material uses locked emulsion asphalt 8% and mud from Lapindo area in variation of 3%, 6%, 9% and 12%. The results of testing the physical and mechanical properties after stabilization indicates increasing of density value around 68%. Plasticity index tends to decrease until 10% from CBR test. CBR values with curing time of 14 days are 8.1% for unsoaked and by 4.6% for soaked conditions.

Keyword: Stabilization, Lapindo Mud, Asphalt Emulsion

1. INTRODUCTION

This study aims to determine and obtain several parameters from the results of physical and mechanical properties testing aimed at stabilizing expansive soil conditions using a mixture of and asphalt emulsion and Lapindo mud [1]. Design of sub-structure is very influenced by size and type of soil foundation where the foundation structure embedded [2] . Mud Lapindo area at Sidoarjo district east Java Province, Indonesia is the side impact produced of oil drilling [3]. Discharge of mudflow reaches 120,000 m per day and flooded of eight villages. This mud still comes out in small volume bursts [4]. Some physical properties have been studied in the detail [5] the results show texture of the clay 62%, dust 35% and sand 3%. Sidoarjo mud soil has a cation exchange capacity (CEC) with 42.58 me / 100g Ref. Lapindo mud contains chemicals, one of which is silicate mineral (SiO2) which is higher than cement and lime (CaO). The silica content is a filler between inter-particles. Meanwhile, the lime content is a binder between outer particles. Normally, mud content is used as cement ingredients [6] [7]. Soil stabilization is one of the efforts aimed to improve the nature properties of soil foundation with the additional materials in increasing shear strength [8]. One of additional material is selected mud from Lapindo and asphalt emulsion to stabilize the expansive soil [9].

Stabilization is a process in which an additive or reagent is mixed with waste to minimize the rate of transfer of contaminants present in the waste to the environment and to reduce the level of toxicity of the waste. From the case of the Lapindo mudflow that occurred The hot mudflow at the drilling site owned by PT Lapindo Brantas that occurred since May 29, 2006 resulted in a number of villages in Sidoarjo, East Java The chemical content of the Lapindo Mud such as SiO2 53.08% and CaO 2.07%, where the silica content functions as a filler material from the test results [10] and has a fairly good effect in increasing the bearing capacity of expansive soils. Therefore, one waste that will be used as a mixing material for expansive soil is Lapindo Mud which aims to increase the carrying capacity of expansive soil.

The process of taking silica content in Lapindo mud can be done by chemical processes and SEM testing to find out how much silica content in the mud.

2. RESEARCH METHOD

Research was conducted at the Laboratory Test Material to find out stabilization value with additional material from Lapindo mud and emulsified asphalt. Figure 1 shows the flowchart of this study.

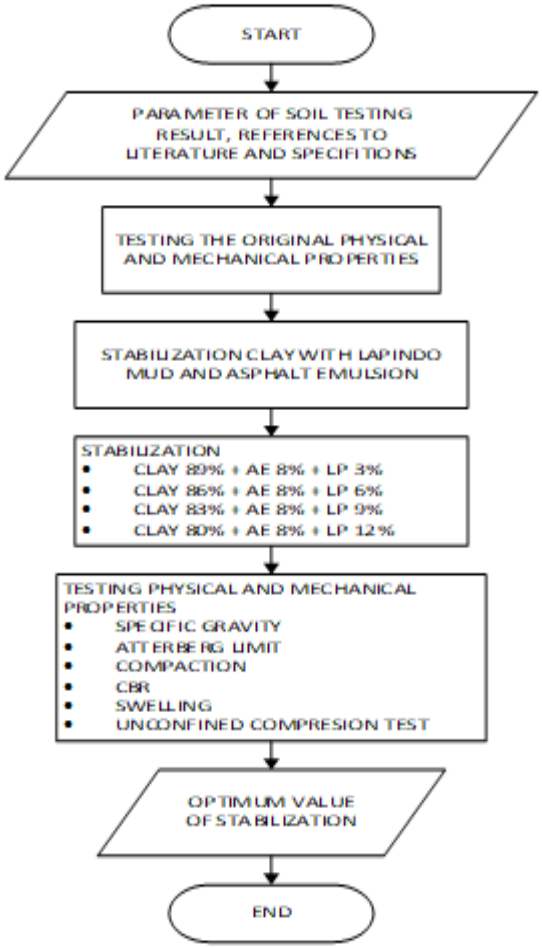

Figure 1. Testing methodology in the laboratory

3. RESULT

3.1 Test Result of Mixed Subgrade Physical Characteristics

Table 1 shows the test results of soil properties and some variables to determine the optimum content of additional material to expansive soil.

Table 1 Physical Properties Testing

	Index Properties	***Symbol***	**Unit**	**Clay**	**Lapindo Mud**	**Variable**			
						1	**2**	**3**	**4**
1	Atterberg Limit								
1.1	Plastic Limit	PL	%	38	21	32.67	26.3	30.9	22.7
1.2	Liquid Limit	LL	%	85	48	48.39	43.0	40.4	40.4
1.3	Plasticity Index	PI	%	47	27	15.72	16.6	9.5	17.7
1.4	Shrinkage Limit	SL	%		14	8.05	14.7	16.5	11.1
2	specific gravity	Gs		2.59	1.15	2.05	2.08	2.03	3.46
3	Grain Size								
3.1	Gravel	G	%	0	-	-	-	-	-
3.2	Sand	Symbol	%	4.62	-	-	-	-	-
3.3	Silt	M	%	39.38	-	-	-	-	-
3.4	Clay	C	%	51	-	-	-	-	-

Information:
Variable 1 = 3% Lapindo Mud
Variable 2 = 6% Lapindo Mud
Variable 3 = 9% Lapindo Mud
Variable 4 = 12% Lapindo Mud

3.2 Mechanical properties test results

1. Compaction

Results of the compaction test is shown that the optimum water content decreases according to increase percentage of Lapindo mud. Can be seen in Figure 2 below:

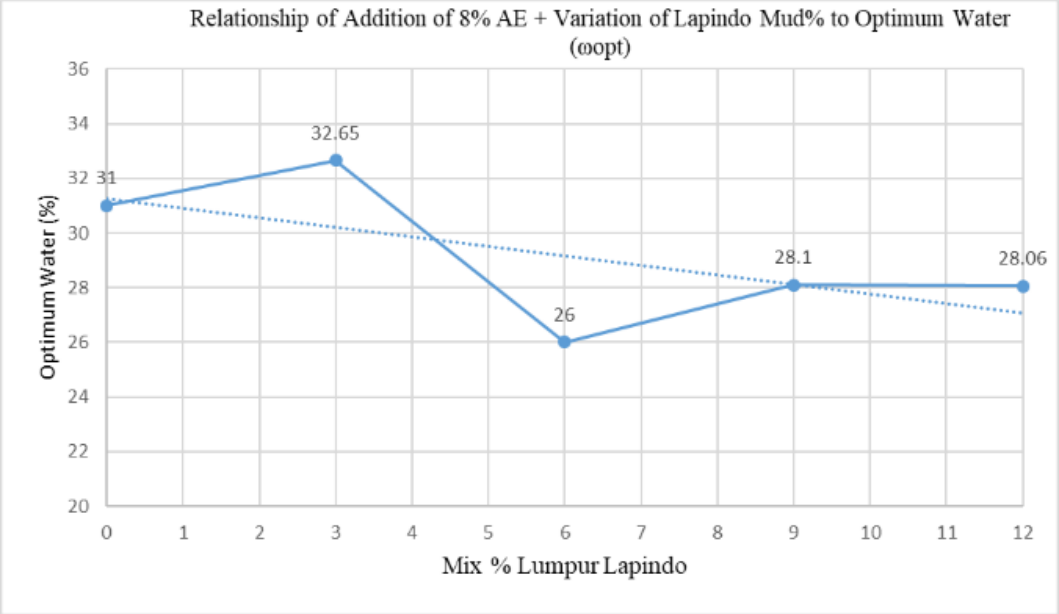

Figure 2 curve of optimum moisture content Addition of% Asphalt Emulsion + Variation of% Lapindo Mud Mixture

The compaction test shows that the dry weight volume increases with the addition of Lapindo mud.

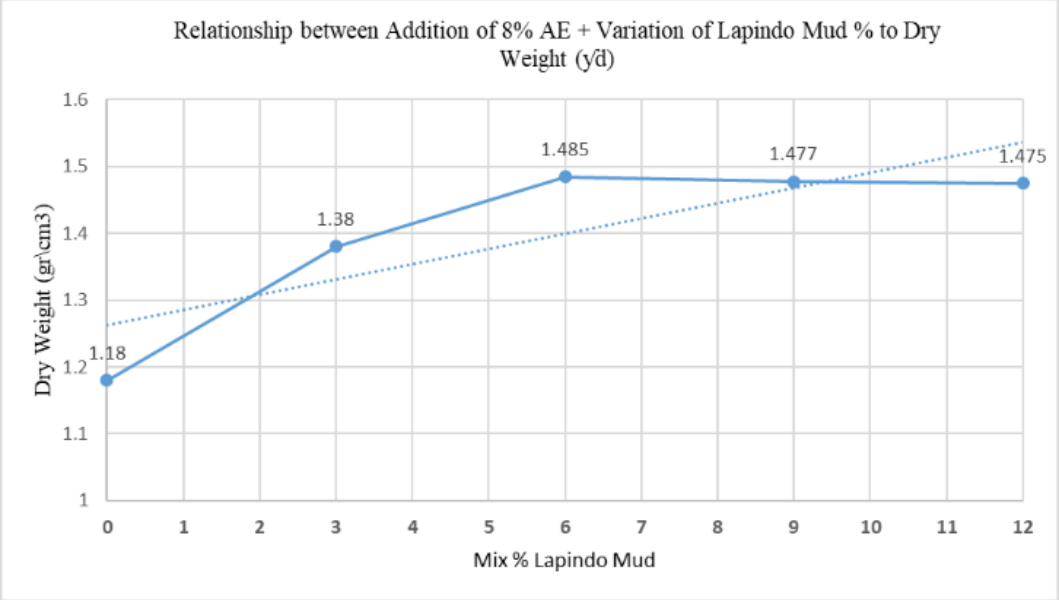

Figure 3 curve of Mixture Dry Weight (γ_d) Addition of% Asphalt Emulsion + Variation of% Lapindo Mud

From the results of the dry weight compaction test (γ_d) in the image above, this shows that in mixing 0, The dry weight value (γ_d) is 1.18 gr/cm^3, while the locked emulsion asphalt mixture variable is 8% and the Lapindo mud mix varies. Then the dry weight (γ_d) value of the 3% Lapindo mud is 1.38gr/cm^3, at 6% it is 1.485 gr/cm^3, the 9% mixture is 1.477 gr/cm^3. obtained dry weight (γ_d) of 1.475 gr/cm^3.

2. Testing CBR (*California Bearing Ratio*)

Plastic Index decrease until below 11% with the additional Lapindo mud from the CBR test.

Table 2 CBR test results from the variable mixture of asphalt emulsion and Lapindo mud

	Technical Properties	Days	*Symbol*	Unit	Expansive Soil	Variable 3
1	Unsoaked					
1.1	Curing	0	CBR design	%	4.1	4.5
1.2	Curing	3	CBR design	%	-	6
1.3	Curing	7	CBR design	%	-	6.9
1.4	Curing	14	CBR design	%	-	8.1
2	Soaked					
2.1	Curing	0	CBR design	%	1.8	2.1
2.2	Curing	3	CBR design	%	-	2.7
2.3	Curing	7	CBR design	%	-	3
2.4	Curing	14	CBR design	%	-	4.6

In table 2, the results of unsoaked and soaked CBR showed that the percentage value of variable 3 continued to increase with curing time compared to expansive soil with the percentage of unsoaked CBR values of 4.1% and 1.8% of Soaked.

3. *Swelling*

Swelling potential value below the optimum moisture content is taken from the index plasticity tests. This study was conducted to determine how much swelling percentage and Expansive Soil mixtures of Asphalt emulsion with 9% Lapindo Mud.

Table 3 Result Swelling Stabilization Materials

Technical Properties		Days	Unit	Expansive Soil	Variable 3
1.1	Curing	0	%	3.37	2.7
1.2	Curing	3	%	-	2.53
1.3	Curing	7	%	-	2.33
1.4	Curing	14	%	-	1.90

Table 3 shows that the value of swelling test specimen volume (Swelling) Mix 3 at 0 days curing time was 2.7% decreased by 1.7% at 3 days curing time and then dropped back to 0.2% at 7 days curing time and at 14 days curing time decreased also 0.43% or decreased by 99.92% from the 0-day curing time.

4. Unconfined Compression (q_u)

Table 4 Result Testing Unconfined Compression (q_u)

	Technical Properties	*symbol*	unit	Variable 1	2	3	4
1.	Unconfined Compression (UCS)						
1.1	Curing 0 Days	q_u	Kg/cm^2	5.552	4.995	3.930	3.366
1.2	Curing 3 Days	q_u	Kg/cm^2	6.530	6.329	5.147	4.501
1.3	Curing 7 Days	q_u	Kg/cm^2	7.465	7.475	6.559	5.795
1.4	Curing 14 Days	q_u	Kg/cm^2	6.998	6.649	6.343	6.1261

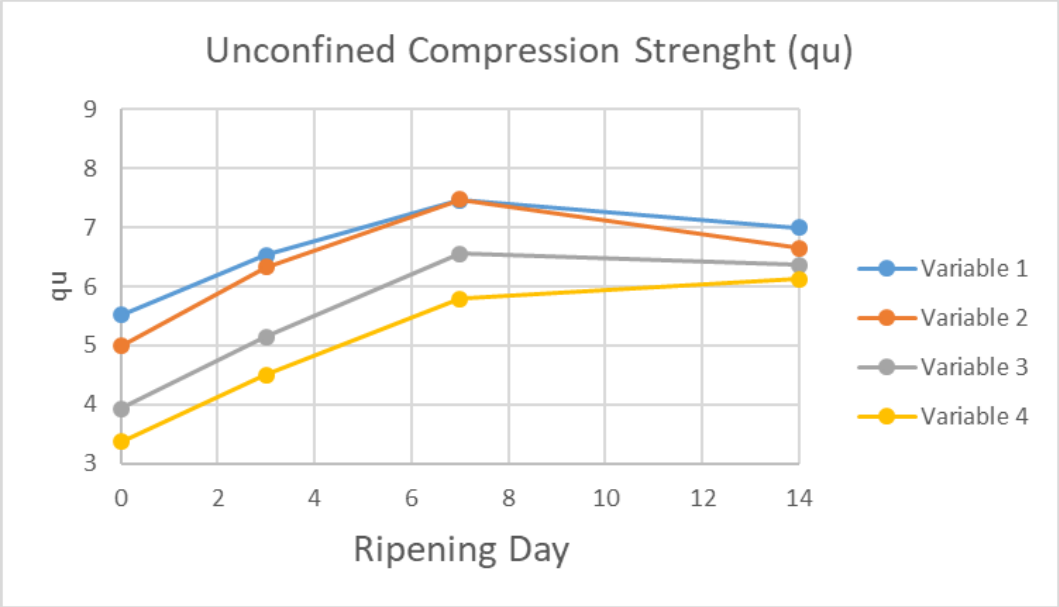

Figure 4 Soil compressive strength value curve

Graph of figure 4 In the use of soil compressive strength, this is one of the methods used to evaluate the performance of soil stabilization, and the value of free compressive strength is one of the main parameters that can be applied in planning the design of a project for earthworks [11]. the value of compressive strength, the longer the curing time, the value of the free compressive strength increases.

5. CONCLUSION

Based on the results of tests carried out in the laboratory, from the results of the compaction test by adding a mixture of asphalt emulsion material and Lapindo mud. From the results of soil compaction testing, the optimum dry weight (γd) value in the 12% Lapindo mud mixture is 1.475gr/cm3. Meanwhile, the optimum water content value (ωopt) was obtained in the 3% Lapindo mud mixture of 32.65%. For the CBR test, variable 3 is taken because it has a significant plasticity index value, which is less than 10%. The CBR value for unsoaked was 8.1% and 4.6% for soaked. Meanwhile, from the test results of the four Unconfined Compression Test (UCS) variables, the value of the independent compressive strength continued to increase up to 7 days of curing time, while at 14 days of curing it decreased.

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