Effect of Additive Chemicals on Soil Characteristics

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Abstract. The occurrence of landslides in the hills of Walahir, Kidang Pananjung village, Cililin subdistrict. Bandung in May 2004 needed attention and research so that the causes of the landslide could be identified. This landslide took many lives and property, heaped around 5 hectares of rice fields and residents' villages below and claimed 15 lives. Based on geotechnical investigations, the slip plane is at a depth of 4 meters from the ground surface and the area of the landslide ranges from 30,000 m2 leaving weathered rock beneath. Is the opening of agricultural land and fields followed by the use of chemical fertilizers is one of the causes of landslides? This study aims to determine the effect of a single chemical fertilizer (Urea, Za, SP36) and compound (Green Giant NPK, MKP) on the soil under conditions of optimum water content and water saturation or soaked which are carried out at the Chemical Laboratory of the Department of Energy and Mineral Resources of Bandung and Mechanics Laboratory Bandung Institute of Technology. Research on the influence of chemical fertilizers which is carried out using percentages of 1%, 2% and 3% with a relatively short ripening time intends to analyze the extent to which chemical fertilizers have an effect. Research is limited to the identification of minerals and chemical elements of original soil, soil physis properties, Atterberg boundaries, soil index properties, soil classification, soil elastic modulus. Hypothesis; The chemical content of fertilizers in the soil causes changes in soil characteristics. The method of taking original soil is by drilling original soil around the area where landslide disaster occurred at the same height as the height of the landslide slope, soil samples taken from depths of 1 meter and 3 meters from the surface of the land or the base layer between soil and rocks based on ASTM D-1452, 1587, 1586. Laboratory data from the original soil and chemical soil mixture of fertilizers is needed as input data for the study material and is an analytical proof of the hypothesis. Based on research that the presence of chemical fertilizers in soil samples with optimum water content causes the water content in the soil to decrease this is because chemical fertilizers absorb water while the soaked soil samples cause the water content in the soil to increase, the plasticity index decreases so that changing the soil classification in the area from OH-MH becomes ML-OL unified classification and the elasticity of the soil changes. Based on the analysis that the presence of chemical fertilizers showed an influence on the physical properties of the soil where soil minerals are very possible the replacement of cations of the chemical elements contained in the chemical fertilizers. The addition of chemical fertilizer by 3% and curing time for 14 days is a maximum condition compared to the percentage and age of other curing.

1. Introduction

1.1. Background and problems

The occurrence of landslides in the hills of Walahir, Kidang Pananjung Village, Cililin District. Bandung is a natural disaster that needs attention and research so that the strength of the soil can be known and stabilizes the soil around the incident, so that the strength of the land increases and the disaster does not recur in the future both in the region and elsewhere with the slope, structure and texture relatively the same soil. The landslide occurred in May 2004, claimed many lives and property, heaped around 5 hectares of rice fields and residents' villages below and claimed 15 lives. The Landslide Field is at a depth of 4 meters from the surface of the land and the area of the landslide ranges from 30,000 m2, leaving weathered rocks beneath. Hypothesis; The chemical content of fertilizers in the soil causes changes in soil characteristics.

1.2. Research purpose

Objectives This study aims to determine the effect of chemical fertilizers on the soil against:
Soil plasticity index (Atterberg limit) and water content. This research is limited to studies including: (1) Identification of minerals and chemical elements of original soil, (2) The physical properties of original soils and soils plus chemical fertilizers, (3) Atterberg boundaries of original soil and soil plus chemical fertilizers; Plasticity index, Liquid limit and Plastic limit, (4) Index of original soil properties, (5) Classification of the original soil and soil plus chemical fertilizers.

1.3. Research methodology and data collection location

1.3.1. Methodology research

Testing of soil in landslide areas is research material to be studied with a tendency to increase the chemical elements of fertilizer either single fertilizer and compound fertilizer, the type of testing include: (1) Test Lab physical properties of soil (γdry,γwet ASTM D-2049), (2) Lab Test boundaries of Atterberg - ASTM D-427, 423,424, (3) Soil Classification, (4) Soil specific gravity (Gs), (5) Index properties, (6) Compacting Lab Test, (7) Swelling-ASTM Lab Test D-4546. [1][2][3][4]
This soil testing is a quantitative research with full experimental approach. [16]

1.3.2. Data Collection Location

Original soil samples were taken around the area of the May 2004 landslide on the slopes of the hills of Walahir, Kidang Pananjung Village, Cililin District, Bandung Regency. Landslide May 2004, Pictures Taken on August 29, 2005.

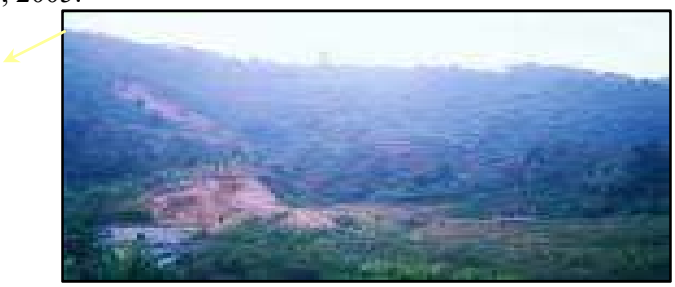

Figure 1. Location of walahir hills landslide

Figure 1 is a problem and research location of landslide disasters occurring in Walahir hills. The research was carried out at the Bandung Institute of Technology Laboratory and chemical laboratory of the Bandung Department of Energy and Mineral Resources.

2. Data collection method, soil parameters and additive substances chemical

2.1. Data collection method

Intake of original soil by drilling at the location point with each soil sample at a depth of 1.00 - 1.40 m which is a surface soil with a dominant fertilizing effect and a depth of 3.00 - 3.40 m which is the basic layer between soil and rock, Lab-based test - ASTM D 1452, 1587, 1586. [4][5][6][14][15]

Table 1. Minerals and structure chemical of walahir soil

Score	Scale Factor	Compound Name	Chemical Formula
10	0.065	Nontronite clay	$Fe_2\ Si_4\ O_{10}\ (OH)_2$!4 H_2O
6	0.074	Illite-1\ITM\RG [NR]	$K0.7\ Al_2\ (Si, Al)_4\ O_{10}\ (OH)_2$
6	0.057	Chloritoid	$(Fe, Mg)_2\ Al_4\ Si_2\ O_{10}\ (OH)_4$
9	0.127	Faujasite	$La_{13.6}\ Al_{41.28}\ Si1_{50.72}\ O_{384}\ (H_2O)_{46.9}$
15	0.136	Silicon oxide - $-alpha	SiO_2
9	0.155	Sodium tecto-tris	$Na_2(Zn_2(TeO_3)_3)(H_2O)_{2.97}$

2.2. Parameter of walahir original soil

Data Soil Mechanics Lab Test Results on Soil Walahir [4][12][13].

Table 2. Swelling index soil walahir, depth: 1 to 1.4 m

Number of Collision	Swelling Index (%)
10 x	0.65
25 x	0.49
56 x	0.39

Table 3. Walahir grains

Soil Type	Percentage Weight Escaped Filter # 200 In Depth		Type Test
	1 - 1.4 m	3 - 3.4 m	
Gravel	0.000	0.203	Grain Size
Sand	10.907	12.808	
Silt	81.339	78.475	
Clay	7.754	8.514	

2.3. Data Substance Additive Chemical

Fertilizers have long been used as a medium to improve quality and yield of plants, various trademarks and various chemical constituents therein. [5][6][7][8][11].

Types of fertilizers that are often used include: (1) Single fertilizer type; Urea, Za, SP36, (2) Types of Compound Fertilizers, among others are listed in the table 4.

Table 4. Types of compound chemical fertilizer

No	Fertilizer Name	Element Content
1	Green Giant NPK	N, P_2O_5, K_2O, Ca, Cu, Mg, Mo, Mn, B, Fe, S, Se, Na, Zn
2	M.K.P	P_2O_5, K_2O

3. Research result

Laboratory Data Test Results of Soil Plus Chemical Fertilizer.Soil is added with chemical fertilizer by mixed / stirred in different percentages of chemical fertilizers and the effect of curing time span is to obtain data from soil tests plus chemical fertilizers. Data from laboratory tests on soil sample tests plus chemical fertilizers about, Atterberg limits and Soil Classification Walahir Coupled Chemical Fertilizer [4][9][10].

Table 5. Limits liquid, limits of plasticity, plasticity index and classification of soil walahir plus chemical fertilizer 3%

Type of Soils	Boundary Liquids (%)	Limit Plastis (%)	Plasticity Index (%)	Soil Classification Unified
Soil + Urea	56.30	41.60	14.70	OH - MH
Soil + SP36	45.90	29.34	16.57	ML - OL
Soil + ZA	46.00	28.36	17.65	ML - OL

3.1. Moisture content of walahir original soil plus chemical fertilizer 3%at depth of 1.00 – 1.40 m, optimum sample conditions

Table 6. Time relationship to content groundwater water fertilizer chemical 3% optimum sample condition

Soil Type	Curing Time (Day)		
	4	7	14
Without Fertilizer	27.00	27.00	27.00
Soil + Urea	26.67	26.59	26.53
Soil + SP 36	26.79	26.69	26.62
Soil + ZA	26.62	26.57	26.51
Soil + MKP	26.56	26.51	26.48
Soil + Green Giant	26.67	26.61	26.53

3.2. Relationship percentage of chemical fertilizer to water content in walahir soil depth of 1.00 –1.40 m, fertilizer percentage of 3%, optimum sample conditions

Table 7. Relationship percentage of chemical fertilizer 3% on the level of water conditions sample optimum

Soil	Persentase Pupuk			
Type	0%	1%	2%	3%
Without Fertilizers	27			

Soil Type	Persentase Pupuk			
	0%	1%	2%	3%
Soil + Urea	27	26.75	26.57	26.53
Soil + SP 36	27	26.72	26.66	26.62
Soil + ZA	27	26.70	26.67	26.51
Soil + MKP	27	26.76	26.51	26.48
Soil + Green Giant	27	26.66	26.59	26.53

3.3. Moisture content in walahir soil without chemical fertilizer and soil add 3% chemical fertilizer, depth 1.00 – 1.40 m, 14 hours a day, sample conditions immersed.the ratio of soil water content plus chemical fertilizer to soil without chemical fertilizer in submerged sample conditions is shown in table 8.

Table 8. Relationship of percentage of 3% chemical fertilizer towards water contents sample optimum conditions

Soil Type	Content Water	Water Content Ratio Sample Soaked
Without Fertilizer	28.82	1,000
Soil + Urea	28.85	1,001
Soil + SP 36	28.79	0.999
Soil + ZA	28.74	0.997
Soil + MKP	27.48	0.954
Soil + Green Giant	29.25	1.015

4. Analysis and discussion

4.1. Analysis

1. From the test results against the Atterberg boundary Soil without fertilizer with soil plus fertilizer is shown in Table 2 for original soil and Table 8 for soil plus fertilizer that; With the existence of fertilizer index plasticity changes and tends to decrease due to the decrease in the liquid limit of the soil, thus changing from soil classification such ason SP36 mixed soil, ZA which was originally classified as OH-MH becomes ML-OL
2. From the results of laboratory tests of Atterberg limits on soil samples obtained LL > 50% with moderate plasticity. Walahir Soil is classified into OH - MH based on Unified Classification
3. SoilTests based on filter test and hydrometer tests including types:
   Silt; 81,339% for the depth of 1.00 - 1.40 m
   Silt; 78.475% for the depth of 3.00 - 3.40 m
   Grain diameter between 0.002 mm to 0.06 mm.
4. From equation S = 2.16 x 10-3 (PI) 2.44 where from the lab test results obtained PI = 36.69%, then empirically swelling will be obtained for: S = 2.16 x 10-3 (0.3669) 2.44 = 0.018705 or 1.87%. From the swelling test results on soil with compacted (compacted) conditions then swelling tests are shown in Table 4 so from the test results and empirically it can be concluded; Swelling Index without compacted beforehand produces a greater value than the initial condensed condition.
5. Under optimum conditions the water content in soil without dalma fertilizer is obtained from the compacting test of 27%, whereas after adding chemical fertilizer with a percentage of chemical fertilizer; 1%, 2% and 3% with curing time from 4 days to 14 days showed changes as shown in Table 10 and Figure 4 below;

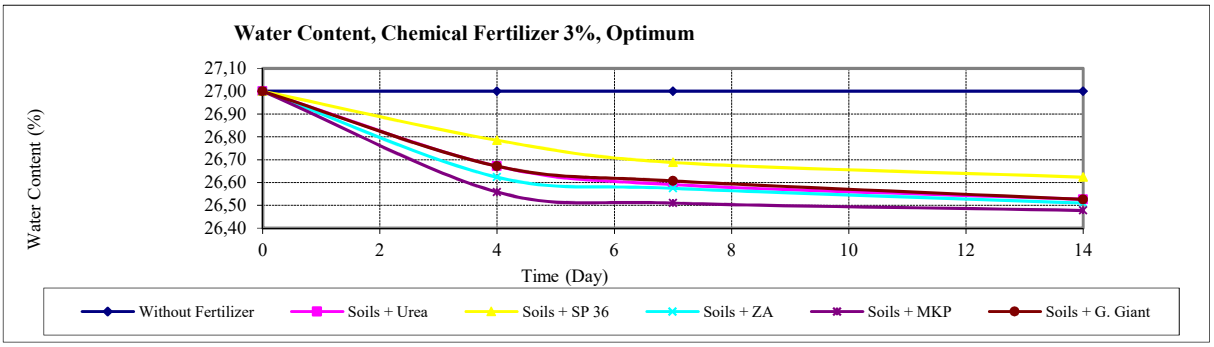

Figure 2. Relationship of time against water content in chemical earthis added from chemical fertilizer 3% depth 1.00 –1.4 m, optimum sample condition

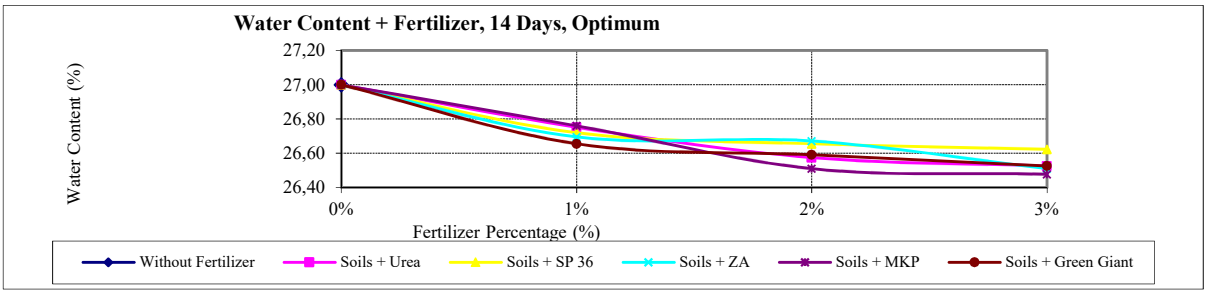

Figure 3. Relationship of percentage of chemical fertilizer against water content in walahir soil plus chemical fertilizer, from depth 1.00 –1.4 m, 14 day bruised, optimum sample condition

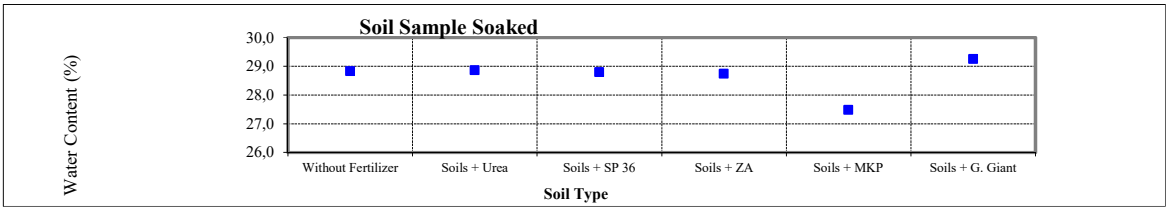

Figure 4. Water content in walahir soil plus 3% chemical fertilizer, 14 days bruised, soaked sample condition

4.2. Discussion

Figure 4 and Figure 5 show;

Condition of soil samples with optimum moisture content; The addition of chemical fertilizers as well as increasing the time of curing, the water content in the soil plus chemical fertilizers decreases, this is because the nature of the fertilizer absorbs water while the water available in the sample is optimum or the water available in the sample is limited (the water content of the compaction test results). Figure 6 and Table 11 show that: The addition of chemical fertilizers in the condition of the sample soaked in the water content of the soil increases, while the water inside and outside the sample is sufficiently available.

5. Conclusion and suggestion

5.1. Conclusions

From the results of research based on laboratory tests and analysis of soil Walahir hills with silt type with a percentage of 81.34%, clay by 7.754%, and minerals Nontronaite Clay and SiO2 are dominant, the presence of chemical fertilizers can be concluded:

1. Plasticity index decreases due to decreasing limits liquid (LL) thereby changing the soil classification from OH - MH to ML - OL unified classification.
2. In soil conditions with optimum water content, the addition of the percentage of chemical fertilizers and the duration of curing caused the water content to decrease with increasing percentage of chemical fertilizers as well as the duration of curing while in the soaked condition causing changes in water content tends to increase.

5.2. Suggestions

1. Research on the influence of chemical fertilizers is carried out using fertilizer percentages of 1%, 2% and 3% with relatively short curing time with the aim to analyze the extent to which chemical fertilizers affect the plasticity index and water content.
2. The author hopes for further analysis with more variety; percentage, type of fertilizer, time scale and type of soil, mineralogical analysis and composition of the main soil.

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