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Study added of waste carbide in clay

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***Abstract*—Soil is the foundation of structure or construction that will receive the load transfer through to foundation. If the soil has a carrying capacity of small and cannot withstand the load transfer can result in the failure of construction. If the soil has a carrying capacity of small ground it is necessary to stabilize or improve the soil so that an increase in the carrying capacity of the land so that it can be used for construction. This research is use waste carbide as a material added at clay. Value CBR unsoaked with the addition of 20% waste calcium carbide has increased from 4,4 to 18,69, the increase was of 76.45% and the CBR soaked with the addition of 20% waste calcium carbide an increase from 3,17 becomes 11,81, the increase was 73.15%.**

***Keywords*—clay, waste carbide, bearing capacity, california bearing ratio**

I. Introduction

Soil stability is mixing the soil with certain materials to improve the engineering properties of soil stabilization. Process covering soil mixing with other soil or added material to obtain the desired gradation so that the engineering properties of the soil such as strong support, compressibility, permeability, potential for development and sensitivity becomes better (Hardiyatmo, 2010). Soil stabilization was defined as an improvement of existing local materials, by means of mechanical stabilization or by adding the ingredients additive into the ground.

II. Waste Carbide

Waste carbide is the residue of reaction of the water produces acetylene gas Oxyacetylene, classified in types of lime extinguished (Zainal Abidin, 1984) has the properties of lime for building materials in accordance with SII 0024-80 with two parameters, namely aberrant levels of CaO + MgO lower and CO_2 are high enough.

Waste carbide at the same time is a filler material Gas Dicarbide Calcium (Calcium acetylide, calcium carbide), or more commonly known as acetylene is a colorless compound $CaCO_2$. Jhon Daith in Istiwinarni M. (1999) explains when water is added to the resulting calcium carbide base material in the form of organic ethyne gas and sediment.

Calcium carbide which is a byproduct of making acetelin gas is a solid white or grayish-black with a specific gravity of 2:22. The beginning of waste produced in the form of colloidal carbide (semi-liquid) because gas contains gas and water. After 3-7 days, the gas contained slowly evaporate as gas evaporation and water waste carbide lime began to dry up, turning into clumps are fragile and easily destroyed and can be powder.

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III. Soil Physical Properties test

Water content (w)

Water content (Moisture Content) is the ratio between weight of water to weight of the soil grains. The water content is percentage of water a material that can be expressed by wet weight (wet basis) or based on the dry weight (dry basis). The water content of the wet weight has a theoretical maximum limit of 100 percent, while the water content by dry weight can be more than 100 percent (Sharif and Halid, 1993).

Specific gravity (G)

Specific gravity is the ratio of the density of a substance to the density of a reference substance; equivalently, it is the ratio of the mass of a substance to the mass of a reference substance for the same given volume. *Apparent* specific gravity is the ratio of the weight of a volume of the substance to the weight of an equal volume of the reference substance.

Attegberg limit

Atterberg limits introduced by Albert Atterberg in 1911 with the aim of fine-grained soil to classify and determine the nature of the soil property index. Atterberg limits comprise the liquid limit, plastic limit, and shrinkage limit.

Fine grained soils usually have plastic properties. The plastic properties of the soil's ability to adjust the shape change of the ground after mixed with water at a fixed volume. The land will be a liquid, plastic, semi-solid or solid depending on the amount of water that is mixed in the soil. Atterberg limits show the shape of the solid ground to become viscous fluids according to their water content. Atterberg limits of test parameters will be obtained liquid limit, plastic limit, sticky limit and limit cohesion which is the state of the soil consistency. Atterberg boundaries can be seen in the following Table 1:

Tabel 1. Plasticity limit of soils

PL(%)	Character	Type of soils	Cohesif
0	Non plastic	Sand	Non cohesif
< 7	Low plasticity	Silt	Cohesion partly
7 - 17	Medium plasticity	Clayed silt	Cohesif
> 17	High plasticity	Clay	Cohesif

a. Liquid Limit (LL)
   Liquid limit (LL) is the water content of soil for the values above, the soil will behave as a viscous liquid (the boundary between the liquid state and a plastic state), which is the upper limit of the plastic area.
b. Plastic Limit (PL)
   Plastic limit (PL) is the water content to values below, the ground is no longer influential as the plastic material. Soil will be a plastic material in a water content ranging

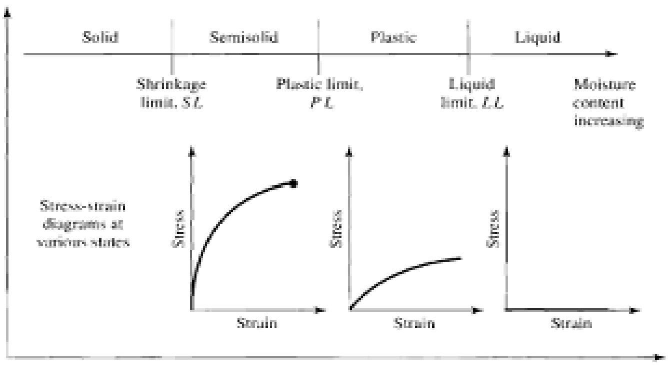
between LL and PL. This range is called the plasticity index.

c. Plasticity Index (PI)
Plasticity index is an interval of water content, the soil still is plastic. Therefore, the plastic index indicates the nature of the soil to plasticity. If the soil has a water content interval small plastic area, then this state is called invitation thin soil. In contrast, if soil water content interval area has a large plastic called peat. Plasticity index value can be calculated with the following equation:

$$IP = LL - PL \tag{1}$$

Restrictions on plastic index, the nature, kinds of soil and cohesion provided by Atterberg contained in the following Table 2:

Table 2 : Attegberg limits



Shrinkage Limit (SL)
Condition water content at the position between the semi-solid and solid areas, namely the percentage of moisture content where further reduction of water content does not lead to changes in the volume of soil is called Limit Losses.

$$SL = (V_0 / W_0 - 1 / Gs) \times 100\% \tag{2}$$

Where :
SL = Shrinkage limit
V_0 = Volume of specimen dry
W_0 = Weight of specimen dry
Gs = Specific gravity

IV. Mechanical analysis of soil

Gradation of soils

Mechanical analysis is the determination of the size range of particles present in a soil, expressed as a percentage of the total dry weight. Two methods are generally used to find the particle size distribution of soil:

a. Sieve analysis – for particle sizes larger than 0,075 mm in diameter.
b. Hydrometer analysis – for particle sizes smaller than 0,075 mm in diameter.

The basic principle of sieve analysis and hydrometer analysis are briefly described in the following two section.

Proctor Standard Test

Proctor standard compaction test is a laboratory method to determine the optimal experimental moisture content where in a particular type of soil will be the most solid and achieve maximum dry density. The term proctor standart is to honor RR Proctor, who in 1933 showed that the dry density for a given compaction effort depends on the amount of groundwater during soil compaction and the original tests often referred to as a standard proctor compaction test. Laboratory tests generally consist of soil compaction on water levels known to the cylinder mold dimensions using the standard amount of compaction effort is controlled. The soil is usually compacted into molds with a certain amount of the same layer, each received a blow from a hammer-weighted standard at a certain height. The process is then repeated for a range of water content and dry density determined for each. Graphic relationship of the dry density of the water content is then plotted to form a curve compaction. Finally maximum dry density obtained from the cusp of the curve compaction and moisture content are appropriate, also known as the optimum moisture content.

The formula used in the calculation proctor standard as follows:

$$ZAV = Gs / (1 + (Gs + w) / 80) \tag{3}$$

$$\gamma = \text{(weight of wet soil / (volume mold)} \tag{4}$$

$$\gamma_d = \gamma/(1 + w) \tag{5}$$

Where ;
Z.A.V = zero void water
w = moisture content
Gs = specific gravity
γ_d = unit weight dry (g/cm^3)
γ = unit weight (g/cm^3)

California Bearing Ratio (CBR)

California Bearing Ratio is the soil bearing capacity experiment developed by the California State Highway Department. The principle of this test is a penetration testing by inserting objects into the test object. In this way can be assessed strength of the subgrade or other material used to make the pavement.

Soil strength was tested with CBR test in accordance with ISO-1744-1989. The value of the land force is used as a reference to whether or not stabilized as compared with that required in the specifications.

CBR test is a comparison between the load of penetration of a substance against a standard material with the depth and speed of penetration the same value CBR is the ratio (in percent) between the pressure needed to penetrate the soil with sectional spherical piston area of 3 inch^2 with a speed of 0,05 inch/min to pressure required to penetrate a certain standard materials. The purpose of this test is to determine the CBR CBR value in the variation of moisture content compaction. To determine the strength of the subgrade layer by means of CBR experimental values obtained is then used to determine the required thickness of pavement layers above a certain value CBR (Wesley, 1977) In testing the CBR value of the land can be done in a laboratory.

CBR laboratory can be divided into two kinds:

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a. CBR laboratory immersion (soaked design CBR)
b. CBR laboratory without immersion (unsoaked design CBR)

V. Soil sampling test

Soil sampling sites taken in Mangala village, Antang districts in South Sulawesi Province, country Indonesia.
Waste disposal carbide taken from the welding workshop in Kapasa village, Tamalanrea districts in area of Daya.
Testing was conducted in laboratory test soil mechanics Universitas Kristen Indonesia Paulus Makassar.

VI. Flow diagram

Flow diagram is shown in the following Figure 1:

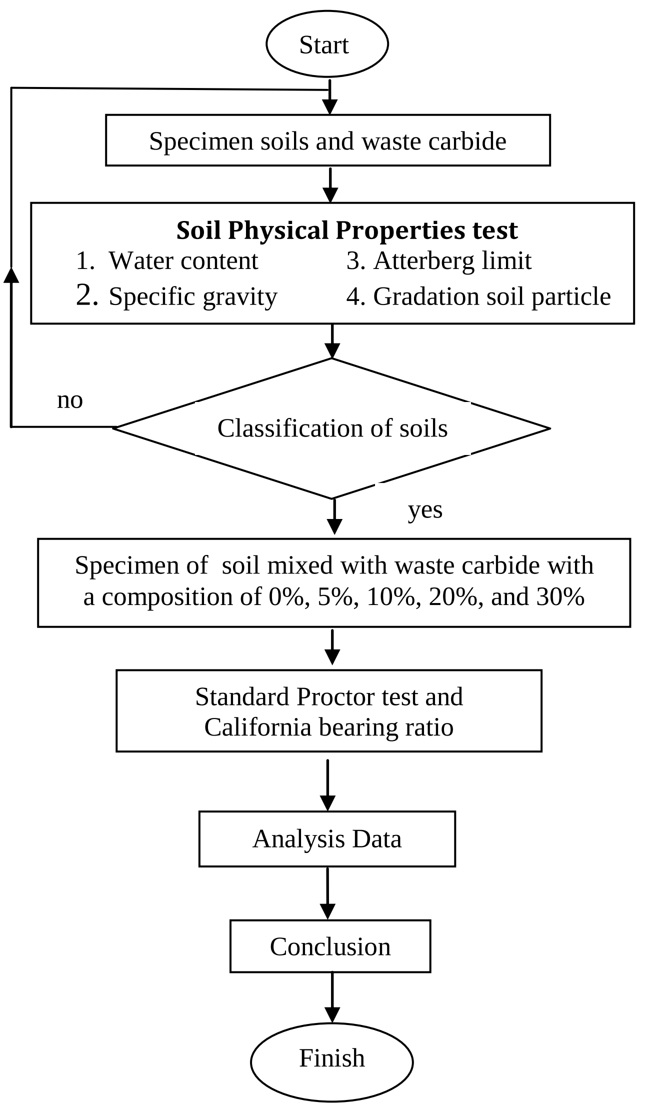

Figure 1. Flow diagram

VII. Analysis Data

a. Soil physical mechanical properties

Soil physical properties test results are shown in Table 1:

Table 1 Testing physical and mechanical properties of clay

No	Soil test	Value
1	Water content (w)	40,72%
2	Unit weight (γ)	2,421
3	Liquid Limit (LL)	72,00%
4	Plastic Limit (PL)	23,83%
5	Index Plasticity (IP)	48.17%
6	Shrinkage Limit (SL)	19,44%
7	Percent passing sieve 200	99,77%
8	Unit weight dry (γd)	1,464
9	Optimun Moisture Content (OMC)	20,07%
10	CBR soaked (non waste carbite)	3,17
11	CBR unsoaked (non waste carbite)	4,40

According to the USCS, including fine-grained soil, this is expressed by percent through sieve 200 more than 50%. Liquid limit values obtained more than 50% causes the soil has a high plasticity. From the results of soil classification by USCS then Mangala village land, Antang belonging to the types of inorganic clay with high plasticity (CH). Meanwhile, according to AASHTO Mangala village land, Antang including a group of A-7-6, which is determined by sieve 200 percent more than often 35%, liquid limit value of more than 41%, the value of plasticity index of more than 11% and the value of plastic limit of less than 30 %

b. Testing chemical properties of waste carbide

Testing chemical properties of waste carbide results are shown in Table 2:

Table 2 Result testing chemical properties of waste carbide

Chemical compounds	Persentase (%)
Silika Oksida (SiO_2)	6,78
Kalsium Oksida (CaO)	48,82
Magnesium Oksida (MgO)	4,77
Aluminium Oksida (Al_2O_3)	1,54
Besi Oksida (Fe_2O_3)	2,28

Source:Laboratory of Center Public Health Makassar (2015)

Chemical test results show that waste carbide contains Calcium Oxide (CaO) which is large enough around 48,82%

c. Standart Proctor test

Standart Proctor test results are shown in Table 3:

Table 3 Result Standard Proctor test

No	Waste carbide	Unit weight dry max (gr/cm^3)	Optimun Moistuire Content
1.	0 %	1,464	20,07
2.	5 %	1,520	21,33
3.	10 %	1,535	22,42
4.	20 %	1,540	23,18
5.	30 %	1,556	24,25

The test results showed an increase in Unit weight dry maksimum ($\gamma_{dry\ max}$) and optimum moisture content along with the addition of waste carbide

d. *California Bearing Ratio* Test (CBR)

California bearing ratio results are shown in Table 4

Table 4 Result CBR Unsoaked and CBR Soaked test

No	Waste carbide	CBR unsoaked	CBR soaked
1.	0 %	4,40	3,17
2.	5 %	15,09	10,11
3.	10 %	16,44	10,71
4.	20 %	18,69	11,81
5.	30 %	18,67	11,78

The test results indicate CBR in addition 20% of waste carbide obtained maximum value of 18.67 for the CBR unsoaked and CBR soaked amounted to 11.81 and at addition 30% waste carbide impaired 18.67 for CBR unsoaked and became 11.78 for CBR soaked.

The figure 2 below shows a comparison chart of CBR CBR without immersion and immersion with the addition of waste carbide at 0%, 5%, 10%, 20% and 30%.

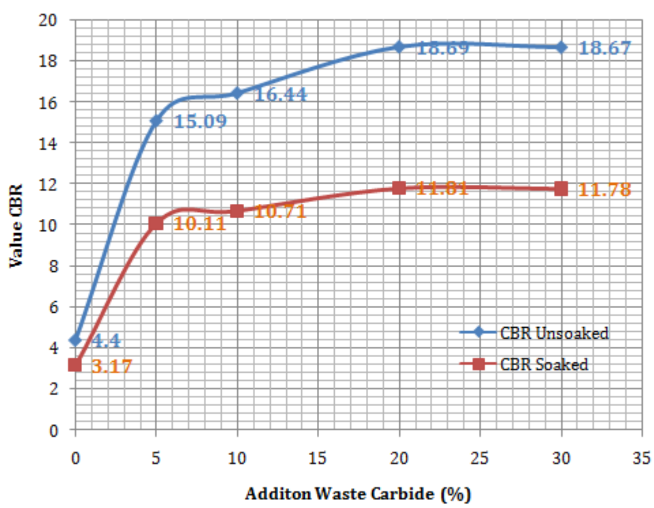

Figure 2 Addition waste carbide vs Value CBR unsoaked and CBR Soaked

Figure 2 shows an increase in CBR value added waste carbide on clay. The addition of carbide waste by 20% shows the highest value and at the addition 30% carbide waste on clay began to be impaired CBR unsoaked and CBR soaked.

VIII. Conclusion

Results of research on clay is added to the waste carbide as follows:

1. Soil samples from Mangala village, Antang districts in South Sulawesi Province, country Indonesia have passing 99,77% sieve #200 with value of liquid limit (LL) 72,00 and the plasticity index (IP) 48,188 so that land including the type of inorganic clay with high plasticity (CH).
2. On the addition waste carbide by 20% the value of CBR unsoaked increased from 4,4 to 18,69, the increase was of 76,45%
3. On the addition waste carbide by 20% the value of CBR soaked an increase from 3,17 becomes 11,81, the increase was 73.15%.

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