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The Effect Of Clam Shell Powder And Fly Ash as Clay Stabilizier on California Bearing Ratio (CBR) And Unconfined Compression Test (UCT)

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Abstract. Stabilization is an attempt to improve soil conditions that have poor properties index. One of the stabilization of soils is usually done by adding chemicals to the soil. Common chemicals used are cement, lime, bitumen. In this study clay soil stabilization was carried out by the addition of clam shell powder and fly ash.

The purpose of this study was to determine the value of the index properties, the Atterberg value, the standard Compaction value, the value of the California Bearing Ratio (CBR) and compressive strength test values of Unconfined Compression Test (UCT) on clay.

From the study, it was obtained that the original soil sample had a moisture content of 34.43%, a specific weight of 2.65, a liquid limit of 47.33% and a plasticity index of 29.88%. The original soil classification according to USCS is classified as Clay - Low Plasticity (CL) and according to AASHTO it is classified as A-7-6 (9). The unconfined Compression Test (UCT) of the original soil added was 1.42 kg / cm2. Soaked laboratory CBR values for native soils are 6.29%.

The most effective results were obtained from a mixture of 8% of shell powder and 5% fly ash with a UCT value of 2.50% kg / cm2. For the CBR testing of laboratory mixtures the most effective variation on the mixture of 8% of shell powder and 5% fly ash with a laboratory CBR value soaked by 9.57%. The soil that has been mixed with the most effective stabilizer material, 8% of clam shell powder and 5% fly ash, belongs to the type of Clay - Low Plasticity (CL) based on USCS classification and classified as A-6 (6) based on AASHTO classification.

Keyword: Clay, fly ash, sea shells powder, Soil Stabilization, CBR, Unconfined Compression Test

Abstrak. *Stabilisasi merupakan salah satu usaha dalam memperbaiki kondisi tanah yang memiliki indeks properties yang kurang baik. Salah satu stabilisasi tanah yang biasa dilakukan yaitu dengan menambahkan bahan kimia pada tanah. Bahan kimia yang biasa digunakan berupa semen, kapur, bitumen. Dalam penelitian ini stabilisasi tanah lempung dilakukan dengan penambahan serbuk cangkang kerang dan fly ash.*

Tujuan penelitian ini adalah untuk mengetahui nilai index properties, nilai atterberg, nilai Compaction standar, nilai California Bearing Ratio (CBR) dan nilai pengujian kuat tekan bebas Unconfined Compression Test (UCT) pada tanah lempung.

Dari penelitian diperoleh sampel tanah asli memiliki kadar air 34,43% , berat spesifik 2,65, batas cair 47,33% dan indeks plastisitas 29,88%. Klasifikasi tanah asli menurut USCS

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tergolong Clay – Low Plasticity (CL) dan menurut AASHTO tergolong A-7-6 (9). Nilai Unconfined Compression Test (UCT) tanah asli ditambah adalah 1,42 kg/cm2. Nilai CBR laboratorium terendam (soaked) untuk tanah asli adalah 6,29%.

Hasil yang paling efektif diperoleh dari campuran 8% serbuk cangkang kerang dan 5% fly ash yaitu dengan nilai UCT 2,50% kg/cm2. Untuk pengujian CBR laboratorium campuran paling efektif pada variasi campuran 8% serbuk cangkang kerang dan 5% fly ash dengan nilai CBR laboratorium terendam (soaked) sebesar 9,57 % . Tanah yang telah dicampur material stabilisator yang paling efektif yaitu 8 % serbuk cangkang kerang dan 5% fly ash termasuk dalam jenis Clay - Low Plasticity (CL) berdasarkan klasifikasi USCS dan tergolong A-6 (6) berdasarkan klasifikasi AASHTO

Kata Kunci: *lempung, fly ash, serbuk cangkang kerang, stabilisasi tanah, CBR, kuat tekan bebas*

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1 Introduction

Soil can be defined as the material on top of bedrock, loose and unconsolidated, produced by weathering of rocks. Soil type or soil classification based on use is more adequate for engineering purposes. Because the basis of classification takes into account the physical properties of the soil in addition to the percentage of grain size. Soils can be classified generally as cohesive and non-cohesive soils or fine-grained and coarse-grained. Soil can be defined as the material on top of bedrock, loose and unconsolidated, produced by weathering of rocks.

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Clay is a microscopic and submicroscopic aggregate of particles derived from the chemical decay of the constituent elements of rock, and is plastic in medium to wide moisture intervals. In the dry state it is very hard, and not easily peeled off with just fingers the clay permeability is very low. Clay is commonly used as a backfill material for highways. But when the moisture content is high, the clay soil will be sticky (cohesive) and very soft. Therefore, clay need to be stabilized.

Mussels are one of the fishery commodities that have long been cultivated as one of the side businesses of coastal communities. Fly ash is the residue from burning coal in power plants. Fly ash has a melting point of about 1300 °C and has a mass density (density), between 2.0– 2.5 g/cm^3. In this study, the effect of clam shell powder and fly ash as clay stability material will be identified.

2 Research Methods

The research methodology was conducted using experimental methods at the Soil Mechanics Laboratory, Department of Civil Engineering, University of North Sumatra. The research carried out was samples of native soil and soil that had been given additional clam shell powder.

2.1 Preparatory work

The preparation carried out in this study is: The initial stage of this research is the stage of literature study which includes collecting and studying literature related to this research. After the literature study, the research proceeded to determine the location of clay sampling and take specific soil samples. At the location previously determined, soil samples were taken, the soil used in the test was clay soil from PTPN II Patumbak, Deli Serdang. Simultaneously with clay sampling, shell powder material is prepared.

2.2 Experimental Samples

Sample experiments were carried out as many as 13 soil samples, where 1 sample was used without a mixture of shellfish powder and fly ash or real soil. where The addition of the percentage of shells powder and fly ash is 2%, 4%, 6%, 8%, 10%, 12%, and 3%, 5% of the weight of the soil.

2.3 Research Objectives

This study aims to determine the effect of clam shell powder and fly ash on the clay property index, Knowing the effect of adding clam shell powder and fly ash on soil plastic properties, Knowing the effect of clam shell powder and fly ash on the CBR and UCT values of clay soil, Looking for the optimal mixture that provides the California Bearing Ratio (CBR) value and Unconfined Compression Test (UCT) of clay.

3 Results and Analysis

3.1 Soil Testing

Data on soil physical properties test results can be seen from Table 1 below:

Table 1 Data for soil physical properties

Testing	Result
Water Content	34,43%
Specific Grafity	2,65
Liquid Limit	47,33%
Plasticity Limit	17,45%
Plasticity Index	29,88%
Percent Passed Sieve	48,81%

Optimum moisture content	21,12%
Maximum Dry unit weigt	1,340 gr/cm^3
CBR	6,29 %

Table 2 Data for the physical properties of clamshell powder

Testing	**Result**
Specific Grafity	2,55
Liquid Limit	Non Plasticity
Plasticity Limit	Non Plasticity
Plasticity Index	Non Plasticity
Percent Passed Sieve	2,57%

Table 3 Physical properties test data of fly ash

Testing	**Result**
Specific Grafity	2,6
Liquid Limit	Non Plasticity
Plasticity Limit	Non Plasticity
Plasticity Index	Non Plasticity
Percent Passed Sieve	48,05%

3.2 Testing of Soil Physical Properties with Stabilizer Materials

The results of physical properties tests mixed with stabilizers such as clam shell powder are shown in figure 1 to figure 3 below:

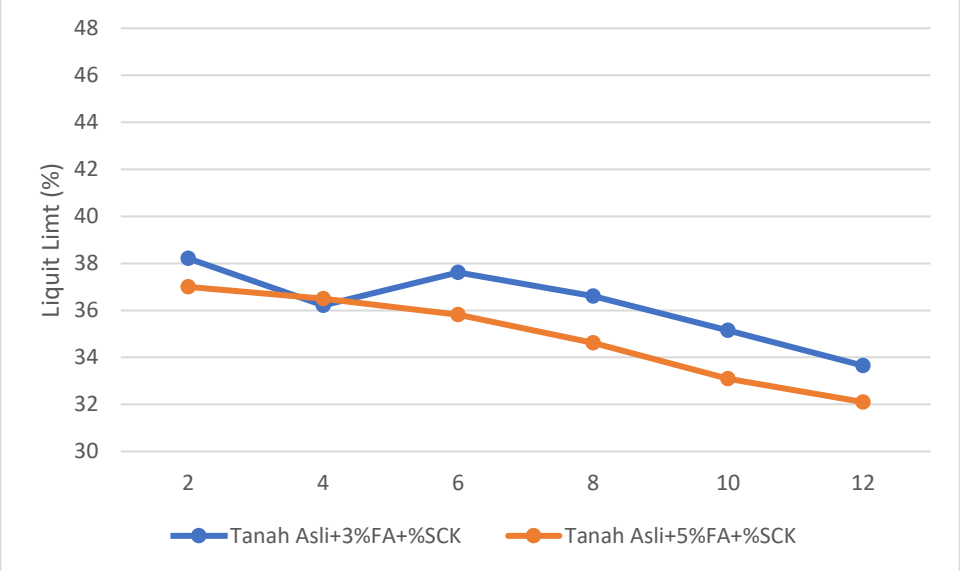

Figure 1 Graph of the relationship between liquid limit (LL) and the variation of the mixture of clamshell powder and fly ash

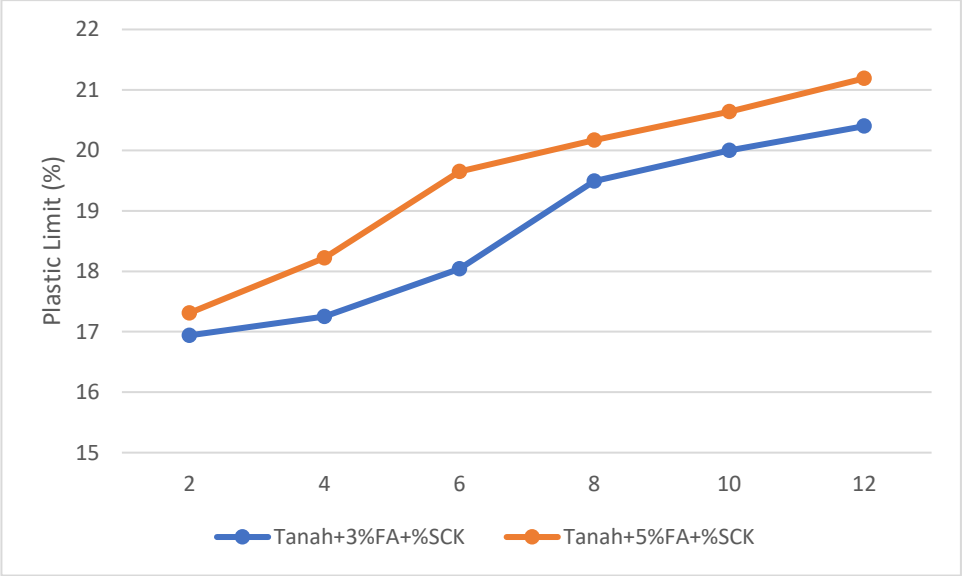

Figure 2 Graph of the relationship between plastic limit value (PL) and variations in shellshell powder and fly ash

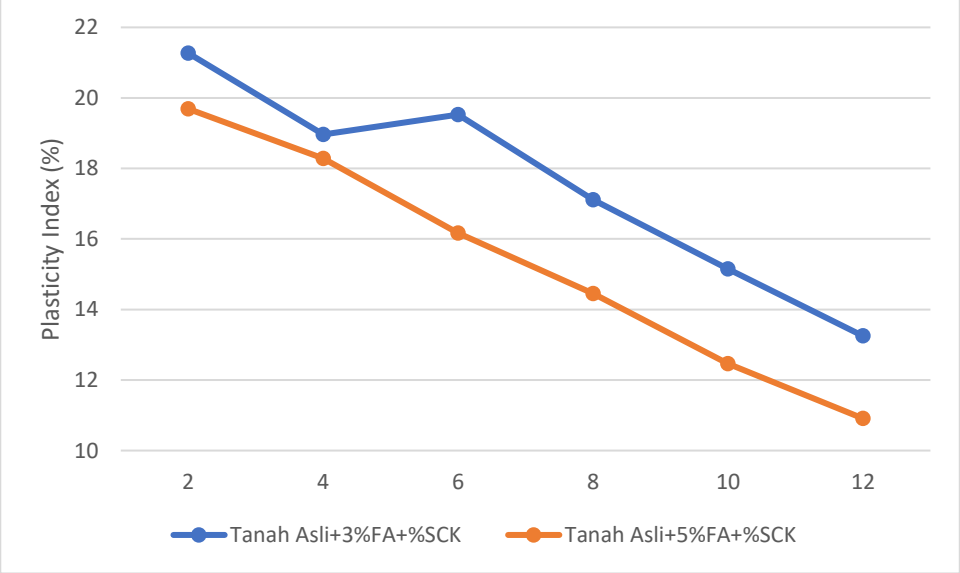

Figure 3 Graph of the relationship between the plasticity index (PI) value and the variation of the clamshell powder mixture and fly ash

In figure 1, it shows that the liquid limit due to the addition of clam shell powder has decreased. The greater the percentage of the clamshell powder mixture, the smaller the liquid limit. In native soils the liquid limit reaches 47,33%, while the lowest liquid limit value at the addition of 12%SCK + 3%FA is 33,65% and 12%SCK + 5%FA is 32,10%. Figure 2 shows an increase in plastic limit values due to the addition of shells powder and fly ash. For original soils, the plastic limit is 17,45% and continues to increase until the variation of the mixture of 12%SCK + 3%FA is 20,40% and 12%SCK + 5%FA is 21,19%

Figure 3 shows that with the addition of stabilization materials, the plasticity index will decrease. The plasticity index of original soils which initially with a value of 29,88% then fell to 12%SCK

+ 3%FA was 13,25% and 12%K + 5%FA was 10,91%. A decrease in the plasticity index can reduce the potential for shrinkage from the soil. It can be seen that the higher the powder content of clam shells, the plastic limit increases and the liquid limit decreases, so the soil plasticity index (IP) decreases.

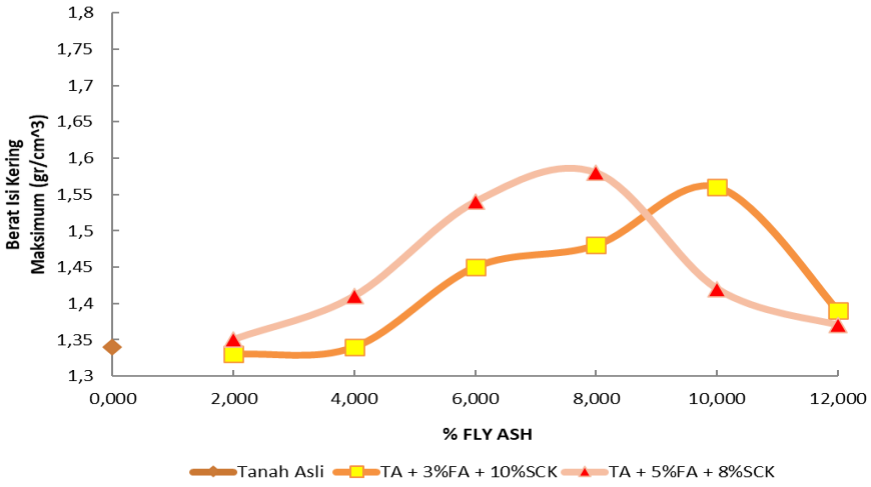

Figure 4 The relationship between the maximum dry unit weight ($\gamma_{d\ max}$) of the soil with a mixture of clam shell powder and fly ash

From soil compaction tests that have been carried out on original soils, the maximum dry unit weigt of original soil is 1,34 gr/cm³. In Figure 4 it can be seen that the maximum dry unit weigt decreases after adding shellshell powder and fly ash starting from the addition of 2%SCK + 3%FA and 2%SCK + 5%FA to 12%SCK + 3%FA and 12%SCK + 5%FA, in additions of 10%SCK + 3%FA and 8%SCK + 5%FA has the most optimal dry unit weigt of 1,56 gr/cm^3 and 1,58 gr/cm^3. It decreases when the subsequent addition of shellfish powder and fly ash levels.

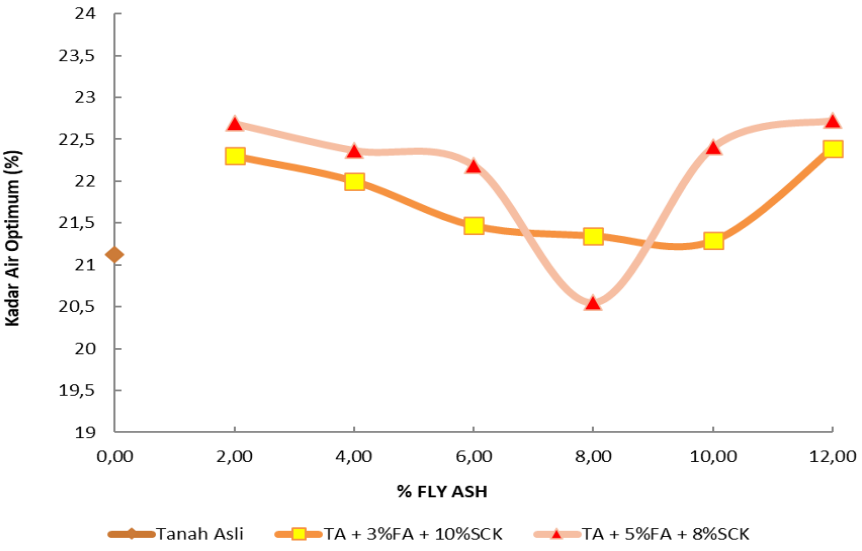

Figure 5 Graph of the relationshipbetween the optimum moisture content of the soil (wopt) with variations in the mixture of clam shell powder and fly ash

The optimum moisture content results from the experiments conducted found that the optimum moisture content value of the original soil was 21,12% and subsequently increased. Figure 5 shows the optimum optimum moisture content is in variations of 10%SCK + 3%FA and 8%SCK + 5%FA which have values of 21,35% and 20,55%. on reaching the maximum dry fill weight and increasing when passing the maximum dry fill weight.

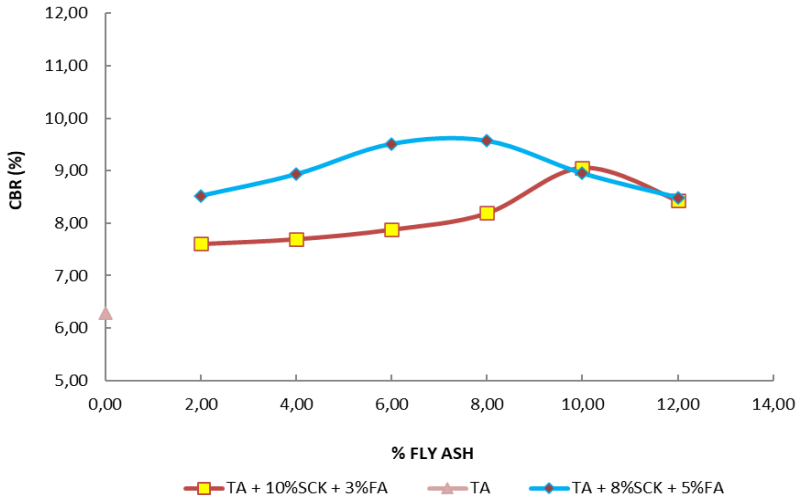

Figure 6 Graph of the relationship of CBR values with variations in the percentage of addition of the mixture Clamshell powder and fly ash

Figure 6 shows the effect of the variation in the addition of a mixture of clam shell powder and fly ash on the CBR value. In the graph shown by Figure 6, the largest CBR values is obtained in variations of 10%SCK + 3%FA and 8%SCK + 5%FA, namely 9,05% and 9,57%.

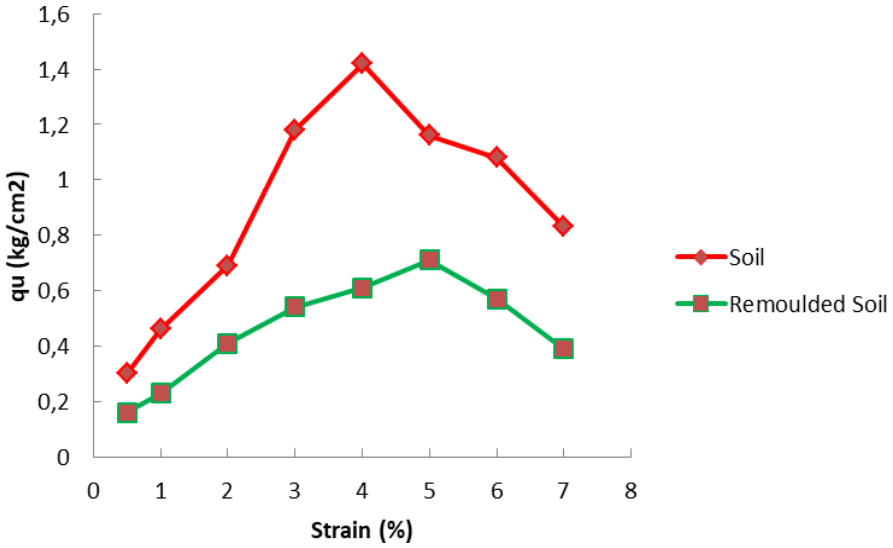

Figure 7 Graph of the relationship between soil compressive strength (q_u) values and strains given to original and remoulded soil samples

In figure 7 it can be seen that the compressive strength of the original soil is 1,42 kg / cm. On remoulded soils obtained by 0,71 kg/cm². There was a considerable decrease as shown in Figure 7. This decrease is caused by damaged soil structure received by remoulded soil. The reduced of

soil strength due to structural damage to the soil is called sensitivity. This sensitivity value will determine the classification of soil according to its sensitivity.

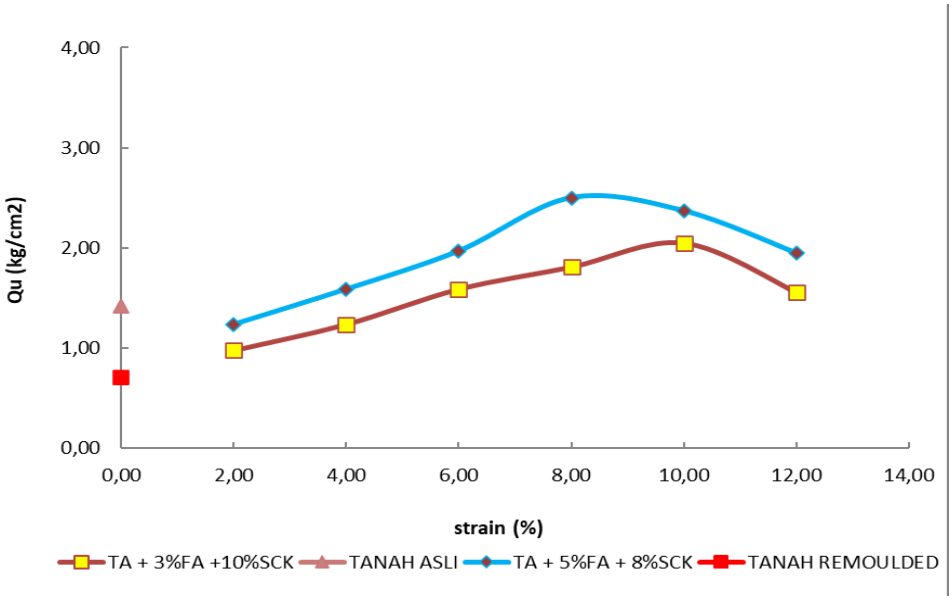

Figure 8 Compressive strength graph with a wide variety of additions Clamshell powder and fly ash

In figure 8, the compressive strength of the original soil (qu) is 1,42 kg/cm². Then with the addition of clam shell powder and fly ash the compressive strength increases but only on the variation 10% K + 3% FA and 8% K + 5%FA, On that variation the compressive strength of the soil reach its maximum strength which is 2,05 kg/cm² and 2,50 kg/cm².

4 Conclusion

From the experiment we concluded that:

1. Based on the USCS classification, the original soil sample belongs to the CL (Clay-Low Plasticity) type, which is an inorganic clay with low to medium plasticity.
2. Based on the AASHTO classification, the original soil sample belongs to type A-7-6 (9).
3. From the results of the Water Content test, it was found that the original groundwater content value was 34,43%.
4. From the results of the Specific Gravity test, it was found that the Specific Gravity value of the original soil was 2,65, the Specific Gravity of clam shell powder was 2,55 and fly ash was 2,6 .
5. From the Atterberg test of original soil, Liquid Limit (LL) of 47,33% and a plasticity index of 29,88% were obtained. Based on the results of the experiment conducted, it is known that the addition of 12%SCK + 5 %FA, has the lowest plasticity index (IP) of 5,24%. With Liquid Limit is 10%.
6. From the test results, Proctor Standard produces an optimum content value on original soil of 21,12% and a maximum dry unit weight of 1,34 gr/cm³, while the optimum moisture content and the maximum dry unit weight of all mixtures is in variations of 10%SCK +

3%FA and 8%K + 5%FA where the optimum moisture content is 22,73% and the maximum dry unit weight is 1,37 gr/cm³.

7. From the results of laboratory CBR tests conducted on original soil, a CBR of 6,29% was obtained. From the results of the study conducted, the largest CBR value was in a mixture variation of 8%K + 5%FA where the CBR value was 9,57%.
8. From the Unconfined Compression Test test carried out, the value of soil compressive strength (qu) on original soil was 1,42 kg / cm^2, while on remoulded soil a value of 0,71 kg/cm^2 was obtained. And the maximum compressive strength of all mixtures is found in the variation of the mixture 8%K + 5%FA where the value of qu is 2,50 kg/cm^2.

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