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Characteristics study of over boulder asbuton as pozzolanic material for soft soil stabilization

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Abstract. Over Boulder Asbuton is a natural asphalt from Buton Island which is a layer of topsoil with a large deposit that can be used as a road material because besides containing bitumen, the mineral also has lime (CaCO3) which is quite high up to 80% with its mineralogy content containing Calcium amounting to 79.64% and silica element at 9.63% so that the mineral composition contains positive ions and can be said to be pozzolanic material, which can function as a stabilizing material on soft soil. Therefore, in this study utilizing these minerals as an alternative to soil stabilization ingredients. The purpose of this study was to evaluate the Asbuton Over Boulder characteristics as a stabilization material through laboratory tests so that the proportion and variation of Asbuton Over Boulder minerals were obtained to increase the bearing capacity on expansive soils. Over Boulder Asbuton was taken at the location of the Kabungka, Lawale, and Sampolawa blocks, then the preparation of the material was carried out in the laboratory, namely by drying in the open air until it reached air dry. The specimens used were cylindrical in H = 2D size, from the Asbuton Over Boulder mineral test results, the qu max value was obtained at 21 days curing time = 0.624kg / cm3, in the Proctor optimum moisture content. The value of California Bearing Ratio (CBR-Unsoaked) was 12.06% and the value of California Bearing Ratio (CBR-Soaked) obtained was 8.04%. So from the results obtained, that the utilization of Asbuton Over Boulder greatly affects the stability of the soil that will be used as a construction material.

1. Introduction

Expansive land is a common problem faced in developing Indonesia. Soft Soil is in the form of peatland, or soft clay distributed in part of east Sumatra, Kalimantan and West, West Coast Sulawesi, North Sumatra Beach, and Southern Papua covering an area of + 20,000,000 hectares. Expansive land thickness varies with low carrying capacity (Extremely Low Bearing Capacity), the consequences cause many problems for construction built on peat soil due to high permeability properties and high compression (consolidation) properties and long secondary compression. Wetland is an area where the soil is saturated with water [1]. Included in this wetland are swamps, marshes, and peatlands. About 20 million hectares or more than 10% of the land area in Indonesia is soft soil which consists of soft clay soil and peat soil (peatsoil). Distribution of soft clay in Indonesia is along the north coast of Java Island, the east coast of Sumatra Island, the west coast of Kalimantan Island, the south coast of Kalimantan Island, the east coast of Kalimantan Island, the south coast of Sulawesi Island, the west coast of Papua Island and the south coast of Papua Island. Soft soil has a low pH level, has a high cation exchange capacity, low base saturation, contains elements of K, Ca, Mg, low P and microelements (such as Cu, Zn, Mn, B) is low. Looking at the complexity of the problems faced in optimizing the use of Asbuton as the main ingredient of road pavement both in terms of production technology, distribution networks and Asbuton application technology in the field that is still not

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completely mastered, it is appropriate to re-orient Asbuton study to examine various policies and procedures [2]. Asbuton management which aims to develop and test resource management systems. The treatment with the mixing of lime and asbuton is expected to improve the stability of expansive soil. Increased stability is observed from the comparison of the California Bearing Ratio (CBR) and welling Potential values.

Asbuton is a natural asphalt found on Buton Island with a very large deposit that can be used as a material from the road foundation because it contains bitumen, the mineral also has a lime content (CaCO3) which is quite high at around 70% - 80%. In this study using soft soil stabilization method using pozzolanic material in this case Over Boulder Asbuton. Where the stabilizing material used results in changes in the properties of the polyurethane which is directed at the increased support, therefore, in this study soil stabilization was carried out by improving the gradation which was discussed with the Over Boulder Asbuton. This study presented the results of a study of Asbuton Over Boulder use laboratories which are very potential as local content which can be used as a stabilization material with a low bearing capacity on the subsoil layer or as a sub-base layer on the road. physical, mineralogy, chemistry, mechanics, and microstructure. With the title Expansive Soil Stabilization and the Addition of Lime Application to the Stockpile Work, the results showed that the magnitude of expansion (CBR) of expansive soil which has not been added to lime has passed the process of compaction Standard Compaction has a CBR value of 2.316% [3]. The amount of CBR value as a form of stability from expansive soil added with lime from 3%, 6%, 9%, and 12% as a material deposit, obtaining a maximum CBR of 12.5% when the optimum lime content is between 4% and 6%.

The difference in stability (CBR) between expansive soil and expansive soil with the addition of lime is 10.184%. The effect of the addition of lime on expansive soil which is compacted to stability (CBR) gives a very significant value of influence, especially until the addition of quenched lime content of 4% to 6%. Budi, et al., in 2002 stated that the addition of 24% of lime can increase soil strength up to 400%, whereas if 60% of the lime is replaced with chaff ash, its strength drops to 300% [4]. Meanwhile, the research using lime content variations of 2%, 4%, 6%, 8%, 10% without bagasse ash, then added bagasse ash with a variation of 2.5%, 5%, 7.5% 10%, 12.5%, 15%, resulting in a maximum density of 4% lime content, free compressive strength up to 10% ash content or the proportion of CaO and SiO2, the best Al2O3 at 10% ash content [5]. At higher levels of ash, there is not enough limestone to be able to bind the silicate and aluminate in the ash. For free compressive strength test, a large enough increase occurs at 36 days curing time. Pozzolanic reactions occur when there is water. Pozzolan is a material that contains silica and alumina compounds where the ingredient pozzolans not having the effect such as cement, will remain with its smooth form with water, so the reaction reacts chemically with calcium hydroxide (the resulting reaction of the sludge) the room temperature forms the calcium oxide compound which has properties such as cement. The pavement layer function to receive the traffic load and spread the layer below it. Pavement construction consists of a surface course, base course, bottom foundation (subbase course), subgrade layer. Soil Stabilization is the mixing of soil with certain material in order to improve the technical properties of the soil, soil stabilization is an attempt to change or improve the technical properties of the soil to meet certain technical requirements. The soil stabilization process involves mixing the soil with other soil to obtain cool gradations, or mixing the soil with factory-made additives so that the soil's technical properties become better. Matters that need to be considered if the land in a place does not qualify for the construction of the structure, is (1) dismantling the material at the site and replacing it with suitable material, (2) changing or improving the properties of the soil in place, so that the material meets the requirements. On-road pavement development, subgrade with CBR < 2 generally requires stabilization.

2 Experimental program

2.1 Materials

2.1.1 Over boulder asbuton

The location of asbuton over boulder used in the study was at the island of Buton indicated by the location coordinates in Sampolawa Block 5 ° 33'7.99 "Sdan122 ° 44'28.39" E, Block Kabungka 5 °

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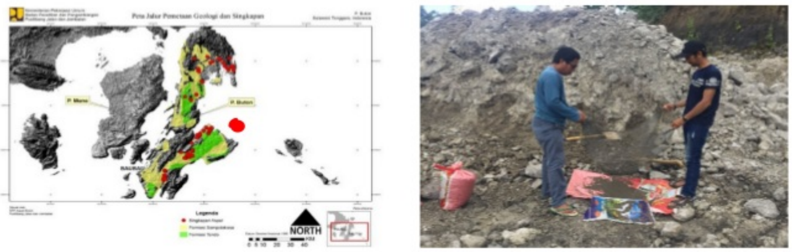
23'2.62 "S and 122 ° 53'33.67" E, and Lawele Block 5 ° 13'53.56 "S and 122 ° 58'0.40" E. (Figure 1). Basic property testing, asbuton over boulder used is included in the sample class which is coarse-grained with non-plastic index properties. Overall the physical properties of asbuton over boulder used are presented in table 1.



(a) (b)

Figure 1. (a) Location of asbuton over boulder samples, (b) Visual asbuton over the boulder.

Tabel 1. Physical properties of over boulder asbuton

Testing	Unit	Result
Specific Gravity (Gs)		2,652
Sieve Analysis :		
Gravel	%	0,00
Sand	%	81,04
Silt	%	13,70
Clay	%	5,10
Standard Proctor (Compaction)		
γ_{dry} max	gr/cm^3	1,37
Optimum Moisture Content (ω_{opt})	%	19,13
Bearing Capacity (q_u)	kg/cm^3	0,624
Classification Soil OB Asbuton	USCS	SP
	AASHTO	A – 1 - b
California Bearing Ratio (Unsoaked)	%	12,06
California Bearing Ratio (Soaked)	%	8,04

Based on the results of testing the physical characteristics showed that the Asbuton Over Boulder characteristic examination results showed that the addition of basic material to the expansive soil material would result in changes in the characteristics of the materials which were supported, supported. From the test results showed the classification parameters of Asbuton Boulder soil Over based on USCS parameters included in the SP classification, namely samples with coarse grains with non-plastic properties, while according to AASHTO included in the classification of A-1-b, the type of sample with assessment as subgrade material to bad Therefore, this research is based on the results of the parameters containing pozzolanic material which can increase the bearing capacity on expansive soils.

2.1.2 Research design

Physical, Mechanical and Microstructural Behavior Test laboratories to express the physical properties of water, the consistency limit, specificity of gravity, while the mechanical properties include compactness, strong pressure, and carrying capacity. Tests for Boulder Asbuton OVER consistency limits were not tested. Tests of Thermbergers Limit was subjected to this material having non-plasticity index properties, testing the adherence and performing standard Proctor compaction, the test was conducted and the Unconfined Compression Test was performed, and supported by the

CBR test (Figure 2). Asbuton Boulder Over Test Method, weighed by the composition of the plan to produce a mixture of test materials in accordance with the predetermined, mixed done researched and corrected for 24 hours to achieve the chemical precursor before testing. collide 25 times.

(a) (b)

Figure 2. a) Unconfined compression test, b) CBR test tools.

2.2 Sample preparation

2.2.1 Mixed ratio and sample preparation
The mechanical characteristics used in this laboratory study include the effect of free compressive strength testing will be carried out on the composition of Over Boulder Asbuton interfering as a stability material using curing times for 0, 3, 7, 21 days.

2.2.2 UCT test objects
In making UCT specimens, the application of static compaction is applied to avoid damage to EPS granules (Figure 3). This static compaction procedure is based on research that has been carried out. For this compaction process, CBR equipment is used with a speed of 1.2 mm / minute. UCT samples with a dimension of 5.5 cm x 11.00 cm. taken for curing time for 7 days and 21 days.

Figure 3. Making a test model with static compaction

Static compaction is based on the volume of the test object and constant voltage. The test material is divided into three parts, the first layer is compacted to reach 1/3 the mold volume and the amount of pressure obtained is used as the stress value to be applied in layers 2 and 3.

2.3 Testing procedure
Testing of compressive strength was carried out using a universal testing machine (UTM) with the strain speed used was 0.3 mm / minute. In addition to obtaining maximum tension, the strain that

occurs due to loading is also measured by installing LVDT at the time the test is carried out. The effect of curing time on compressive strength for each specimen is carried out, were in this study the compressive strength value.

3. Experimental result and discussion

3.1 Value of compaction testing
In standard compaction testing (proctor test) obtained the maximum moisture content in the original soil is W_{opt} = 19,13% and the maximum dry content weight is γ_{dmaks}= 1,37 gr/cm^3.
The graph of the relationship between water content and dry content weight determines the value of adding water to the preparation of CBR soil samples which will be tested for the carrying capacity. The addition of water for CBR soil samples is 54.99 ml.

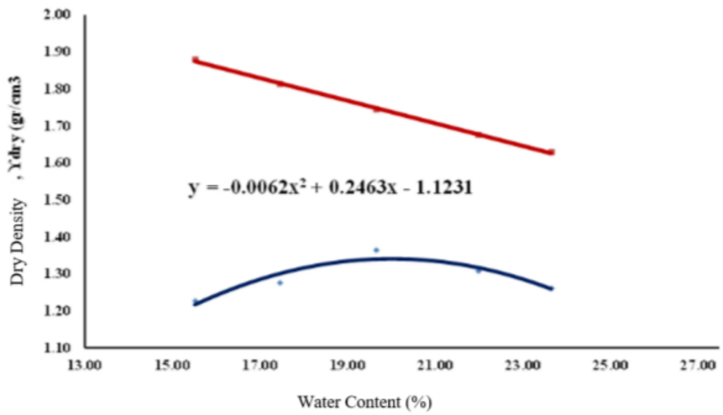


Figure 4. Relation with w_{opt} to γ_{dry} Of Over Boulder Asbuton

3.2 *Testing of california bearing ratio (CBR) without immersion*
As seen from the CBR Samples Over Boulder Asbuton test results, the cost of approaching 500 lbs.

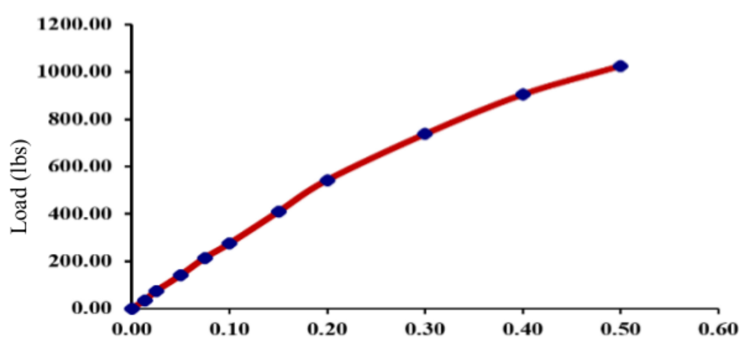


Figure 5. Graph of the relationship between load and decrease of CBR samples of over boulder asbuton

At a 0.1-inch decrease, the CBR value was 9.16%. And at the penetration of 0.2 inches by 12.06%. The CBR value that is used is in accordance with ASTM D-1833 standard where the CBR penetration value of 0.2 inches is greater than the 0.1-inch penetration so that the CBR value of 0.2 penetration is 12.06%.

3.3 Testing of california bearing ratio (CBR) soaked

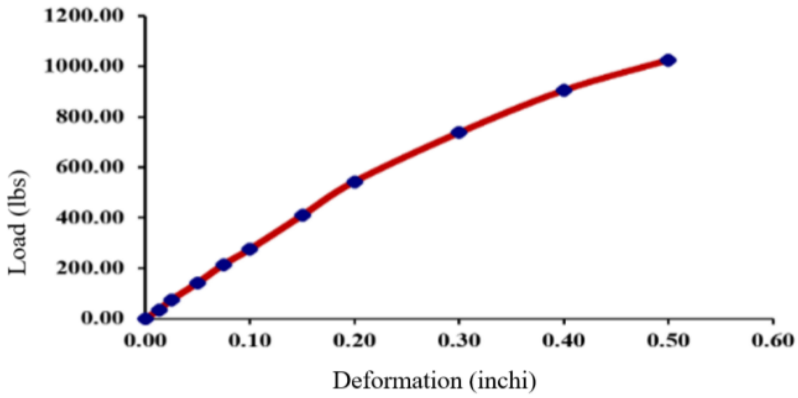


Figure 6. Relationship chart of CBR load and decrease in over boulder asbuton samples.

3.4 Testing for unconfined compression test (UCT) based on the age of curing

The unconfined streghth is shown in the following table 1.

Table. 2 The UCT Test Result

Age of Sample (Day)	0	3	7	14	21
qu Max Value (kg/cm^2)	0,354	0,656	0,590	0,605	0,624

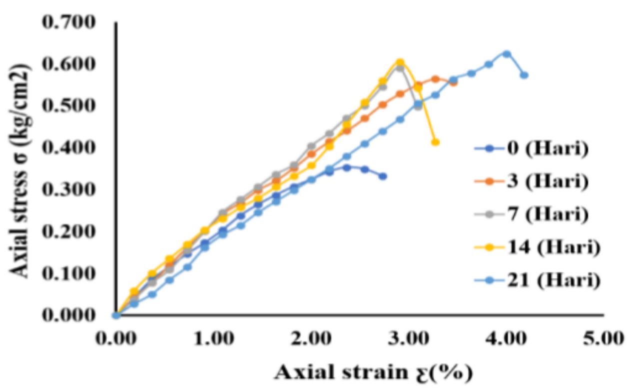


Figure 7. Asbuton over boulder graph based on curing

Based on the Asbuton Over Boulder UCT chart based on the ripening age, it can be seen that the ripening age of sample 3 (Day) has increased with a qu value of 0,565 kg/cm^2 from the sample age of 0 (Day) with a qu value of 0,354 kg/cm^2, compressive strength experienced an increase in ripening age of 7 (days) with a qu value of 0,590 kg/cm^2, an increase in compressive strength occurred at the age of 14 (days) with a qu value of 0,605 kg/cm^2, and at the ripening age of 21 (days) experienced an increase with a qu value of 0,624 kg/cm^2.

This happens because the material particles have a high surface charge that can attract cations (positively charged ions) and water dipoles. The occurrences of reaction and rapid agglomeration flocculation between material particles can produce reinforcement in the ability and strength during curing. So that this type of material can be used as a pozzolanic material capable of stabilizing soft soil with the ability to reduce the pattern of decline that will occur.

3.5 Mineralogical and microstructure test results over boulder asbuton

The mineralogy material content parameters were tested using the X-Ray Diffraction (XRD) method according to the ASTMD3906-03 (2013) standard, while the micro-chemical parameters were tested using Scanning Electron Microscope (SEM) according to the standard ASTM E986-04 (2010), and method energy dispersive X-Ray Spectroscopy (EDS / EDAX) as ASTM E1508 standard 12a [6].

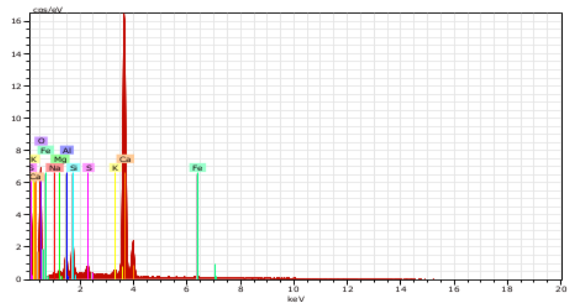


Figure 8. Energy dispersive X-Ray spectroscopy of over boulder asbuton

Microstructure behavior was tested by testing XRD, SEM, and EDS. Based on the test results of Energy Dispersive Asbuton X-Ray Spectroscopy of Over Boulder, it was described that in the mineralogy spectrum of Over Boulder Asbuton dominated by calcium content of 79.64% and silicon content of 9.63%, so that in the composition contained by these minerals can be used as pozzolanic material that can function as a binder and filler from soft soil material that can increase the bearing capacity of the material.

4. Conclusion

The test results of Asbuton Over Boulder physical properties characteristics were obtained based on USCS parameters included in the SP classification, namely samples with coarse-grained characteristics with non-plastic index properties, while according to AASHTO included in the classification of A-1-b ie the type of sample with assessment as good subgrade material bad. Based on CBR values the laboratory conditions and bath conditions showed a relatively low level of between 8.04% - 12.06%, its use as a fill material that can function on the pavement layer of the road as a subgrade layer, so that by looking at the results of gradation of granules and mineral content capable of material this as a stabilizing agent on expansive soil. Asbuton Over Boulder natural material is a natural material that has been investigated which shows pozzolanic behavior. So that it can be used as an expansive soil stabilization embankment material. Based on the test results and microstructure behavior of the Asbuton Over Boulder material compiled in the spectrum test showed that the calcium content was very dominant at 79.64% while the silicon content was 9.63%. The results of this test can be concluded that the mineral content of Over Boulder Asbuton contains pozzolanic composition.

Acknowledgement

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