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The Behavior Of The Clay Shale On Slope Stability At The Nation's Capital (IKN) Sepaku

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ABSTRACT
Clay shale at the nation's capital (IKN)is a type of clay that is easy to expand when it comes into contact with water because of the montmorillonite clay mineral it contains. The effect of water also causes a decrease in strength in the clay shale. As a result of the clay shale behavior, some buildings become damaged or landslides occur on the slope. The soil stabilization method with a cement binder is one solution to improve the detrimental properties of the clay shale. We determine the mineralogical compositions of shales primarily by advanced X-ray powder diffraction analyses. These include determinations of the bulk (whole rock) compositions of shales by full pattern fitting and more even more detailed determinations of the types of and relative abundance of clay minerals based on analyses of clay size fractions, usually 2 micron. In addition chemical analyses, for example by XRF give complimentary information on the chemical composition of shales. We also often determine various chemical and physical properties such as cation exchange capacity (CEC), surface area and porosity. Fundamentally the reactivity of many shales is determined by how the clay minerals they contain influence chemical and physical properties and our analyses can help you understand the behaviour of your shales in the subsurface. Where shale gas is the interest, desirable physical properties such as brittleness can also be related to mineralogical compositions. As shown in the image above, we can also use techniques such a Scanning Electron Microscopy (SEM) to view the micro-structure of shales. The maturity of shales (degree of diagenesis) is also a factor that influences brittleness and fracturability, since crystal growth processes, particularly of clay minerals result in coarsening of particle size and resultant changes in texture. Durability is an important aspect of clay shale stability. Measurement for the durability of stabilized soil has been developed for many years. This paper proposes the investigation of clay shale durability stabilized intheslakingtest.ThespecimenwasmadeaccordingtoASTMstandardweightforslakingtest.

Keywords:*Clay Shale, Durability, Slaking, Stability, Sloping*

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I. INTRODUCTION

Clay shale at the nation' capital (IKN) Sepaku is a type of soil that can increase in volume or swelling when interacting with water due to the mineral content of clay in the form of montmorillonite. Ca^{2+} and Na^{+} are several cations in the montmorillonite mineral which tend to be hydrated or bind to water molecules. The montmorillonite hydration process occurs because of the weak bonds between the outer layers of particles which make iteasierforwatermoleculestoenterthegapbetweenlayers[1].Basedonthenatureandcontentithas, clay shale, including expansivesoils.

main components of clay minerals that make up clay shale particles consist of montmorillonite, illite, and kaolinite [1]. The differences between clay shale and clay in general, in addition to having clay minerals, they also contain iron-containing minerals in the form of glauconite, volcanic glass, biogenic silica, and phosphatic material formed from sedimentation [2].

Summaryofcharacteristicsandparametersofclayshalesoilresultsofsoilinvestigationscarriedout onclayshaleasnativesoilontheslopesoftheCisomangbridgebyShoumanetal.[3]areexplainedin Table 1 which is completed with Table 2 to Table4.

Any of a group of fine-grained, laminated sedimentary rocks consisting of silt- and clay-sized particles. Shale is the most abundant of the sedimentary rocks, accounting for roughly 70 percent of this rock type in the crust of the Earth. Shales are often found with layers of sandstone or limestone. They typically form in environments where muds, silts, and other sediments were deposited by gentle transporting currents and became compacted, as, for example, the deep-ocean floor, basins of shallow seas, river floodplains, and playas. Most shales occur in extensive sheets several metres thick, though some develop in lenticular formations. Shales characteristically consist of at least 30 percent clay minerals and substantial amounts of quartz. They also contain smaller quantities of carbonates, feldspars, iron oxides, fossils, and organic matter. Some organic-rich

shales, called oil shales, contain kerogen (a chemically complex mixture of solid hydrocarbons derived from plant and animal matter) in large enough quantities to yield oil when subjected to intense heat.

This seems strict enough, but it is ambiguous. '10% of the sedimentary clasts' might be a very small volumetric component of the rock, if those 'clasts' are small enough. I am sure they meant to write 10% of the bulk rock volume'. The Wikipedia entry for shale cites Blatt and Tracy (1965), giving a definition that also centres on grain size, but requiring the rock to be *fissile*.A fine-grained clastic sedimentary rock composed of mud that is a mix of flakes of clay minerals and [silt-sized particle. The ratio of clay to other minerals is variable. Shale is characterized by breaks along thin laminae or parallel layering called fissility. Mudstones, on the other hand, are similar in composition but do not show the fissility.

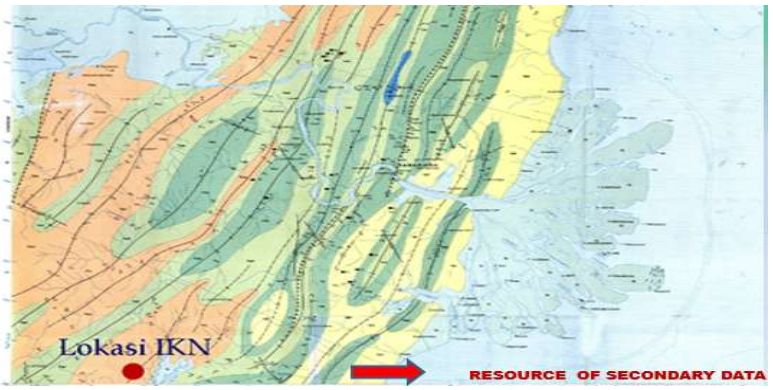

Figure 1. Geology Condition Maping At the Nation's Capital (IKN)

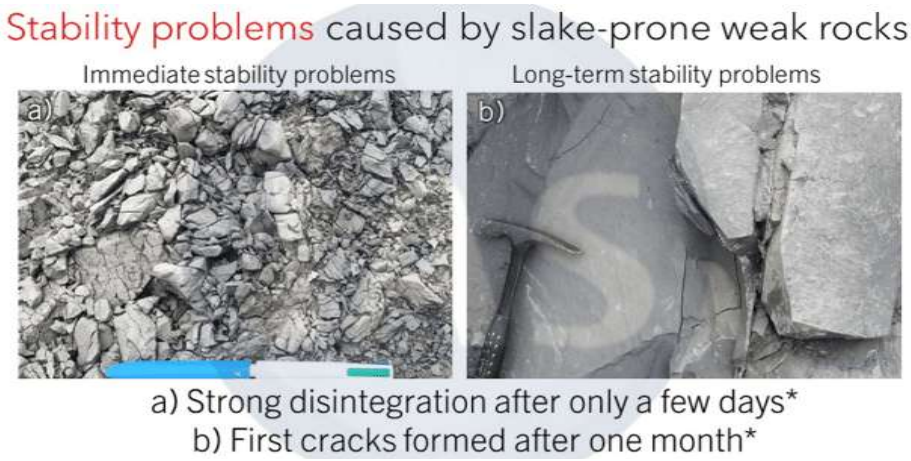

Figure 2. Disintegration Performance Clay Shale At the Nation's Capital(IKN)

Figure 3. Characteristic Of Layer Clay Shale At the Nation's Capital (IKN)

Table 1. Characteristics and parameters of clay shale around the Cisomang bridge slopes.

No	Characteristic		Unit	Value	Information
1	Specific Gravity		-	2.58	Soil includes organic clay (**Hardiyatmo, 1992**)
2	Atterberg Limits	LL	%	65.37	Soil includes high plasticity clay (**Bowles, 1991**)
		PL	%	20.41	
		PI	%	44.96	
3.	Swelling Pressure		kg/cm²	0.192	Soil includes high swelling clay (**Chen, 1975**)
4.	Swelling		%	25.32	

Table 2. Soil type based on specific gravity value.

Soil Type	Specific Gravity
Gravel	2.65 - 2.68
Sand	2.65 - 2.68
Anorganic Silt	2.62 - 2.68
Organic Clay	2.58 - 2.65
Anorganic Clay	2.68 - 2.75
Humus	1.37
Peat	1.25 - 1.80

Table 3. Correlation of Plastic Limits With Types of Soil And Their Characteristics.

Plastic Limit	Plasticity Level	Soil Type	Cohesi Level
0	Non Plastic	Sand	Non Cohesion
< 7	Low Plasticity	Silt	Partial Cohesion
7 - 17	Medium Plasticity	Silty Clay	Cohesion
> 17	High Plasticity	Clay	Cohesion

The clay shale layer on the slope in contact with water will reduce the shear strength and increase the shear stress which causes the water content in the clay shale to increase, so that the weight of the soil.

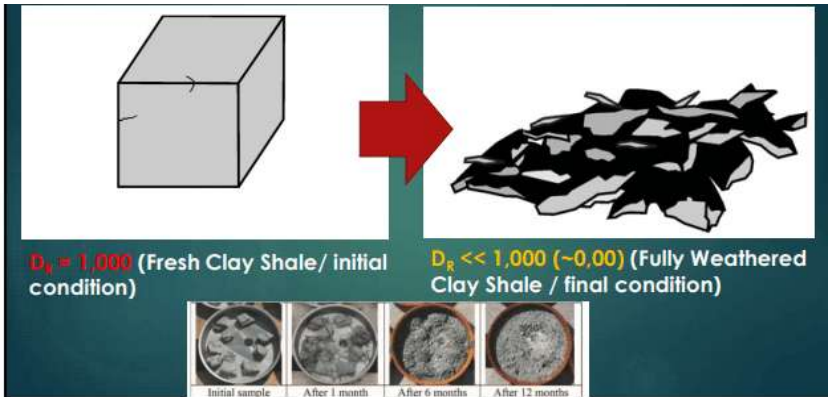

Figure 4. Sieve Analysis Of Clay Shale At the Nation's Capital (IKN)

Volume increases and the slope burden becomes heavier. If the shear stress exceeds the shear strength, thenlandslideswilloccur.Asaresultoftheclayshale'sbehavior,itisnotuncommonforsomebuildings to be damaged. Adverse properties of the clay shale are interesting to be improved, one of which is the soil stabilization method with a slooping to change the clay shaleparameters.

This research will test and analyze the formula of clay shale-cement mixture which produces optimumproperties.Determinationofvariationsinthevalueofslooping water content factor based on previousstudies.

II. RESEARCH METHODS

The method used in the form of laboratory testing is property, mechanical, and chemical. Laboratory testingconsistsofpropertestingofspecificgravityandatterberglimits.Laboratorytestingmechanically consists of swelling and unconfined compression. Then, chemical testing of the laboratory consists of cation exchange capacity, x-ray diffraction, and scanning electronmicroscope.

Tests carried out in laboratories with a number and form of certain samples in accordance with the tests carried out. The composition of each sample used for testing in accordance with predetermined variables. The number and composition of samples are explained in Table 5.

III. RESULTS AND DISCUSSION

Laboratorytestingiscarriedouttofindtheoptimummixturethatproducessuperiorcharacter.Mixtures that reduce the expansive nature and produce high compressive strength, so that the shortage of clay shale can be minimized. The following is a summary of the results from testing in a soillaboratory:

Figure 5. Borlog of Clay Shale At the Nation's Capital (IKN)

Figure 5 shows that the greater the value of SPT content used in the mixture, the greater the density value of the clay shale –5 meter. This shows that the addition of cement material to the clay shale has increased the value of its specific gravity.

The SPT in the soil will cause reduced water in the mixture and gluing between particlesthatarehardanddifficulttopenetratewater[4].Thisresultsinareductioninthevolumeweight of the water and an increase in the volume weight of the solids mixture, thereby increasing the value of specific gravity which is the ratio between the weight or the volume weight of solid granules with the weight volume ofwater.

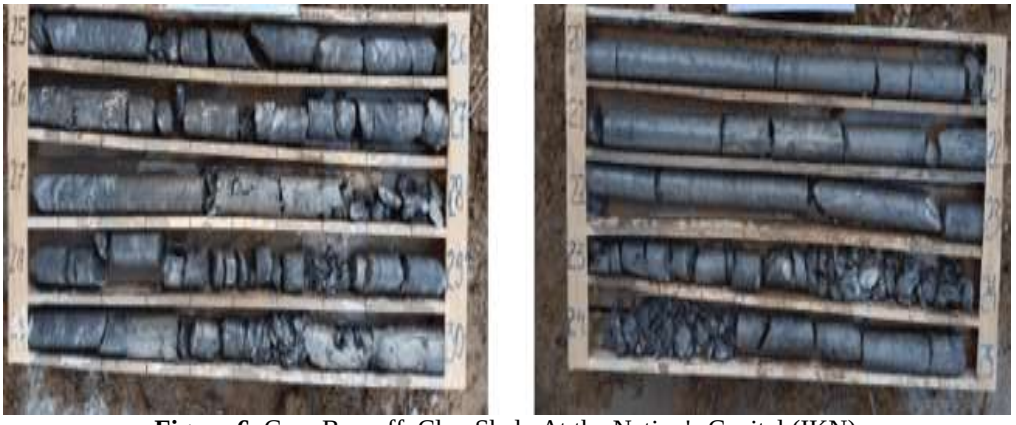

Figure 6. Core Box off Clay Shale At the Nation's Capital (IKN)

Figure 6 shows that the decrease in the value of the plasticity index with concomitant addition of SPT.

The decrease in the value of the plasticity index occurs because of an increase in the value of the plastic limit, where plastic is a condition of minimum water content when a soil is still in a plastic state. This plastic boundary shift occurs due to the absorption of water by cement during the sedimentation process, the higher the addition of cement content, the higher the absorption of water. In a sense, the mixture will be higher the minimum water content limit in achieving plastic conditions.

Table 6. The Resulting ff Mineralogy Sample in test

NO	JENIS PENGUJIAN			HASIL PENGUJIAN					METODE
				BH 4 7 M	BH 6 15 M	BH 8 20 M	BH 9 15 M	BH 10 25 M	
1	XRD Mineral								X-Ray Diffraction (XRD)
	Quartz	(SiO_2)	(%)	79.00	62.00	55.00	83.00	63.00	
	Kaolinite	($Al_2(Si_2O_5)(OH)_4$)	(%)	5.00	8.00	13.00	7.00	7.00	
	Illite	($(K,H_{30})Al2(Si3Al)O_{10}(OH)_{2}H_2O$)	(%)	Trace	7.00	6.00	4.00	7.00	
	Clinochlore	($Mg_{5.0}Al_5Fe._4Si_{2.5}Al_{1.5}O_{16}(OH)_8$)	(%)	5.00	4.00	4.00	Trace	4.00	
	Albite	($(Na(AlSi_3O_8))$)	(%)	11.00	6.00	5.00	6.00	7.00	
	Siderite	($FeCO_3$)	(%)	0.00	0.00	6.00	0.00	12.00	
	Ankerite	($Ca(Fe^{+2},Mg)(CO_3)_2$)	(%)	0.00	8.00	7.00	0.00	0.00	
	Pyrite	(FeS_2)	(%)	0.00	5.00	4.00	0.00	0.00	
	TOTAL		(%)	100.00	100.00	100.00	100.00	100.00	

Table6 shows that the more age of the sample, the lower the value of swelling pressure. The decline inthevalueofswellingpressureoccursbecauseclaymineralsthatplayaroleinbindingwaterhavereacted with composition of clay shale .The compressive strength value increases with age in each sample, but on the others there are a decrease in strength so that the highest compressive strength value is shown by more depth whosecompressivestrengthcontinuestoincrease.Thedecreaseincompressivestrengththatoccurs.

Figure 7.The Resulting Anticline of Layer Clay shale At the Nation's Capital (IKN)

Figure 8. Visiting Site of Layer Clay shale At theNation's Capital (IKN)

More depth issuspectedfromthehighincreaseincementcontentwhichmakesthemixturemorebrittle. In addition, the decrease can occur due to the high amount of water in the mixture that fills thecavity.Based on a series of laboratory tests that have been carried out, it is known that the mixture of clay shale –soaked and unsoaked of the results of soil testing.

In addition to soil testing, chemical testing is also carried out, namely cation exchange capacity testing, X-RayDiffraction(X-RD),andScanningElectronMycroscope(SEM).Thefollowingisasummaryof the results of chemicaltests.

Figure 9. Scanning Electron Microscope (SEM) Test Result

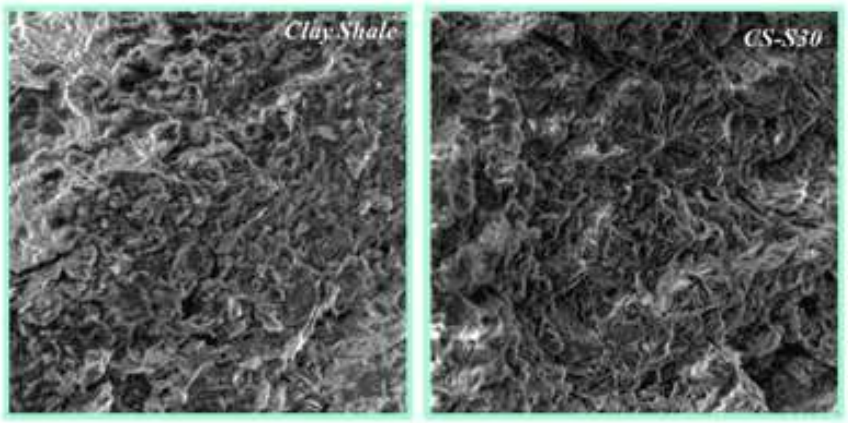

Figure 9 shows that montmorillonite clay minerals are not found in CS-C30. This decreases the ability oftheclayshalecationtoreactwithwatercationsasindicatedbythedecreasedvalueofcationexchange capacity. So that the expansive nature decreases. Figure 5 also show that the solid granules in CS-C30 arelockedbycementpasteandhavelesssocketswhencomparedtotheoriginalclayshale,thusmaking CS-C30 has a higher strength.

Table 7. The Resulting of Slake Durability Test

Depth	Slake Durability Index (%)
BH-2A - 2 m	95.38
BH-3A - 12 m	87.64
BH-3A - 16 m	80.14
BH-4A - 9 m	84.84
BH-5A - 13 m	70.32
BH-6A - 3 m	81.24
BH-6A - 14 m	86.49
BH-7A - 21 m	91.68
BH-8A - 15 m	75.56
BH-A6 - 23 m	74.5

IV. CONCLUSION

The clay shale-mineralogy has been obtained from a series of laboratory tests. Clay ShaleProperties test in parameters and characteristics of clay shale in the formof:

1. Swelling pressure decreased by 42.71%, from 0.192 to 0.110 kg /cm².
2. Decreased plasticity index by 27.55%, from 44.95% to32.57%.
3. Increasing the compressive strength value that continues without any decreaseon more depth
4. The decrease in expansive nature was also demonstrated through the XRD test with no montmoriloniteclayparticlesbeingfoundaftertheadditionofcement,whichwasstrengthened by the reduction in the value of the cation exchange capacity of 79.31%, from 22.52 to 4.66 me/100g.
5. Slake durability test to result at 74.5 % until 95.38 %

V. ACKNOWLEDGMENT

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CONFLICT OF INTEREST STATEMENT

The authors state that there are no financial interests or personal relationships that might influence the work reported in this paper.

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