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The Use of Plastic Sack Fiber and Rice Husk Ash in Increasing the California Bearing Ratio (CBR) Value on the Girisubo Road Section Gunung Kidul Regency

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ABSTRACT

Soil conditions in the Girisubo area, Gunung Kidul Regency, have low soil bearing capacity, so road infrastructure is bumpy and landslides. Therefore, the soil in the area needs to be stabilized and looking for bearing capacity of the soil before use for road subgrades. Clay can be improved by various soil improvement methods, including testing, by mixing plastic sack fiber and rice husk ash. These materials are used based on the high availability of plastic waste and rice husk waste, which are piling up every year. The additional material used was plastic sack fiber with variations of 0.1%, 0.2%, and 0.3% in rice husk ash variations of 0%, 2%, 4%, 6%, and 8% of the dry weight of the soil with the number of test objects 15 pieces. Based on the results, it found the highest CBR value change was obtained in the composition of a mixture of 0.3% plastic sack fiber and 4% rice husk ash of 18.49% and able to increase the percentage of the soil CBR value by 201.50% from the original soil value of 6,13%. Using plastic sack fiber and rice husk ash with the appropriate composition can increase the CBR value and have good quality.

Keywords: *CBR, Plastic sack fiber, Rice husk ash, Soil, Stabilization*

Introduction

The soil consists of minerals, organic matter, and deposits related to Ionggar and terIetak on bedrock, such as sand, Iempung, Ianau, or Iumpur are used to describe the size of soil partakes at a certain grain size limit [1]. The Girisubo area in Gunung Kidul Regency, Yogyakarta, has the ability soil unable to support the load, so many facilities, such as roads, experience waves and landslides[2]. Therefore, stabilization of the soil in the area is required. And the carrying capacity of the soil is sought before it is used for road *subgrade*. A way to determine the ability of the soil to support the load is to test the CBR (California Bearing Ratio)[3].

The Iunak soil can be improved in quality through various soil improvement methods, including physical improvement and using a mixture of plastic sack fiber and rice husk ash [4]. The use of pIastic sack fiber and rice husk ash is based on the high amount of plastic waste and rice husks that are increasing yearly [5]. The lack of utilization of these materials has become the background whythese materials are used to increase the value of CBR [6]. The CBR value is very important to determine the guesswork required in soil construction, especially in road planning [7].

In 2014, Reza conducted a study onthe effect of adding pIastic sack fiber and lime on changes in CBR value on Iempung Iunak soil [8]. This study aims to analyze the effect of *adding add* mixture on CBR value, as well as comparing soil CBR value before and sethas been mixed with *add mixture ingredients.*This study used pIastic sack fiber as a lightweight stockpile material with a percentage variation of 0.15%, 0.3%, and 0.45%. In addition, lime puia is used with a percentage variation of 0%, 5%, and 10% of the dry weight of Iempung Iunak soil. From the test results, the CBR value in the largest unsoaked condition was found in the variation in the percentage of sack fiber by 0.4% and lime by 10%. Therefore, it can be concluded that in order to achieve good results of clay soil stabilization, it is recommended to use sack fiber with a percentage of 0.4%.

Conducted a study on the evaluation of the effect of pIastic waste waste and rice husk ash on changes in CBR values on Iempung Iunak soil. This research focuses on major changes in CBR soil Iempung Iunak after mixed with Iimbah pIastic waste and rice husk ash [9]. The percentage variations used in this study were

0.1%, 0.2%, and 0.3% for waste iimbah pIasti k and 0%, 3%, and 6% for rice husk ash from totaI heavy soil mixture. This study found that mixing plastic waste and rice husk ash increased the CBR value of soft clay soil by up to 367% without soaking first [10][11]. The most significant increase in CBR value occurred in variations in plastic waste levels of 0.3% of the total mixed weight.

This study was carried out to analyze the ability of soil that has undergone stabiization with a mixture of rice husk ash and lime with various percentages, namely4%, 8%, and 12% of the weight of the soil mixture. The test results showed that the use of a mixture of rice husk ash and lime with certain variations in levels can increase the CBR value without soaking in stabilized soils [12]. The largest increase in CBR value occurs in mixture variation with a content of 8% of the total weight of the mixture, where the CBR value can increase up to 329% compared to the original soil CBR value [13].

Conducted research on the effect of rice husk ash onswampland stability using CBR value testing on soil [14]. This study was conducted with the aim of evaluating the effect of adding rice husk ash on soil stability, with variations in addition of 5%, 10%, and 15% of the dry weight of the original soil. In addition, the ripening time for 1 day, 3 days, 7 days, and 14 days was also tested and soaking for 4 days in each variation. This study evaluated the effect of adding rice husk ash as a stabilization mixture on swampland stability with variations in additions of 5%, 10%, and 15% [15]. The test results showed that the higher the amount of rice husk ash mixture added and the more the planting time, the higher the soil CBR value would be t. The highest increase occurred in the variation of adding 15% rice husk ash and the curing time of 14 days, with the CBR value reaching 9.84%. This increased by 363% from the CBR value of asIi soil which was only 2.71%.

Research Methods

Job Preparation

In this study, the land used was occupied in D.I.Y. Province, Gunung Kidul Region, Gisirubo District shown in Figure 1. The fiber used in making these products is taken from used sacks that are no longer used,especially rice bags, and then released the webbing so that it becomes fiber. While the rice husk ash used is ash that has passed through filter number 40 and has passed the drying and drying process.

Figure 1. Research Map Location

For Atterberg boundary testing, sieve analysis, *Proctor modified* compaction, and *Unsoaked* CBR, *disturbed soil samples* were used. The SampeI is taken using a hook, then put into the daIam karung to be tested. The process of taking sampeI is carried out with the aim that the test results can represent the condition of the soil in Iapangan and disturbed as little as possible as the process of extraction. All tests in the laboratory are carried out in the laboratory of PT Aneka Dharma Persada and refer to SNI standards that can beobserved in TabeI 4 below [16]–[22].

TabeI 4. Standardization Testing for PeneIitian

No	Testing	Standard
1	Water Quantity	SNl 1965:2008
2	Density	SNl 1964:2008
3	Limitan Atterberg	SNl 1966:2008 and SNI 3422:2008
4	AnaIisa Sieve and Hydrometer	SNl 3423:2008
	Density Modified	SNl 1742:2008
6	.CBR	SNl 1744:2012

Test Specimen Manufacturing

Take a sample of disturbed soil and mix it with fibers taken from used plastic sacks, and add ash from a rice husk filter. Add water until it reaches the best moisture content and stir until the soil becomes uniform. The hardening process is carried out by maintaining the condition of the mixture for 24 hours so that the moisture content is evenly distributed and the soil becomes denser and more stable. Make test specimens using soil that has been mixed in 15 modified molds. Then continued CBR testing without soaking [14].

Table 5. Vary in the number of samples and the percentage of the mixture.

The composition of mixed soil			
Soil	Fiber Plastic Sacks (SKP)	Abu Sekam Rice (ASP)	Number of Samples
100 - (SKP + ASP) %	0,1% 0,2% 0;3%	0%	3
		2%	3
		4%	3
		6%	3
		8%	3
	Total		15

After all tests are completed, the data is processed using the *Microsoft Excel* program to obtain CBR values which are then compared for each sample in the form of diagrams. The goal is to derive conclusions from the results oftesting.

Result and Discussion

Physical Testing

The soil used in the test is disturbed *soil (disturbed soiI sampIe)* which has 4 stages of testing before it is carried out soil classification grouping. The stages of assessmentcarried out include moisture content testing, specific gravity tests, atterberg limit tests, and sieve analysis tests. The test HasiI was then shown on TabeI 6.

TabeI 6. Test results regarding the physical properties of soil samples.

No	Experimental Approach	HasiI Testing
1	Water Intensity (%)	21,19 %
2	Density (Gs)	2,60
3	Limitan *Atterberg*	
	a. Liquid Limit (LL)	61,48 %
	b. Limitan PIastis (PL)	36,11 %
	c. l index P Iasticity (Pl)	25,37 %
4	AnaIisa Sieve	
	a. Loios sieve nomor 4	100 %
	b. LoIos sieve nomor 10	89,35 %
	c. LoIos filter nomor 40	68,18 %
	d. LoIos filter nomor 200	63,20 %
	e. LoIos size less than 2 µm (Iempung)	19,32 %
5	*Examination SweIiing*	5,84 %

After evaluating the physical properties testing data listed in Table 3, the next step is to identify and classify soils by category or type. Based on the results of the sieve analysis test on soil samples of the Jalan Raya Tepus - Jerukwudel phase II Development Project, where it was found that the percentage of passing filter no.200 was 63.20%, the liquid limit was 61.48%, and the plasticity index was 25.37%, then this type of soil can be categorized as an OH group (organic clay withmedium to high p lasticity) according to the *Unified Soil Classification System* (USCS) and group A-7-5 with clay soil material types and have moderate to poor general ratings according to the *American Association of State Highway and Transportation Officials* (AASHTO).

Land Activities and Development Potential

Activity is the angle of inclination of the line connecting the values of the plasticity index (PI) with the percentage of the clay grain size fraction, where the clay fraction is defined as the weight percentage of the grain smaller than 0.002 mm or 2 µm. The magnitude of soil activity is related in line with the expansion of the soil itself. Based on the results of Atterberg boundary testing and sieve analysis, namely the plasticity index value of 25.37% and the percentage of < size fraction of 2 μm of 19.32%, an activity value of 1.313 was obtained. This shows that clay soils in the Girisubo area are active soils because their activity value is greater than 1.25. For potentdevelopment, only 65 collision variations were carried out and a value of 5.84% of the average development result from the first day to the fourth day of immersion.

Soil Density Testing

Soil compaction testing aims todetermine the maximum dry voIume weight (γd) and optimal moisture content (□opt) of a soil type by collision. Figure 2 shows the test results for maximum dry voIume weight and optimum moisture content to be used as a reference for soil density with CBR values. In the test, the maximum dry volume weight value of 1.48 gr/cm^3 and the optimum moisture content value of 18.00% were obtained.

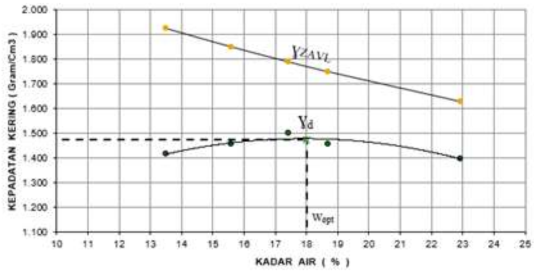

Figure 2. Relationship of dry VoIume weight and levels

In the *CBR Unsoaked* test for soil mixture, the mixture material used consisted of pIastic sack fibers that had been cut into 1-2 cm sizes with fiber content of 0.1%, 0.2%, and 0.3%, and rice husk ash with levels of 0%, 2%, 4%, 6%, and 8%. The test hasiIis then shown in TabeI 7.

Table 7. Results of CBR Value Calculation

SampeI	NiIai CBR Penetration 0.1"
Land AsI i i	6.13 %
SKP0.1ASP0	6.45 %
SKP0.2ASP0	7.76 %
SKP0,3ASP0	9.29 %
SKP0,1ASP2	8.68 %
SKP0.2ASP2	11.81 %
SKP0.3ASP2	12.48 %
SKP0.1ASP4	9.97 %
SKP0.2ASP4	15.24 %
SKP0.3ASP4	18.49 %
SKP0.1ASP6	8.92 %
SKP0.2ASP6	11.38 %
SKP0.3ASP6	8.49 %
SKP0.1ASP8	8.43 %
SKP0.2ASP8	10.36 %
SKP0.3ASP8	7.76 %

From the results of testing the CBR value in mixed variations, a comparison of results was divided into two stages, namely when adding rice husk ash and adding plastic sack fiber. The image of the test results will be displayed as follows:

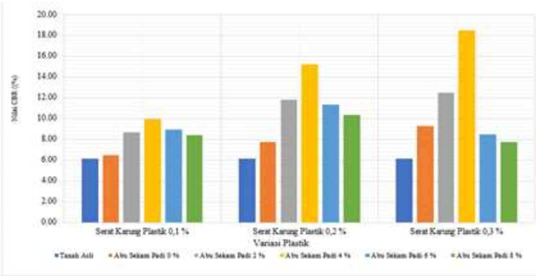

Figure 3. Diagram of CBR Value of Variation in Rice Husk Ash Content

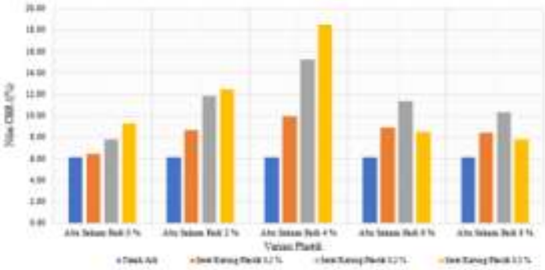

Figure 4. Plastic Sack Fiber CBR Value Graph Against Variations in Rice Husk Ash Content

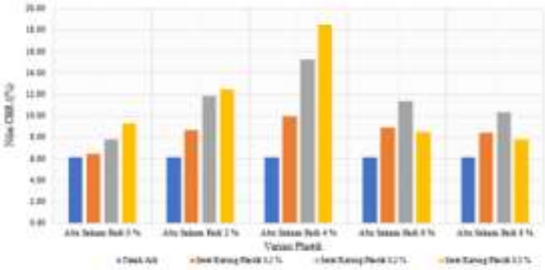

Figure 5. Diagram of CBR values against rate variation Plastic Sack Fiber

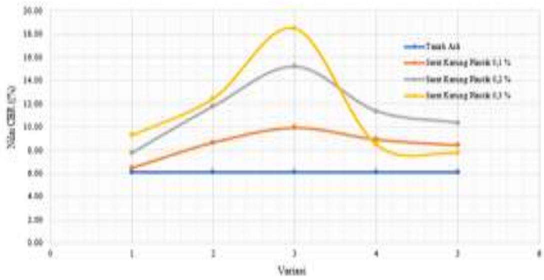

Figure 6. Graph of Tilapiai CBR Ash Husk of Rice Against Variations in the fiber content of plastic sacks

Percentage Change in Mixed Soil CBR Value Against Native Soil CBR

In Table 8 and Figure 7, the percentage change in the CBR value of mixed soil against native soil will be displayed.

Table 8. Percentage Change in Soil CBR Value Blends Against Native Soil CBR

Sample	CBR Penetration Value 0.1"	Change in CBR Value (%)
Native Land	6.13	0.00%
SKP0.1ASP0	6.45	5.15%
SKP0.2ASP0	7.76	26.50%
SKP0,3ASP0	9.29	51.50%
SKP0,1ASP2	8.68	41.50%
SKP0.2ASP2	11.81	92.50%
SKP0.3ASP2	12.48	103.50%

SKP0.1ASP4	9.97	62.50%
SKP0.2ASP4	15.24	148.50%
SKP0.3ASP4	18.49	201.50%
SKP0.1ASP6	8.92	45.50%
SKP0.2ASP6	11.38	85.50%
SKP0.3ASP6	8.49	38.50%
SKP0.1ASP8	8.43	37.50%
SKP0.2ASP8	10.36	68.90%
SKP0.3ASP8	7.76	26.50%

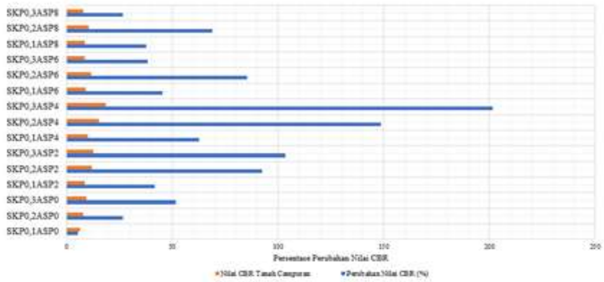

Figure 7. Graph of Percentage Change in CBR Value

It can be seen from table 8 and figure 7 above that the CBR value experienced the highest change in the SKP0.3ASP4 mixture with an increase of 201.50%, while the lowest value change occurred in the SKP0.1ASP0 mixture with an increase of only 5.15%.

The increase in niIai CBR occurs due to the presence of a mixture of rice husk ash containing siIika, which serves to absorb water andis very suitable for Iempung Iunak soil with large reIative water content. Meanwhile, pIastic sack fiber has physical properties that are not easily brittle or rotten when pulled by hand, so it has a good pulling capacity. The two materials together increase the soil stabiization ability of the mixture and result in a significant increase in CBR value.

To achieve optimal CBR, the right mixture of pIastic sack fiber and rice husk ash is needed. If the ash content of rice husks is high, the water absorption will increase significantly, which can cause the soil to become dry. If the fiber content of the pIastic sack is high, it can cause the soil structure to bedamaged because the fiber of the pIastic sack does not have a strong concentration on the soil, thus causing soil grain abrasion or reducing its binding power. This can cause the quality of mixed soils to be poor and the CBR value will be low because mixed soils tend to crumble easily.

Conclusion

Based on the results of the research and discussion that has been carried out, it can be concluded that the mixture of pieces of pIastic sack fiber and rice husk ash on asIi soil tends to increase the CBR value so that the carrying capacity of the soil increases, because the mixture of pIastic sack fiber and rice husk ash has a function to absorb water and has non-fragile properties. The highest CBR value was obtained in the composition of a mixture of 0.3% plastic sack fiber and 4% rice husk ash by 18.49% and was able to increase the percentage change in soil CBR value by 201.50%, while for the lowest obtained in the composition of 0.1% plastic sack fiber and 0% rice husk ash by 6.45% which increased the percentage change in soil CBR valueby 5.15% from the original land. To get a good CBR value, the right composition of the mixture between plastic sack fibers and rice husk ash is needed. With the right composition, the CBR value will increase and have good quality.

Suggestion

Based on the results of the study, it is recommended to carry out more research by testing the type of soil as soon as Iempung Iunak, to ascertain whether the addition of variations in pIastic sack fiber and rice husk ash can increase the CBR value of different soils. In addition, more research is carried out using a variety of mixtures and different methods, so that better compositions and more effective methods can be found to improve the CBR value and soil quality. Thus, the results of research can be more credible and can make a more significant contribution to the development of soil stabiization technology.

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