PAPER NAME

777IJCIET_13_12_003.pdf

WORD COUNT	CHARACTER COUNT
3595 Words	17834 Characters
PAGE COUNT	FILE SIZE
8 Pages	213.2KB
SUBMISSION DATE	REPORT DATE
Feb 9, 2023 9:33 AM GMT+8	Feb 9, 2023 9:34 AM GMT+8

7% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

- 3% Internet database
- 1% Publications database
- Crossref database
- Crossref Posted Content database
- 3% Submitted Works database

Excluded from Similarity Report

- Bibliographic material
- Quoted material
- Cited material
- Small Matches (Less then 20 words)

International Journal of Civil Engineering and Technology (IJCIET)
Volume 13, Issue 12, December 2022, pp. 30-37, Article ID: IJCIET_13_12_003
Available online at https://iaeme.com/Home/issue/IJCIET?Volume=13&Issue=12
ISSN Print: 0976-6308 and ISSN Online: 0976-6316

THE EFFECT OF ADDITIONAL OF SAGO DREGS ASH ON CBR VALUES IN FINE GRAIN SOIL

Mukti
Doctoral Program in Environmental Science, Graduate School, Brawijaya University, Malang, Indonesia

Abdul Hakim
Faculty of Administration Science, Universitas Brawijaya, Malang, Indonesia

As'ad Munawir
Faculty of Engineering, Universitas Brawijaya, Malang, Indonesia

Hanafi Asad
Faculty of Engineering, Universitas Muslim Indonesia, Makassar, Indonesia

ABSTRACT

Efforts have been made to stabilize clay soils both in terms of stabilizers and soil improvement technologies. Materials for stabilizing clay soils that are currently often used include materials that are still imported and are relatively expensive, lime, fly ash, which used to be waste, currently used for pozzolaning in concrete mixes and soil stabilization, so that the economic value becomes high. In this research, an alternative material for soil stabilization will be sought, namely the use of ash from burning sago fiber dregs originating from sago waste which continues to increase and has not been utilized properly. The tests carried out were: the consistency limits of clay before and after being mixed with the ashes of burning sago dregs fiber. Testing of original soil compaction and stabilized soil, as well as testing of soil bearing capacity tested by California Bearing Ratio (CBR) test. The results showed that: The addition of ash from burning sago dregs has an effect on the characteristics of clay soil. On the addition of 6% bagasse ash, the liquid limit decreased by 31.13% from the original soil condition, the plastic limit decreased by 6.39% from the original soil condition, the plasticity index decreased by 87.842% from the original soil condition, the specific gravity decreased of 4.63% of the original soil conditions, the optimum water content increased by 48.41% of the original soil conditions. The addition of ash from burning sago dregs has an effect on the CBR value of clay soil. The maximum CBR value is achieved by adding 6% of sago dregs combustion ash. The penetration CBR of 0.1 increased by 28.57% and the penetration CBR of 0.2 was 23.83% from the soil condition without the addition of ash burning sago dregs.

Keyword head: Soil Stabilization, CBR, Burning Ash of Sago Dregs Fiber.

Cite this Article: Mukti, Abdul Hakim, As’ad Munawir and Hanafi Asad, The effect of additional of sago dregs ash on CBR values in fine grain soil, International Journal of Civil Engineering and Technology (IJCIET), 2022, 13(12), pp. 30-37
https://iaeme.com/Home/issue/IJCIET?Volume=13&Issue=12

1. INTRODUCTION

The phenomenon of clay soil swelling has various impacts on civil building construction. A number of losses have been suffered by the community since realizing its damaging effects on a number of civil buildings that were built on clay soil. Therefore it is very necessary to have a soil improvement method that can be applied in Indonesia to overcome these problems. Efforts have been made to stabilize clay soils both in terms of stabilizers and soil improvement technologies [1-3]. Several methods of handling fine-grained soils including clay soils have been carried out, among others by replacing the material or mixing the soil with Sago Dregs Ash.

In general, most of Indonesia's territory is covered by fine-grained soil with a fairly large expansion (high plasticity), the volume will change (expand) when water content increases (changes). Its volume will increase in wet conditions and will shrink when in dry conditions. This characteristic causes damage to building constructions, especially to the foundation which is a construction in a building that connects the building to the ground.

Subgrade soil is the foundation for road pavements, both pavements on traffic lanes and road shoulders. Thus, the subgrade is the final construction that receives the vehicle load distributed by the pavement. As a pavement foundation, besides having to have the strength or carrying capacity of vehicle loads, the subgrade must also have volume stability due to environmental influences, especially water. Subgrade soils that have low volume strength and stability will result in the pavement easily deforming and cracking. Thus, pavements built on subgrade soils that are weak and easily influenced by the environment will have a short service life [4].

Sometimes we encounter clay with unfavorable properties, such as low CBR value, high swelling and shrinkage value so that when used for road subgrades it will produce a construction that is not optimal (quickly damaged). For this reason, it requires an increase in the CBR value so that it is able to withstand the load on it, the swelling and shrinkage is reduced so that the soil volume is stable when it is hit by rain it does not expand otherwise when the dry season does not shrink too high so that the cracks on the road can be reduced or eliminated. Soil stabilization is one way to improve soil conditions by mixing the soil with certain materials. The soil properties that are most often changed by stabilization are strength, volume stability, durability, and permeability [5].

The level of environmental damage as a result of development continues to increase. This condition becomes a growing problem and issue related to environmental problems and encourages researchers to conduct scientific studies on the potential use of several natural materials that have eco-friendly, bio-degradable, bio-composites, bio-materials, biofuels and green environment. Indonesia as a country with wide biodiversity has a great opportunity to explore the use of natural fiber materials as soil reinforcement [6].

Soil stability is an attempt to improve the properties and strength of the soil. One effort to stabilize the soil is by using additives. Additives that are often used are fly ash, cement, lime, gypsum powder, and rice husk ash. The additive used in this study was using ash from burning Sago Dregs Fiber. The use of ash from burning sago dregs fiber in this study was 0%, 2%, 6% and 10% needed from the dry weight of the soil samples tested. It is hoped that the mixture of these two materials can get a good increase in soil characteristics and soil carrying capacity.

One effort to improve the properties of clay soil is soil stabilization. The additional material used in this study was ash from burning sago dregs fiber. The ash from burning sago dregs fiber was chosen because it physically has loose properties so that it can become a filler and reduce the cohesion of clay soil. In addition, the ash from burning sago dregs fiber contains the elements Ca, Al, and Mg which contribute to preventing the absorption of water by clay particles as well as SiO2 and Al2O3 compounds which have the potential to produce pozzolanic properties when reacted with water and Ca(OH)2.

The purpose of this study was to determine the effect of adding sago dregs fiber burning ash to soil property index values, and the potential for changes in the CBR value of mixed variations of sago dregs burning ash.

Clay soil is an accumulation of weak mineral particles in the bonds between the particles, which are formed from the weathering of rocks. The process of rock weathering occurs physically and chemically. Physical processes include erosion, wind blowing, water erosion, glistening and so on. The soil resulting from this process has the same composition as the rock of origin, this type has nearly equal particle sizes and is described as intact. Meanwhile, chemically caused weathering produces groups of microscopic to submicroscopic, colloidal (<0.002 mm) sized crystalline particles known as clay minerals (clay minerals).

Judging from the minerals that form clay, it can be divided into two groups, namely non-expansive clay and expansive clay. Non-expansive clay is not sensitive to changes in water content, meaning that the potential for swelling and shrinkage is small if there is a change in water content. While expansive clay is soil that has a large potential for swelling and shrinkage when there is a change in soil water content.

Clay minerals are very small (less than 2 microns) and are electrochemically active particles that can only be seen with an electron microscope. Clay minerals show characteristics of attraction with water and produce plasticity that is not shown by other materials even though the material may be clay-sized or smaller. The ash from burning sago dregs fiber is a by-product of agricultural products, which is only considered as waste. However, when it is burned it has pozzolanic properties which have high silicate elements, the average SiO2 is 69.90%. This pozzolan contains cementation properties when mixed with water. Sago dregs ash as filler. The function of the filler is to fill the voids between the aggregates (coarse) which is expected to increase the density and reduce the permeability of the mixture.

Besides its size which must be relatively fine, filler material must have certain properties such as cementation when exposed to water and having high adhesion with other aggregates [7]. The research will be focused on the carrying capacity of fine-grained soil with variations in the mixing of ash from burning sago dregs fiber with the CBR (California Bearing Ratio) test. This research is expected to be able to increase the carrying capacity of fine-grained soils with new and economical alternative stabilizers.

2. RESEARCH METHODS

2.1. Research design

This research was carried out experimentally with seven research stages, namely the initial stage of examining the characteristics of the concrete forming material to determine the physical and mechanical properties of the materials that meet the terms and conditions based on material specification standards. The final stage is testing the characteristics of precast concrete to determine the physical and mechanical properties produced based on the planned concrete quality standards and guidelines for testing implementation for precast concrete types.

2.2. Research Stages

The clay was collected from Moncongloe Village, Maros Regency. Soil sampling was carried out in disturbed soil conditions. In laboratory work, the methods used include:
1. Specific Gravity Check (ASTM 1989 D854-83)
2. Consistency Limit Check (ASTM1989 D 4318)
3. Standard Proctor Testing (ASTM D-698 (Method B))
4. CBR Testing (ASTM D-1883)

The percentage of addition of ash from sago dregs fiber used included 0%, 2%, 4% 6%, 8% and 10%, of the total weight of the soil. Examination of specific gravity and consistency limits is used to determine the physical properties of the original soil. Standard proctor testing is used to determine the optimum density and moisture content. The optimum water content obtained is used in CBR testing.

2.3. CBR (California Bearing Ratio)

California bearing ratio (CBR) is the ratio between the load that the soil can carry against the standard load at a certain level of settlement. If the 0.2 inch CBR value is greater than the 0.1 inch CBR, then the test is repeated, and if the repetition results still give the same results, then the CBR used is 0.2 inch CBR [8].

3. RESEARCH RESULTS AND DISCUSSION

According to the Unified Soil Classification System (USCS) soil classification system, based on the percentage value of grains that pass the No. sieve. 200 of 50.23% (greater than 50%), then based on the USCS soil classification table, soil samples taken from Kel. Moncongloe Maros Regency is generally categorized in the fine grained (clay) soil group.

Table 1. Soil physical properties testing

No.	Paramater	Value
1	Moisture Content (%)	23.59
2	Fill Weight (γ) (gr/cm^3)	1.79
3	Specific Gravity (Gs) (gr/cm^3)	2.59
4	Atterberg limit	
	Liquid Limit (LL)	43.33
	Plastic Limit	30.17
	Plasticity Index	13.16
5	Grain Gradation	
	Coarse grained soil	49.77
	Fine grined soil	50.23
6	Soil Classification	
	Unified method	-CH

Table 2: Specific Gravity of Soil Composition- Sago Dregs Ash

No	Komposisi	Kode	Density
1	Land	A0	2.59
2	Soil + 2% ash from sago dregs	A1	2.72
3	Soil + 4% ash from sago dregs	A2	2.59
4	Soil + 6% ash from sago dregs	A3	2.47
5	Soil + 8% ash from sago dregs	A4	2.27
6	Soil + 10% ash from sago dregs	A5	2.25

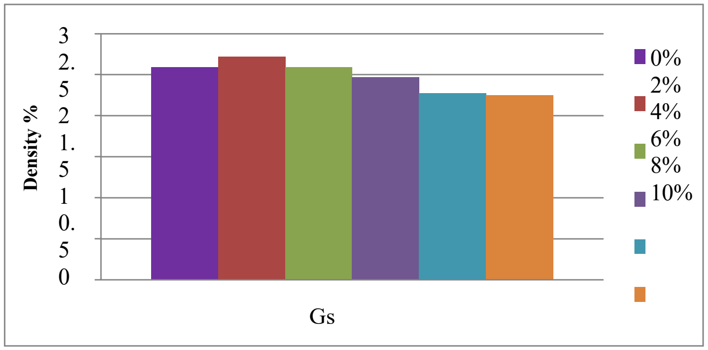

Figure 1. The relationship between water content and average Gs with variations in the addition of sago dregs ash

Table 3: Results of the Atterberg Limit Test of Soil-Ash Sago Dregs

No	Composition	Code	Liquid Limit (LL)%	Plastic Limit (PL) (%)	Plastic Index (PI) (%)
1	Soil	A0	43.33	30.17	13.16
2	Soil + 2% ash from sago dregs	A1	64.62	34.20	3.50
3	Soil + 4% ash from sago dregs	A2	64.60	54.62	2.98
4	Soil + 6% ash from sago dregs	A3	29.84	28.24	1.60
5	Soil + 8% ash from sago dregs	A4	71.35	35.12	3.40
6	Soil + 10% ash from sago dregs	A5	68.13	41.64	8.46

Changes in several physical properties of the stabilized soil such as plasticity index, moisture content, specific gravity, and dry weight are associated with an increase in strength. This increase in strength can be called a temporary increase. The increase in permanent strength is related to the long-term reactions, which are associated with the formation of various types of cementation compounds in the soil matrix. Causes agglomeration which glues between particles. Some of the pore cavities are partially surrounded by cementitious material which is harder and difficult for water to penetrate. The pore cavity isolated by the impermeable cementation layer will be measured as the grain volume thereby increasing the grain volume and decreasing the Gs value.

Table 4: Standard Compaction Test of Soil-ash resulting from sago dregs

No	Komposisi	Yd maks (gr/cm3)	Wopt (%)
1	Soil	13.27	28.771
2	Soil + 2% ash from sago dregs	1.43	11.98
3	Soil + 4% ash from sago dregs	1.49	12.42
4	Soil + 6% ash from sago dregs	1.79	13.20
. 5	Soil + 8% ash from sago dregs	0.64	13.70
6	Soil + 10% ash from sago dregs	0.23	14.84

From the table the addition of ash resulting from burning sago dregs with variations of 2%, 4%, 6% , 8% , 10% underwent various changes so that the maximum Ydry value and maximum optimum water content was obtained at the addition of 6% with a value of 1.79 gr /cm3 with an optimum moisture content of 13.20%. With an initial maximum Ydry value of 13.277 gr/cm3 and an optimum water content value of 28.77%, while the minimum value for changes in Ydry occurs at the addition of 10% with a value of 0.23 gr/cm3. The change in maximum density is caused by the water that fills the pores being absorbed by the ash from burning sago dregs.

Table 5. California Bearing Ratio Test Results (CBR)

No	Composition	In	California Bearing Ratio Test Results (%)				
			1	2	3	4	5
1	Soil	0.1	14.969	17.147	19.052	8.165	4.627
		0.2	12.701	15.241	17.963	7.802	4.536
2	Soil + 2% ash	0.1	16.058	19.052	25.039	16.330	8.165
		0.2	14.878	16.511	23.951	15.423	7.984
3	Soil + 6% ash	0.1	18.507	26.128	26.672	19.596	17.147
		0.2	15.423	22.681	23.588	19.052	15.604
4	Soil + 10% ash	0.1	13.336	17.691	20.413	13.881	13.064
		0.2	15.423	16.330	20.322	15.060	15.967

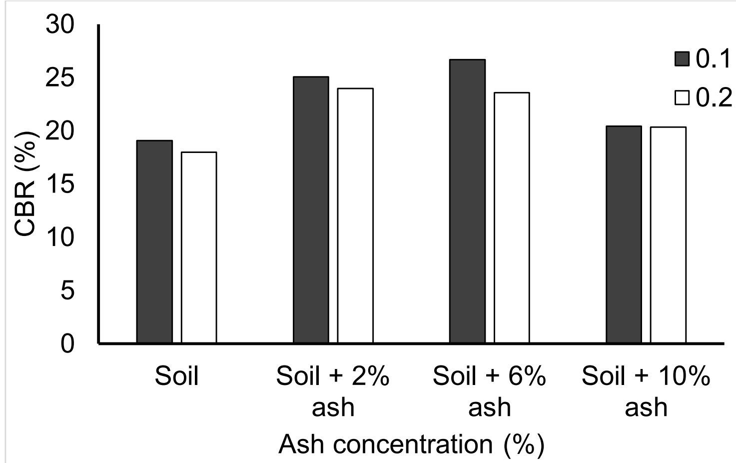

Figure 2. Graph of the Relationship of the Califonia Bearing Ratio (CBR) Value to the Variation of Sago Dregs Combustion Ash

CBR test results for various percentage variations of Sago Dregs Ash mixture in table 4 show that 0% soil (soil without added ash) with LL = 44.33 and PI = 13.16, based on the USCS soil classification that the soil is clay silt with moderate compressibility or loamy soil, this shows that the soil used in this study is a fine-grained soil.

After stabilization, the California Bearing Ratio (CBR) value increased according to the percentage variation of Sago Dregs Combustion Ash. The California Bearing Ratio value of the soil added with Sago Dregs Combustion Ash, is optimal at variations in the addition of 6% APAS with a penetration of 0.1. The reason behind the higher California Bearing Ratio is the additional resistance to penetration that occurs due to the tensile strength of the crushed surface [9]. Ratio (CBR), this is an indicator for increasing soil carrying capacity. The addition of 6% Sago Dregs Combustion Ash showed an increase of 28.57% from the soil without the addition of APAS. This increase can be attributed to the reaction between the soil and the Sago Dregs Ash, forming cementation. The formation of this cementation binds the particles together, by covering the soil grains and filling the pores between the aggregates [10]. Based on these results, it can be concluded that clay soil treated with the addition of Sago Dregs Ash performs well as a stabilizing agent.

The addition of Sago Dregs Ash reduced soil development by increasing the percentage of APAS. Development potential increases when the percentage of addition is more than 6% APA. The use of Sago Dregs Ash as a stabilizer has also shown a change in an increase in the California Bearing Ratio (CBR).

4. CONCLUSION

Based on the results of the research and discussion that has been carried out, it can be concluded as follows:

1. The addition of ash from burning sago pulp has an effect on the characteristics of clay soil. At the addition of 6% bagasse ash, the liquid limit decreased by 31.13% from the

original soil condition, the plastic limit decreased by 6.39% from the original soil condition, the plasticity index decreased by 87.842% from the original soil condition, the specific gravity decreased of 4.63% of the original soil condition, the optimum water content increased by 48.41% of the original soil condition, and the dry density of the soil decreased by 98.26% of the original soil condition.

2. The addition of ash from burning sago pulp has an effect on the CBR value clay. The maximum CBR value is achieved by adding 6% of sago pulp combustion ash. The penetration CBR of 0.1 increased by 28.57% and the penetration CBR of 0.2 was 23.83% from the soil condition without the addition of ash burning sago pulp.

Acknowledgment
The author thanks Chancellor of the Indonesian Muslim University (UMI) Makassar.

REFERENCES

[1] Amir Modarres , Yaser Mohammadi Nosoudy, 2015. Clay stabilization using coal waste and lime — Technical and environmental impacts. Applied Clay Science 116–117 (2015) 281– 288.

[2] Fauzi, A., Nazmi,W.M., Abdul-Rahman,W., Jauhari, Z., 2013. Utilization waste material asstabilizer on Kuantan clayey soil stabilization. Procedia Eng. 53, 42–47.

[3] Hassnen Jafer, William Atherton, Monower Sadique, Felicite Ruddock, Edward L.,2018. Stabilisation of soft soil using binary blending of high calcium fly ash and palm oil fuel ash

[4] Apriyanti, Y., & Hambali, R. (2014). Pemanfaatan fly ash untuk peningkatan nilai CBR tanah dasar. In *Forum Profesional Teknik Sipil* (Vol. 2, No. 2, p. 56040). Bangka Belitung University.

[5] Andriani, A., Putra, H. G., & Hadie, M. S. N. (2019). PENGARUH PENAMBAHAN TANAH MINERAL DAN SEMEN TERHADAP NILAI CALIFORNIA BEARING RATIO (CBR) TANAH GAMBUT. *Applicable Innovation of Engineering and Science Research (AVoER)*, 162-167.

[6] J. Prabakar, R.S. Sridhar, 2002. Effect of random inclusion of sisal fibre on strength behaviour of soil. Construction and Building Materials 16 (2002) 123–131.

[7] Mutohar, Y. (2002). PENGARUH PENGGUNAAN FILLER FLY ASH TERHADAP NILAI KARAKTERISTIK CAMPU RAN ASPAL EMULSI BERGRADASI RAPAT (CEBR) (Doctoral dissertation, program Pascasarjana Universitas Diponegoro).

[8] Hartono, H., Suparman, S., Wahjoedi, W., Mulyono, T., & Utomo, S. (2018). Kajian Eksperimental Dalam Upaya Meningkatkan Nilai Daya Dukung Lempung Merah Melalui Uji CBR. *Bangun Rekaprima: Majalah Ilmiah Pengembangan Rekayasa, Sosial dan Humaniora*, *4*(1, April), 12-22.

[9] Pandian, N. S., & Krishna, K. C. (2003). The pozzolanic effect of fly ash on the California bearing ratio behavior of black cotton soil. *Journal of testing and evaluation*, *31*(6), 479-485.

[10] Etim, R. K., Eberemu, A. O., & Osinubi, K. J. (2017). Stabilization of black cotton soil with lime and iron ore tailings admixture. *Transportation Geotechnics*, *10*, 85-95.

7% Overall Similarity

Top sources found in the following databases:

- 3% Internet database
- 1% Publications database
- Crossref database
- Crossref Posted Content database
- 3% Submitted Works database

TOP SOURCES

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

1	Isra University on 2022-03-28 Submitted works	2%
2	Ahmed, Aly. "Compressive strength and microstructure of soft clay soil... Crossref	1%
3	repository.unisma.ac.id Internet	<1%
4	scilit.net Internet	<1%
5	slideshare.net Internet	<1%
6	jurnal.fkip.unila.ac.id Internet	<1%