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Comparative analysis of increasing cbr value of soil with adding bamboo leaf ash

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ABSTRACT

In road construction, consider the value of the strength of the subgrade, because the value of the strength of the subgrade affects the performance of the soil in accepting the load on it. One of the efforts that can be done to improve the subgrade which has a low bearing capacity is by stabilizing the soil using bamboo leaf ash. This study aims to analyze the increase in CBR value with the addition of bamboo leaf ash. The results of the analysis showed that bamboo leaf ash from the furnace combustion process with a temperature range of 800ºC-1000ºC produced a higher CBR strength value than bamboo leaf ash from ordinary combustion without a furnace. This is due to the higher silica content in the bamboo leaf ash from the furnace combustion process. This silica has pozzolanic and self-cementing properties, namely the ability to harden and increase strength when reacted with water. The addition of bamboo leaf ash with ordinary burning resulted in the optimum CBR value at 7 days of curing of 13.1% at 10% bamboo leaf ash variation. while bamboo leaf ash with Furnace combustion resulted in optimum CBR values of 34.99% and 38.21% at 6% variation of bamboo leaf ash.

ABSTRAK

Dalam konstruksi jalan mempertimbangkan nilai kekuatan tanah dasar, karena nilai kekuatan tanah dasar mempengaruhi performa tanah dalam menerima beban di atasnya. Salah satu upaya yang dapat dilakukan untuk memperbaiki tanah dasar yang memiliki daya dukung rendah yaitu dengan cara stabilisasi tanah menggunakan abu daun bambu. Penelitian ini bertujuan untuk melakukan analisa peningkatan nilai CBR dengan penambahan abu daun bambu. Hasil analisa menunjukkan bahwa abu daun bambu dari proses pembakaran *furnace* dengan range suhu 800ºC-1000ºC menghasilkan nilai kekuatan CBR lebih besar dibandingkan dengan abu daun bambu dari pembakaran biasa tanpa furnace. Hal ini disebabkan karena adanya kandungan silika yang lebih tinggi yang ada pada abu daun bambu dari proses pembakaran furnace. Silika ini memiliki sifat pozzolanic dan self cementing yaitu kemampuan untuk mengeras dan meningkatkan kekuatan jika bereaksi dengan air. Penambahan abu daun bambu dengan pembakaran biasa menghasilkan nilai CBR optimum pada pemeraman 7 hari sebesar 13,1% pada variasi abu daun bambu 10%. sedangkan abu daun bambu dengan pembakaran Furnace menghasilkan nilai CBR optimum sebesar 34,99% dan 38.21% pada variasi abu daun bambu 6%.

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1. Introduction

Road infrastructure development is growing rapidly with the times, so that in its construction it is necessary to consider the condition of the subgrade. One of the efforts that can be done to improve the condition of the subgrade which has a low bearing capacity is stabilization with ash materials such as fly ash, husk ash and bamboo leaf ash [1-5]. Ash material contains silica, iron oxide, aluminum oxide, calcium oxide, magnesium oxide, and sulfate [6-7]. Bamboo leaf ash from furnaces produces high silica content and has the potential to be used as a soil stabilizer [8]. Bamboo leaf ash has a silica content of 75.90-82.86% [8] The increase in Unsoaked CBR value with the addition of bamboo leaf ash is quite significant [8-9].

2. Research Methodology

2.1 Classification method

The research conducted is a research with laboratory test and field test. The test carried out is a test of the physical and mechanical properties of the soil. Field testing was carried out, namely the DCP (Dynamic Cone Penetrometer) test to determine the bearing capacity of the soil at the research site. Laboratory testing consists of testing soil properties, compaction and CBR.

The soil sample was taken from Jalan Raya Munjul, Kampung Ciherang, Pasir Tenjo Village, Pandeglang Regency. The soil sample is disturbed soil. The mixed material was in the form of bamboo leaf ash obtained from the pring tali/bamboo apus (Gingantocchloa Apus) type of bamboo tree.

2.2 Analysis Method

Parameters to be tested include the index of soil properties (test specific gravity, moisture content, grain sieve analysis,atterberg limit),compaction test. and Unsoaked CBR test. The variations of bamboo leaf ash used were 0%, 5%, 10% and 15%.

2.3 Comparative Analysis Method

This study conducted a comparative analysis of the CBR value with the addition of bamboo leaf ash variations of 0%, 5%, 10% and 15% with a study belonging to Olugbenga and Adetuberu in 2010 [9] which carried out soil stabilization research using bamboo leaf ash variations of 0%, 2 %,4%,6%,8% and 10%.

3. Result and Discussion

The following are the results of this study and previous studies to compare the increase in CBR values that occurred with the addition of bamboo leaf ash.

Table 1. Comparison of the results of testing the physical properties of the original soil

Sample	Natural Moisture Content (%)	Specific Gravity	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (PI)	Soil Classification	Soil Type
(Fathonah et al)	11.59	2.64	51.00	30.89	20.11	USCS (OH)	Clay
Sample A (Olugbenga and Adetuberu, 2010) [9]	22.22	1.80	62.10	32.89	29.21	AASHTO (A-2-7(1))	Silty
Sample B (Olugbenga and Adetuberu, 2010) [9]	12.01	1.89	49.80	28.80	21.00	AASHTO (A-2-4(1))	Silty

Based on Table 1 shows the results of the physical properties of the original soil. The research sample of Fathonah et al, Sample A, B, research by Olugbenga and Adetuberu had a plasticity index >17% including the PI in the high category.

The unsoaked CBR test is shown in Table 2 below

Table 2. Comparison of unsoaked CBR test results

Sample	Bamboo leaf ash percentage (%)	CBR unsoaked (%)
(Fathonah et al)	0	4.1
	5	12
	10	13.1
	15	10.5
Sample A (Olugbenga and Adetuberu, 2010)	0	5.44
	2	12.84

	4	17.62
	6	38.21
	8	23.22
Sample B (Olugbenga and Adetuberu, 2010)	0	11.42
	2	13.10
	4	18.22
	6	34.99
	8	21.37

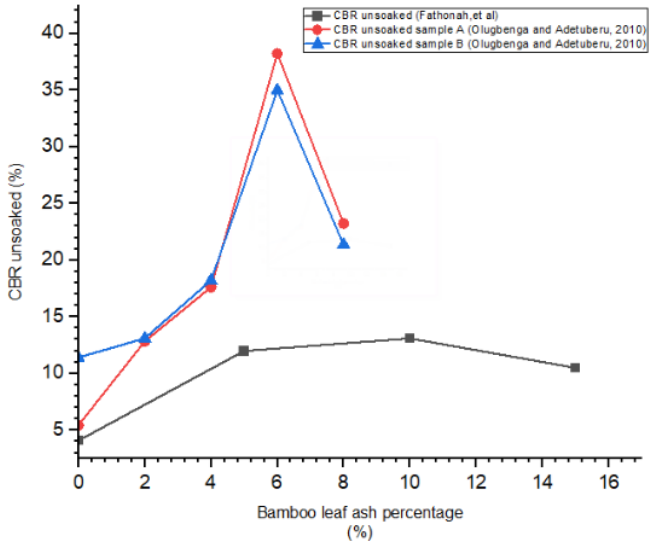

Figure 1. Relationship of bamboo leaf ash percentage (%) and CBR unsoaked (%)

Based on the graph in Figure 1 shows an increase in the CBR value from the original soil CBR value, meaning that the addition of bamboo leaf ash has an effect on increasing the unsoaked CBR value for clay and silt soil types. Bamboo leaf ash used in this research is the result of ordinary combustion without a furnace, while the bamboo leaf ash used in samples A and B (research by Olugbenga and Adetuberu, 2010) is bamboo leaf ash from furnace combustion with temperatures between 800°C-1000°C.

So it can be concluded from both the ordinary combustion process and the furnace that it affects the increase in the CBR value, even though the furnace combustion produces a more significant increase in CBR value and is greater than the addition of bamboo leaf ash from ordinary combustion. This is because the combustion furnace produces a fairly large silica content, silica has pozzolanic and self-cementing properties [8]. The more silica content, the more it will increase strength and harden when reacted with water.

Table 3. Comparison of Plasticity Index test results

Sample	Bamboo leaf ash percentage (%)	Plasticity Index (%)
(Fathonah et al)	0	20.11
	5	19.06
	10	16.94
	15	15.96
Sample A (Olugbenga and Adetuberu, 2010)	0	29.21
	2	27.32
	4	29.19

	6	39.30
	8	21.52
Sample B (Olugbenga and Adetuberu, 2010)	0	21.00
	2	14.24
	4	8.16
	6	17.77
	8	21.57

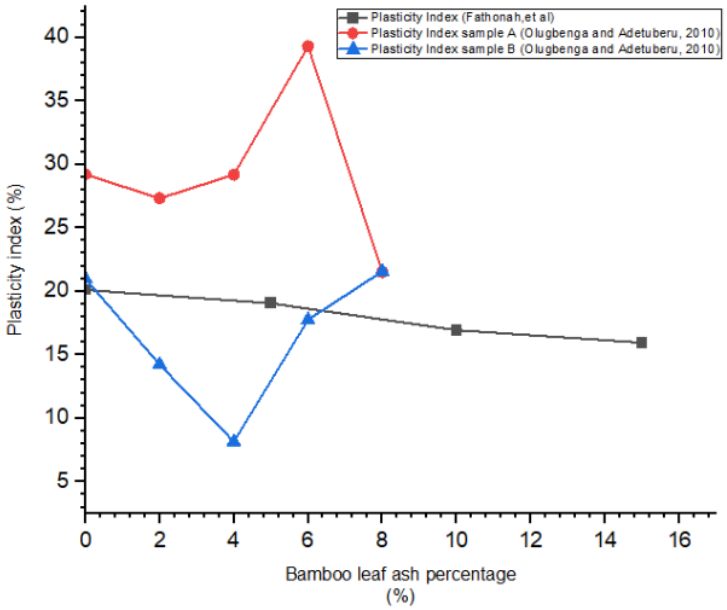

Figure 2. Relationship of bamboo leaf ash percentage (%) and Plasticity index (%)

Based on the graph in Figure 2 shows the value of soil plasticity index with the addition of bamboo leaf ash decreased but not significantly. In Fathonah et al's research, it produced a PI value of 16.94% at the optimum percentage of CBR values including the moderate plasticity category, while samples A and B (Olugbenga and Adetuberu study, 2010) produced a PI value of 39.30% and 17.77% at the optimum percentage of CBR values, belongs to the category of high plasticity.

In sample A, the PI value increased when 6% bamboo leaf ash was added and the PI value decreased again when 8% bamboo leaf ash was added. In sample B, with increasing bamboo leaf ash at a percentage of 6% and 8%, the PI value increased. This means that stabilization with bamboo leaf ash needs to be combined with other added materials that can accommodate the shortcomings of bamboo leaf ash, namely it cannot reduce the plasticity index value significantly.

4. Conclusion

The addition of bamboo leaf ash can increase the unsoaked CBR value of both bamboo leaf ash from the furnace process and ordinary combustion processes, but bamboo leaf ash from the furnace combustion process with a temperature range of 800C-1000C produces a higher CBR strength value than bamboo leaf ash from ordinary combustion without furnaces. This is due to the high silica content.

The addition of bamboo leaf ash with ordinary burning resulted in the optimum CBR value without curing of 10.1% at 10% bamboo leaf ash variation. while bamboo leaf ash with Furnace combustion resulted in optimum CBR values of 34.99% and 38.21% at 6% variation of bamboo leaf ash. The effect of bamboo leaf ash on the decrease in plasticity index was not very significant.

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