Effectiveness of Using Spent Bleaching Earth Stabilized Using Seashells on Concrete Compressive Strength

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Abstract. Bleaching Earth is a material used to refine palm oil to make it brighter in color as we currently consume. However, due to this, the accumulation of Bleaching Earth is increasingly uncontrolled and continues to accumulate. Previously, this research had been carried out but had not found a major impact on concrete durability. Especially in coastal areas which are often exposed to high chloride ions and have the potential to damage concrete. This research aims to create a material that can modify the properties of concrete to have better durability by modifying Spent Bleaching Earth using seashells. This research uses a cylinder measuring 150 x 300 mm with a various admixture. In this research, 3 (three) stabilization fraction models were tried, namely Fraction A with 60% SBE and 40% Seashells, fraction B with 50% SBE and 50% Seashells, and fraction C with 40% SBE and 60% Seashells. The research showed that fraction B showed compressive strength reaching 22,85 MPa and Fraction C showed compressive strength up to 29,44 MPa at 28 days. Meanwhile, Fraction A experienced a decrease in compressive strength, reaching only 20,64 MPa compared to normal concrete of 21,90 MPa at 28 days. This could be caused by many things, so further research is needed regarding the stabilization of these two materials. Based on the research, it can be concluded that Fraction C can be a recommendation because it has higher strength than other fractions and needs to be tested in aggressive environments, especially in coastal areas

Keywords: Spent Bleaching Earth, Stabilization, Coastal

INTRODUCTION

Nowadays, the use of palm oil is increasing every year. According to the Indonesian Palm Oil Entrepreneurs Association (GAPKI), Crude Palm Oil (CPO) production will reach 50.07 tons throughout 2023. Cooking oil from refining CPO oil requires bleaching flour, known as bleaching flour or Bleaching Earth. This Bleaching Earth will be disposed of after use on vacant land/landfills owned by the Company. Bleaching Earth that has been used will become residual oil refining waste, known as Spent Bleaching Earth (SBE). So far, SBE has yet to find its potential to be used as a helpful material in the construction world. SBE will become a mountain of waste, as seen in **FIGURE 1**, and has the potential to cause fires because of the oil content; even though it is not much, it will pollute the soil and cause air and environmental pollution.

FIGURE 1. SBE Tiled up on landfill owned by company

Based on common conditions, research is looking for the potential of SBE as a more helpful material so that the mounting piles of waste can be minimized. Previous research conducted by [1] utilizing SBE as a concrete mixture with cement substitution for compressive strength and flexural strength showed a decrease in quality as the material substitution increased. In addition, research has been carried out using SBE as a cement substitute but with the help of a superplasticizer. It can be done because the condition of SBE is like dust absorbing water, so the concrete lacks water and is very difficult to work with, and the concrete physically looks porous. In this study, 2 (two) treatment methods were used, namely sea water and fresh water. Still, the results tend to be surprising because SBE can make concrete more resistant to chloride attack than concrete in freshwater by not showing a decrease in compressive strength but tending to increase by around 4. 96% [2]

Based on research carried out previously, innovations in the use of SBE in concrete mixtures have shown exciting improvements. This background for research on SBE in concrete mixtures is interesting to continue. It's just that previous research used unstabilized SBE. The idea of stabilizing SBE material comes from the loss of calcium content in cement but is not replaced by SBE as a substitute material. If concrete lacks calcium in its content, it can be brittle as it ages, so this cannot be allowed because it can potentially cause harm and loss of life in the future.

Material stabilization is one method of modifying the properties and characteristics of materials using Seashells, which are known to have high calcium. This is one of the innovations to modify the properties and characteristics of SBE into a more useful material. It has the potential to become a pozzolanic material that can be used as a cement substitute in concrete mixtures.

Based on these conditions, this study will analyze the variation of SBE material stabilization with 3 (three) types of fractions there are fraction A using 60% SBE and 40% Seashells, fraction B using 50% SBE and 50% Seashells, and fraction C using 40% SBE and 60% Seashells. This research will compare the compressive strength produced between concrete with the three designed fractions to obtain recommendations for SBE stabilization suitable for use in aggressive environments like coastal area construction.

METHODS

According to [3] concrete has a mixture of cement, water, coarse aggregate and fine aggregate as well as additives (if needed). The cement used is cement produced by PT. Dynamix Cement and is generally used as the main adhesive. In addition, pozzolanic materials are currently quite commonly used as additives or cement substitutes. The coarse and fine aggregates come from Tanjung Balai Karimun, Riau Islands. There are 2 (two) additives used in this research, it was Spent Bleaching Earth (SBE) and seashell to stabilize the SBE before it used which is expected to make better concrete towards aggressive area. This study has 24 samples consisting of compressive strength testing for ages 7 and 28 days. For compressive strength test objects using cylinders with dimensions of 300 x 150 mm. For more details, see **TABLE 1** below.

TABLE 1. Research Specimens

Mixture Fraction	Specimens Shapes	Curing Age	Specimens Total
Normal Concrete	300 x 150 Cylinder	7 dan 28 Days	6 Pcs
BSS A	300 x 150 Cylinder	7 dan 28 Days	6 Pcs
BSS B	300 x 150 Cylinder	7 dan 28 Days	6 Pcs
BSS C	300 x 150 Cylinder	7 dan 28 Days	6 Pcs
		Total	24 Pcs

As seen in Table 1 above, this study shows 4 (four) types of concrete mixtures, namely normal concrete as control concrete, BSS A, namely concrete with a mixture of SBE (60%) + Seashells (40%) as much as 5% of the weight of cement, BSS B, namely concrete with a mixture of SBE (50%) + Seashells (50%) as much as 5% of the weight of cement, and BSS C, namely concrete with a mixture of SBE (40%) + Seashells (60%) as much as 5% of the weight of cement at the age of 7 and 28 days. So, it will be seen whether this mixture is worthy of being a recommendation for material innovation on Bengkalis Island.

The composition of the concrete mixture is a vital thing that needs to be considered in making a concrete mixture. The concrete mixture used is the same between concrete with seawater immersion and well water immersion. For more details, see Table 2 below.

TABLE 2. Concrete Mixture in 1m3

Mixture Fraction	**Cement (Kg)**	**Water (Kg)**	**Coarse Aggregate (Kg)**	**Fine Aggregates (Kg)**	**Spent Bleaching Earth (Kg)**	**Seashell (Kg)**
Normal Concrete	478,54	158,34	1079,62	624,11	0	0
BSS A	454,62	158,34	1079,62	624,11	14,36	9,57
BSS B	454,62	158,34	1079,62	624,11	11,96	11,96
BSS C	454,62	158,34	1079,62	624,11	9,57	14,36

To determine the quality of concrete, concrete compressive strength testing is carried out according to PBBI NI-2-1971, which determines how much load the concrete can withstand in one unit area.

$$\text{Compressive Strength (MPa)} = \frac{\text{Force (N)}}{\text{Area (mm}^2\text{)}} \quad (1)$$

When a load is applied, there is a reaction between the compressive load and the concrete surface which slowly disintegrates. When the concrete has reached its limit to withstand the load, the ability of the concrete to withstand the load is called the compressive strength of concrete in units of N/mm2 or MPa. The setup for the compressive strength tool can be seen in **FIGURE 2** below.

FIGURE 2. Compressive Testing Machine Setup

RESULTS AND DISCUSSION

Testing for compressive strength will increase or decrease, which will affect the quality of the concrete and the compaction of the concrete during molding. The results of the material properties test also greatly influence the quality of the concrete itself. Concrete has high compressive strength compared to steel material [4], so the quality of the concrete itself greatly influences the strength of the concrete when it plays a role in supporting the design load.

The compressive strength in this study consisted of 7 and 28 days of curing age with 4 different fractions, namely normal concrete, BSS A, BSS B, and BSS C. Based on the test, there are quite interesting results because each fraction shows its own characteristics. Based on the results of the compression test using a concrete compression tester from the four materials, it can be seen in **FIGURE 3** below

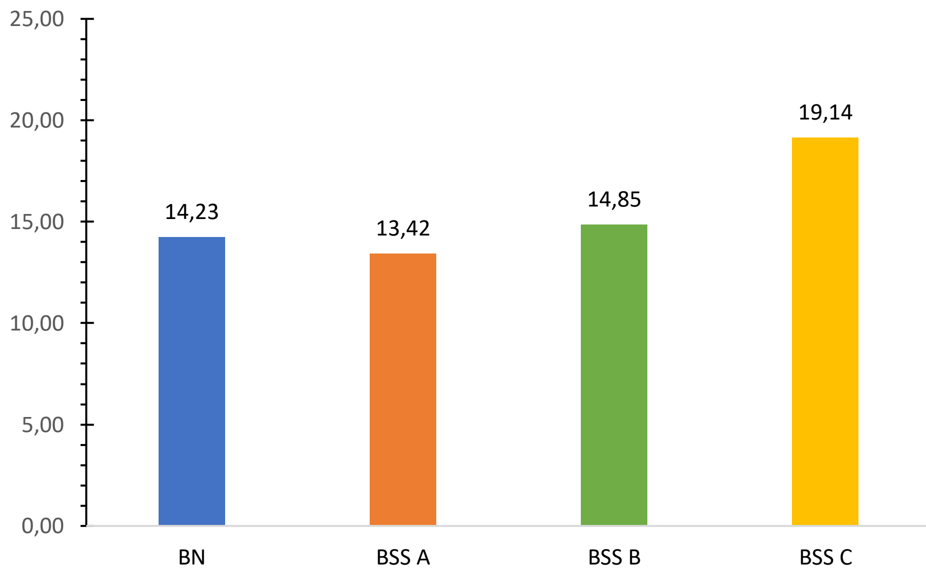

FIGURE 3. Compressive Strength Result in 7 days

Based on the results of concrete testing when it was 7 days curing age can be seen that normal concrete reaches 14,23 MPa, so this value is the benchmark for whether other mixture variations are suitable for use. The BSS A variation has a compressive strength that only reaches 13,42 MPa, which is 5,69% lower than the strength of standard concrete, which reaches 14,23 MPa. However, the BSS B variation shows an increase in compressive strength, reaching 14,85 MPa, which is 4,36% higher than normal concrete. Concrete with the BSS C variation shows the highest compressive strength compared to other concrete variations, namely having a compressive strength of concrete reaching 19,14 MPa or an increase of 28,89% compared to normal concrete. This is quite interesting because it shows that SBE has the potential to be used as a cement substitute material. However, it only needs to be stabilized first using seashells to make the concrete more durable. For details value can be seen at **TABLE 3.** below.

TABLE 3. Compressive Strength Result in 7 days

Mixture Fraction	Curing Ages	Diameter	Height	Area	Compressive Strength	Mean Compressive Strength
	(Days)	(mm)	(mm)	(mm2)	(MPa)	(Mpa)
BN	7	150	300	17671,5	14,57	14,23
	7	150	300	17671,5	12,90	
	7	150	300	17671,5	15,23	
BSS A	7	150	300	17671,5	13,25	13,42

Mixture Fraction	Curing Ages	Diameter	Height	Area	Compressive Strength	Mean Compressive Strength
	(Days)	(mm)	(mm)	(mm2)	(MPa)	(Mpa)
	7	150	300	17671,5	13,55	
	7	150	300	17671,5	13,44	
BSS B	7	150	300	17671,5	14,74	14,85
	7	150	300	17671,5	15,03	
	7	150	300	17671,5	14,78	
BSS C	7	150	300	17671,5	19,99	19,14
	7	150	300	17671,5	18,28	
	7	150	300	17671,5	19,13	

On the other hand, this research was carried out to see the development of concrete compressive strength up to 28 days of curing period so that the concrete strength was considered to have reached 100% strength. At 28 days, the influence of each variation on the concrete mixture is also shown in **FIGURE 4** below.

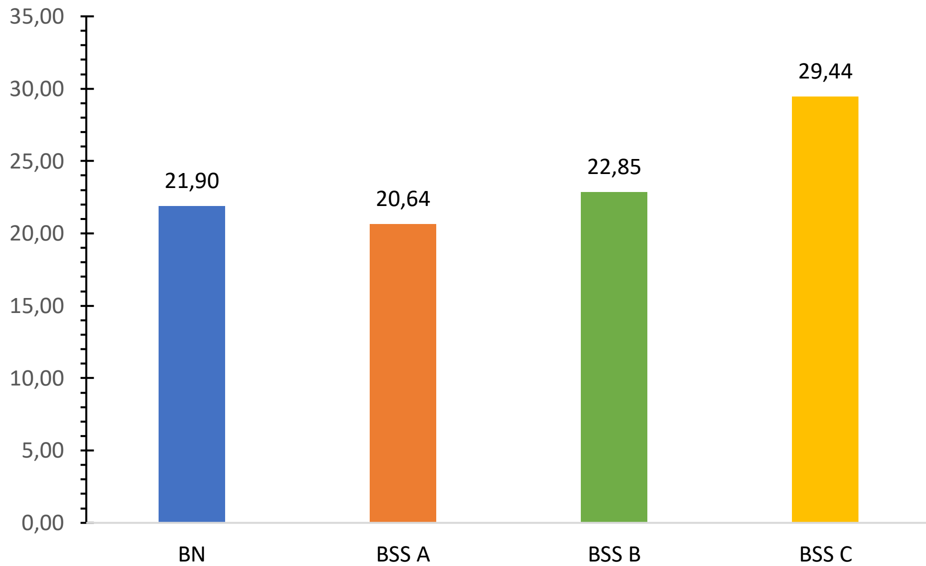

FIGURE 4. Compressive Strength Result in 28 days

Based on the results of concrete testing when it was 28 days curing age can be seen that normal concrete reaches 21,90 MPa, so this value is the benchmark for whether other mixture variations are suitable for use. The BSS A variation has a compressive strength that only reaches 20,64 MPa, which is 5,75% lower than the strength of standard concrete, which reaches 21,90 MPa. However, the BSS B variation shows an increase in compressive strength, reaching 22,85 MPa, which is 4,33% higher than normal concrete. Concrete with the BSS C variation shows the highest compressive strength compared to other concrete variations, namely having a compressive strength of concrete reaching 29,44 MPa or an increase of 34,43% compared to normal concrete. This is quite interesting because it shows that SBE has the potential to be used as a cement substitute material. However, it only needs to be stabilized first using seashells to make the concrete more durable. For details value can be seen at **TABLE 4** below.

TABLE 4. Compressive Strength Result in 28 days

Mixture Fraction	Curing Ages	Diameter	Height	Area	Compressive Strength	Mean Compressive Strength
	(Days)	(mm)	(mm)	(mm2)	(MPa)	(Mpa)
BN	28	150	300	17671,5	22,42	21,90
	28	150	300	17671,5	19,84	
	28	150	300	17671,5	23,43	
BSS A	28	150	300	17671,5	20,38	20,64
	28	150	300	17671,5	20,85	
	28	150	300	17671,5	20,68	
BSS B	28	150	300	17671,5	22,68	22,85
	28	150	300	17671,5	23,12	
	28	150	300	17671,5	22,74	
BSS C	28	150	300	17671,5	30,76	29,44
	28	150	300	17671,5	28,13	
	28	150	300	17671,5	29,43	

CONCLUSIONS

This research produces several conclusions based on the concrete compression tests carried out. Concrete with a mixture of SBE that was stabilized first using crushed seashells with 3 (three) variations. So, the three variations that were tried showed quite exciting developments in utilizing SBE in concrete mixtures because they could be used. After all, it showed an increase in the compressive strength of concrete compared to standard concrete and should also be able to be used in aggressive environments such as coastal areas. Variations in the use of additives with 40% SBE content and 60% seashell as a 5% cement substitute material could be one of the recommendations that need to be reviewed regarding resistance to attack by peat water and sea water before application.

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