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The Effect of Foam Agent's Viscocity to Cellular Lightweight Concrete Brick's Physics and Mechanics Property

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ABSTRACT: The soil's character on Borneo Island has soft structure and lots of peatlands, which is less benefit in construction because of low carrying capacity of soil and soil subsidence may happen by load. Along with the development of technology, many innovations have been invented to overcome the problem. One of themis the usage of light weight brick to reduce construction load. Because there is still no standard in CLC (Cellular Lightweight Concrete) brick, then this research intended to develop standard for producing CLC brick, especially for foam agent composition as independent variable from this research. Experimental method is used in this research by testing materials and sample which are then the result of test are processed by the help of data processor application. The results of research show that there are effects on CLC brick'sphysics and mechanics characteristic by the addition of foam agent, which is the more addition of foam agent produce lighter CLC brick, resistant to sound, resistant to heat, but weakerit's compressive strength and escape water easily.

Keyword : CLC (Cellular Lightweight Concrete) brick, foam agent, physics and mechanic characteristic

I. INTRODUCTION

The soil characteristic on Kalimantan has a soft soil structure becauseit has a lot of peatland. This condition is less favorable in construction because of the lows oil carrying capacity and significant land subsidence can occur due to the loadit carries. The weight of construction can be reduced by using CLC brick because of CLC brick volume weight is much lighter than red brick and cement brick, whichis 400–900 kg/m^{3}for CLC brick's volume weight [1] while red brick has1,500–2,000 kg/m^{3}for it's volume weight [5][6],and 950–1,000 kg/m^{3}for cement brick's volume weight[4].The usage of CLC brick also reduce the reinforcement and dimensionsfor structural elements, and it reduces theusage of cement and sand, resulting more economical building [5][6].

The production of lightweight concrete brick use lesser energy than red brick, and italsomore enviromental friendly because there is less pollution created[8]. This is because of CLC brick composed of sand, cement, water, Sikament LN as chemical admixture, which is then this composition added by foam agent in concrete mixer. The addition of foam createstons of micro bubblein the mixture, whichis general characteristic of cellular lightweight concrete.

Foam agentis one of CLC brick ingrédient, which is a chemical ad mixture that add air bubbles to the mixture with the aim of reducing the weight produced without reducing the value of compressive strength. In using foaming agent as a chemical admixture, the properties of the CLC brick are determined by foaming agent concentration level. The optimal results for CLC brick properties will be achieved by determining the optimum composition of foaming agent. Therefore, comparation of CLC brick property is needed.

II. MATERIAL AND DIMENSIONS OF CLCBRICK

1.1. Cement

Cement used in this study is Dynamix brand Portland composite cement. Type III cement (i.e. ASTM C 150-95a & SNI 7064:2014& BS 12:1989) is high initial strength PCC[10].

2.2 Fine Aggregate

Fine aggregate's properties and characteristic must be tested.Yellow sand is used as fine aggregate in this research (SNI-03-2834–2002) and the qualification limits determined based on the level of refinement separated sand material[5][6].

The sand used includes sand zone III with a fines modulus of1.893[2][11][12].

Table1. FineAggregateGradationTerms[7]

The opening of theshieve(mm)	Percent Passing the Sand			
	Zone I Coarse	**The Zone II Quite Coarse**	**The Zone III Quite Smooth**	**The ZoneIV Smooth**
10	100	100	100	100
4.8	90 - 100	90 - 100	90 - 100	95 - 100
2.4	60 - 100	75 - 100	85 - 100	95 - 100
1.2	30 - 70	55 - 90	75 - 100	90 - 100
0.6	15 - 34	35 - 59	60 - 79	80 - 100
0.3	5 - 20	8 - 30	12 - 40	15 - 50
0.15	0 - 10	0 - 10	0 - 10	0 - 15

2.3 Water

This research used water from the local company with a pH 6-7 (**SNI 03-2874-2002** and meeting the requirements of **PBBI 1971 NI-2**).

2.4 Foaming Agent

The ADT brand foaming agent is used to form foamed concrete. Pre-foaming method andmixed foaming method are methods for producing foamed concrete. The pre-foaming method created from separated base mix cement paste and mixture of foam agent and water, then mixed into the base mix. During the process of mixing, the foam is produced by mixed surface active agent and the base mixture ingredients, resulting in a cellular structure in the concrete as shown in Fig. 1. Table 2 shows the properties of foamed concrete[3].

Table 2. Typical properties of foamed concrete [3]

Dry density (kg/m^3)	Compression strength (MPa)	Modulus of elasticity (E-value) (GPa)	Thermal conductivity (3% moisture) (W/mK)	Drying shrinkage (%)
400	0.5-1.0	0.8-1.0	0.10	0.30-0.35
600	1.0-1.5	1.0-1.5	0.11	0.22-0.25
800	1.5-2.0	2.0-2.5	0.17-0.23	0.20-0.22
1000	2.5-3.0	2.5-3.0	0.23-0.30	0.15-0.18
1200	4.5-5.5	3.5-4.0	0.38-0.42	0.09-0.11
1400	6.0-8.0	5.0-6.0	0.50-0.55	0.07-0.09
1600	7.5-10	10.0-12.0	0.62-0.66	0.06-0.07

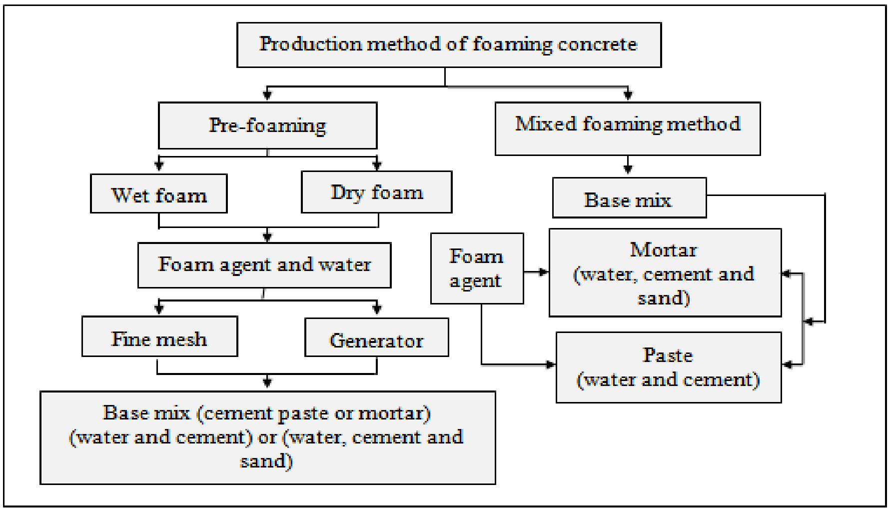

Figure 1. Production method for foamed concrete

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The foam agent must be kept airtight in the container and under temperatures not exceeding 25°C. The solution must be used as soon as possible once it diluted. The minimum weight of the foam solution used is 80 g/l. The foaming agent must be contactless with anything that might decrease its' function[4][9].

2.5 Chemical Admixture

The usage of chemical admixture is usually in small amounts of concrete composition. Chemical admixture usage is intended to improve certain properties of the mixture. The chemical admixture used in this research is a high-range water-reducing admixture. The function of this kind of admixture is reduce the usage of water on mixture by up to a maximum of 15%. The product Sikament LN is a type of chemical admixture used as water reducer and to accelerate the hardening time of mixture. Sikament LN is an admixture classified as ASTM C494-92 type F[1]. With Sikament LN, the composition uses a dose rate of 0.30% of the total cement weight of 300 kg. Therefore, the quantity needed for mixture plan is as much as 0.9 kg.

2.6 Dimensions of the test objects

The dimensions of the CLCbrickare as follows: 600mm length, 200mm height, 75 mmwidth, the dimensions for permeabilitytesting diameter 100 mm and height 200 mm, and the dimension for absorption testing 100 mm diameter and 75 mm height[4][5].

III. EXPERIMENTAL

This research involves the design of mixture plan that will be used in producing samples of CLC brick. This mixture plan is a guide to CLC brick mixture composition that will be investigated in this research and is presented in Table 3.

No	Material	Amount Per m^3			Unit
		V1	V2	V3	
1	Cement	300			kg
2	Sand	500			kg
3	Water For Mixing Foam Agent	35,6	35,4	35,2	Liter
4	Foam Agent	0,4	0,6	0,8	Liter
	Foaming Agent Concentration	1,11	1,67	2,22	%
5	Water (w/c. 50%) From Cement Weight	150			kg
6	Sikamen LN (0,3% dari Berat Semen)	0,9			kg

Table 3. Composition of the basic materials of samples[3][14][15]

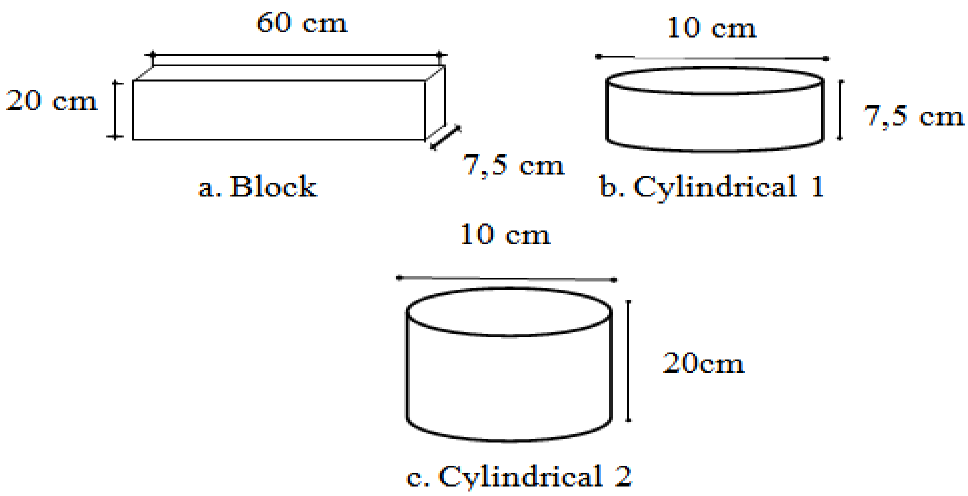

Figure 2. Sample Dimension

IV. RESULTS AND DISCUSSION

From the research that has been done, the findings obtained based on the test results, i.e. according to ASTM and ACIstandards, can be seen inTable4.

Table 4. Test Comparison Recaps of Foaming Agent Concentration Variation in making CLC Brick

No	Parameter	Variation 1 (0,4 L/m^3)	Variation 2 (0,6 L/m^3)	Variation 3 (0,8 L/m^3)	Variation 4 (0 L/m^3)
1	Slump Flow (cm)	73	64,75	65,5	0
2	Setting Time (hour)	8:00:00	8:00:00	8:00:00	4:00:00
3	Qualified Brick (%)	100	100	100	100
4	Shrikage and Expansion (%)	0	0	0	0
5	Volume Weight (kg/m^3)	954,167	877,408	866,506	1370,176
6	Compression Strength (MPa)	1,925	0,746	0,630	1,290
7	Absorption (%)	19,55%	18,19%	16,66%	21,36%
8	Permeability Coefficient (cm/s)	3,41E-06	4,67E-06	6,07E-06	2,00E-01
9	Sound Resistance (dB)	24,60	26,72	27,94	21,94
10	Thermal Conductivity (W/m.K)	0,222	0,270	0,354	0,708

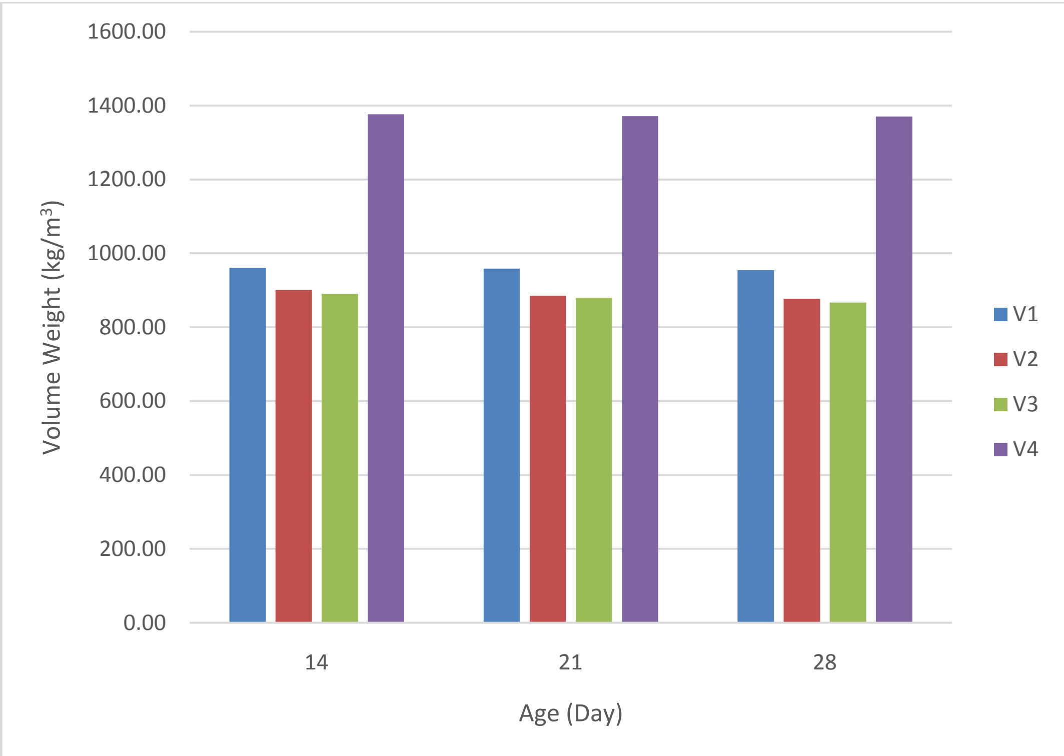

Figure 3. Volume Weight Bar Chart

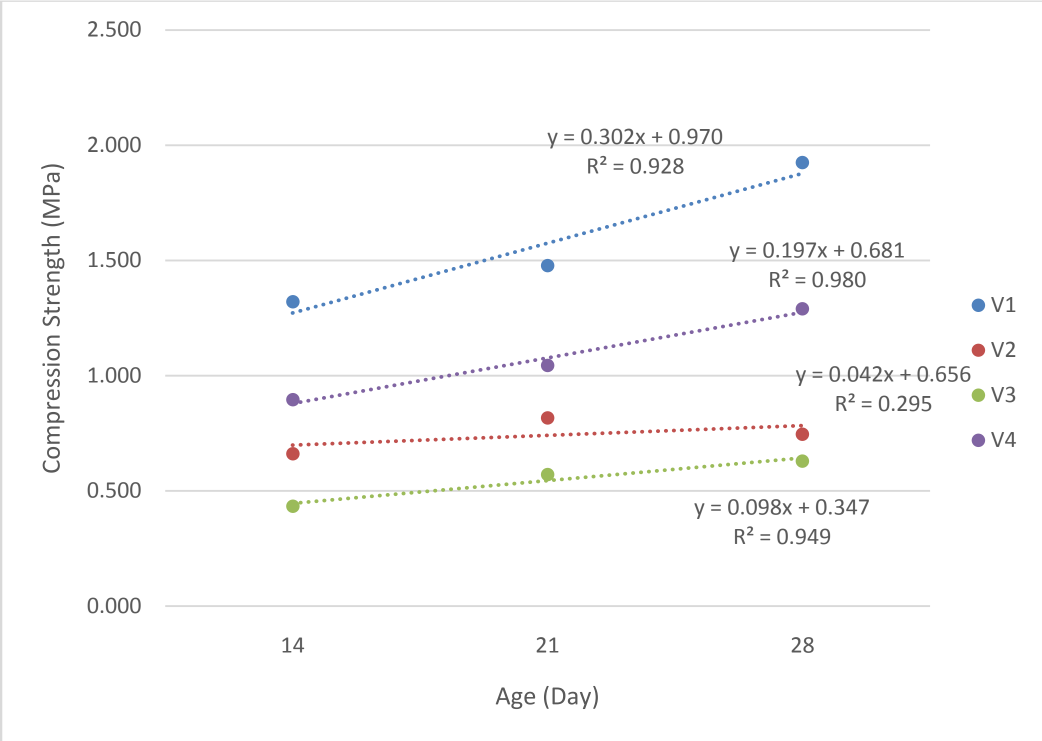

Figure 4. Compression Strength Vs. Age Graph

V. CONCLUSION

All variations except variation 4 (without foaming agent addition) for the slump flow test were obtained on average above 25 cm, thus having a high level of workability. So that the addition of foaming agent affect the mixture's workability.

There is no shrinkage and expansion for all variation, which means all variation is qualified for CLC brick.

The average volume weight of CLC brick is between 866.51 – 954.17 kg/cm3 for foamed bricks and 1,370.18 kg/cm^3 for bricks without foaming agent addition. The lighter volume weight is better for CLC bricks. The results obtained the lighest is variation 3.

The average compressive strength for the age of 28 days is between 0,630 – 1,925 MPa for foamed bricks and 1,290 MPa for bricks without foaming agent addition. From the results obtained the greatest compressive strengthis variation1.

Average absorption for the age of 28 days is obtained between 16,66 - 19,55% for foamed bricks and 21,36% for bricks without foaming agent addition. The more the brick absorbs water, the heavier the brick. From the results obtained, it turns out that variation 3 has lowest absorption level.

Average permeability coefficient of 28 days between3,41 x 10^{-6} – 6,07 x 10^{-6} cm/s for foamed bricks and 2,00 x 10^{-1} cm/s for bricks without foaming agent addition. Permeability coefficient shows bricks ability to escape water. The more impermeable is better for bricks, which is variation 1 has the lowest permeability coefficient.

Average sound damping of 28 days is obtained between23.88 – 27.13% for foamed bricks and 21, 30% for bricks without foaming agent addition. From the results obtained the greatest sound damped is variation1.

Thermal conductivity for foamed bricks of 28 days is obtained between 0.222 – 0.354 W/mK and 0.708 W/mK for bricks without foaming agent addition. The greater heat inhibits is better for bricks, which is variation 3 inhibits the most.

From the conclusions above, the H_a hypothesis which states that there is an effect of foaming agent addition on the physical and mechanical properties of CLC brick is evident from the results obtained. This can be seen from the physical and mechanical properties of the resulting brick.

Judging from the results obtained, the best (optimum) CLC brick is variation 2 in terms of its physical and mechanical properties.

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REFERENCES

[1] ACI. (1991). ACI Manual of Concrete Practice Part 211.2-91, Standard Practice for Selecting Proportions for Structural LightweightConcrete. Farmington Hills, MI, USA: ACI.
[2] Erwin, dkk, Comparison Variation Cement Against PropertiesConcreteMasonry Brick CLC, 2nd International Joint Conference on Advanced Engineering and Technology& International Symposium on Advanced Mechanical and Power Engineering, IJCAET & ISAMPE 2017, Faculty of Engineer, 2017.
[3] Hamad, A. J. (2014). Material, production, properties and application of aeratedlightweightconcrete:Review. International Journal of Materials Science and Engineering, 2 (2), 152-157.
[4] Krishna Bhavani, K. (2012). Cellular light-weightconcrete blocks as a replacement of burntclay bricks. International Journal of Engineering and Advanced Technology (IJEAT), 2 (2), ISSN: 2249-8958.
[5] Kumawat, G., Maru, S. (2016). Analysis and comparison of RCC structure usingheading CLC block withburntclay bricks. International Journal of Engineering Research and General Science, 4 (3), ISSN 2091-2730.
[6] Kumawat, G., Maru, S., & Kumar Pandey, K. (2016). Cost comparison of RCC structure using heading CLC blocks with burnt clay bricks. International Journal of Advanced Research, 4 (7), ISSN 2320-5407.
[7] Mulyono, T. (2004). Concretetechnology. Yogyakarta: Andi.
[8] Nandi, S., Chatterjee, A., Samanta, P., & Hansda, T. (2016). Cellular concrete and its facets of application in Civil Engineering. International Journal of Engineering Research, 5 (Special 1), 37-43, ISSN:2319-6890.
[9] Prakash, C. E. (2013). Properties of aeratedconcrete blocks. International Journal of Scientific and Engineering Research, 4 (1), ISSN 2229-5518.
[10] SNI 7064:2014 (2014). Portland Cement Composites. National Standardization Agency.
[11] Sutandar et al., (2022). Effect of Mineral Admixture on Physical and Mechanical Properties of CLC Concrete Masonry Brick. International Journal Of Scientific Advances, 3 (1), ISSN 2708-7972.
[12] Sutandar et al., (2021). Effect of Sand Gradient Variation on Properties of CLC Concrete Mansory Brick. The International Journal Engineering and Science. 10 (3), ISSN 2024-1805