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PROPERTIES OF UNFIRED COMPRESSED BRICKS USING CASSAVA WASTEWATER

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Abstract

This study was conducted to evaluate the performance of unfired compressed bricks (UCB) using the Indonesian National Standard SNI 15-2094-2000 as a reference. The tests included compressive strength, water absorption, salt content, density, and visual appearance. The bricks were produced by utilizing cassava wastewater, with cement and lime used as binding agents, mixed with red soil, galong soil, and sand, without undergoing a firing process. Variations in the composition of binder, soil, sand, and cassava wastewater were prepared with a ratio of 1:8:2 using 350 ml of wastewater. The specimens were molded using a steel mold with dimensions of 20 cm × 10 cm × 6 cm. Each mixture consisted of eight specimens and was cured for 28 days. The compressive strength of unfired bricks using cassava wastewater reached 6.39 MPa, while the control unfired bricks achieved 7.29 MPa. The average compressive strength of unfired bricks incorporating cassava wastewater still met the requirements of SNI, although several variations did not comply with the standard. However, when evaluated using international standards, all unfired brick variations produced with cassava wastewater met the specified requirements.

***Keywords**: Brick, Cassava Wastewater, Compressive Strength, Red Soil*

INTRODUCTION

Indonesia is the fourth most populous country in the world. Rapid population growth, which has increased by approximately two million people over the past two years, has driven the demand for housing development as one of the government's primary solutions to provide adequate shelter. Bricks are one of the most important materials in building construction. Generally, bricks are made from clay, with or without additives, and are fired at high temperatures so that they do not easily disintegrate when immersed in water. Initially, the clay is made plastic and molded using wooden or steel molds. The molded clay is then dried and fired at high temperatures (Darwis et al., 2016). Red clay bricks have many advantages compared to other masonry materials; however, most red bricks are produced through a firing process that generates carbon dioxide emissions, thereby contributing to greenhouse gas (GHG) emissions into the atmosphere (Dhiaulaq, 2018). Not all fired bricks are usable, as large quantities are loaded into kilns during the firing process. This often results in cracked, damaged, or improperly fired bricks (Maryunani, 2009). Unfired bricks provide an appropriate alternative solution to the shortcomings of conventional brick production. The manufacturing process of unfired bricks does not involve kiln firing but instead relies on natural curing through air drying.

Cassava is a widely cultivated crop in Indonesia. Processed cassava products are produced on both small-scale (MSME) and industrial levels. Both production scales generate

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similar environmental issues, namely cassava processing waste, which consists of liquid and solid waste. Cassava wastewater can cause environmental pollution if discharged directly into rivers without proper treatment to reduce or eliminate contaminants (Mukminin et al., 2003). Therefore, producing unfired bricks using cassava wastewater as a mixing material is proposed as a solution to reduce air pollution from conventional brick firing and to utilize unused cassava wastewater. Cassava wastewater can cause skin irritation and unpleasant odors if left unmanaged. Based on this background, this article—derived from an undergraduate thesis—aims to provide clear information for the development of brick technology and to examine the influence of cassava wastewater as a mixture on the compressive strength of unfired bricks.

Cassava Wastewater

Cassava is a tuber crop widely used by the Indonesian population. The extensive processing of cassava-based products generates significant quantities of cassava wastewater. In the production of tapioca flour, large volumes of cassava wastewater are discharged without treatment. Cassava wastewater is a by-product of tapioca flour production in liquid form, appearing yellowish-white when fresh and dark gray when decomposed. It is rich in starch, sugars, linamarin, proteins, and other compounds. Starch is a biopolymer commonly used in biodegradable materials. The application of cassava starch in construction materials has been discussed in previous studies (Souza et al., 2021). Cassava wastewater contains a high concentration of dissolved solids, including starch composed of polymer molecules with binding properties that function as biopolymers. These starch molecules, together with suspended solids in the solution, can enhance mixture plasticity and durability by filling voids and acting as binders (Souza, 2021). The cassava wastewater used in this study had a pH of 5.74, indicating acidic characteristics (Fig. 1).

Figure 1: Cassava Wastewater

Compressive Strength

Compressive strength testing measures the maximum load that a brick can withstand before failure or physical damage occurs. The test was conducted in accordance with SNI 15-2094-2000. The brick dimensions used were 20 cm in length, 10 cm in width, and 5 cm in height. The compressive strength test was performed using a Compression Testing

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Machine (Fig. 2).

Figure 2: Compression Testing Machine

Brick Production

Table 1 describes the variations in unfired brick mixtures. Soil materials were mixed simultaneously and molded using molds with dimensions of 5 cm in height, 10 cm in width, and 20 cm in length. The bricks were formed using a hydraulic press machine with a pressure capacity of 5 MPa. The unfired bricks were cured at room temperature without direct exposure to sunlight for approximately 28 days.

No	Pengikat		Tanah Merah (gr)	Tanah Galong (gr)	Pasir (gr)	Jumlah Air (ml)	Kode Sampel
	Semen (gr)	Kapur (gr)					
1	172.8		1382.4		345.6	350	CCM
2	172.8			1382.4	345.6	350	CCG
3		172.8	1382.4		345.6	350	CLM
4		172.8		1382.4	345.6	350	CLG
5	172.8		1382.4		345.6	350	CMCW
6	172.8			1382.4	345.6	350	CGCW
7		172.8	1382.4		345.6	350	LMCW
8		172.8		1382.4	345.6	350	LGCW

RESEARCH METHODOLOGY

This research was conducted in two stages: brick production and compressive strength testing. Brick production was carried out at the Laboratory of Universitas Muhammadiyah Sumatera Utara, while compressive strength testing of the unfired bricks was conducted at the Civil Engineering Laboratory of Universitas Sumatera Utar

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RESULTS AND DISCUSSION

To calculate the compressive strength of the samples, measured parameters included the applied compressive load (F) and the cross-sectional area of the brick specimens (A). After compressive strength testing, the results were compared with reference values and established national standards.

Based on Table 2, the highest compressive strength value was obtained for the CMCW variation at 10.5 MPa, while the lowest value was observed for the LGCW variation.

The use of cassava wastewater increased the compressive strength of bricks when cement was used as the binding material. The control bricks and the red soil–cement bricks using cassava wastewater, as well as galong soil– cement bricks using cassava wastewater, met the requirements of SNI 15-2094-2000, which specifies a minimum compressive strength of 5 MPa.

Table 2: Compressive Strength Results

No	Sample Code	Sample Number	Pressure Force (kN)	P = F/A (Kn/mm^2)	Rata-rata (Mpa)
1	Control Cement Red (CCR)	1	176.52	8.82	8.58
		2	176.52	8.82	
		3	161.81	8.09	
2	Control Cement Galong (CCG)	1	117.68	5.88	6.61
		2	147.1	7 .35	
		3	132.39	6.61	
3	Control Lime Merah (CLR)	1	161.81	8.09	7.6
		2	132.39	6.61	
		3	161.81	8.09	
4	Control Lime Galong (CCG)	1	147.1	7.35	6.37
		2	102.97	5.14	
		3	132.39	6.61	
5	Cement Red Cassava Water (CRCW)	1	200	10	10.5
		2	216	10.8	
		3	214	10.7	
6	Cement Galong Cassava Water (CGCW)	1	175	5.88	8.5
		2	163	7 .35	

		3	172	6.61	
7	Lime Red Cassava Water (LRCW)	1	70	8.09	4.00
		2	95	6.61	
		3	75	8.09	
8	Lime Galong Cassava Water (LGCW)	1	58	2.9	2.55
		2	40	2	
		3	55	2.75	

Furthermore, when compared with international standards such as Sri Lanka Standard SLS 1382-1 (1.2 MPa) and New Zealand Standard NZS 4298 (1.3 MPa) for unfired earth bricks, all brick samples satisfied the requirements (Souza et al., 2021).

CONCLUSIONS

The use of cassava wastewater in the production of compressed unfired bricks can improve compressive strength when cement is used as the binding material. This is because cement develops strength more effectively than lime. All brick variations produced in this study can be utilized as non-structural construction materials.

REFERENCES

Darwis, D., Ulum, S., & Kurniawan, G. (2016). Karakteristik Batu Bata Tanpa Pembakaran Berbahan Abu Sekam Padi dan Kapur Banawa Charateristic. *Gravitasi*, *15*(2), 1–9.

Dhiaulaq, N. H. (2018). Batu Bata Merah Interlock Tanpa Bakar Dengan Campuran Semen, Tanah Liat, Dan Alkali AII Sebagai Upaya Mengurangi Gas Rumah Kaca. In *Bitkom Research* (Vol. 63, Issue 2).

Maryunani, W. P. (2009). Batu Bata Non Bakar Solusi Alternatif Bahan Konstruksi Ramah Lingkungan. In Jurnal Penelitian Inovasi (Vol. 31, Issue 1, pp. 44–58).

Mukminin, A., Wignyanto, & Hidayat, N. (2003). Perencanaan Unit Pengolahan

Limbah Cair Tapioka Dengan Sistem Up-Flow Anaerbic Sludge Blanket (UASB) Untuk Industri Sklala Menengah. Teknik, 4(2), 91–107.

Souza, J. M. de. (2021). Use of Cassava Wastewater and Scheelite Residues in Ceramic Formulations

Souza, J. M. de, Ramos Filho, R. E. B., Duarte, J. B., Silva, V. M. da, Rêgo,

S. R. do, Lucena, L. de F. L., & Acchar, W. (2021). Mechanical and durability properties of compressed stabilized earth brick produced with cassava wastewater. Journal of Building Engineering, 44(August). https://doi.org/10.1016/j.jobe.2021.10 3290