

# Waste Cassava as Brick Additive. (*Building Material Innovation for Green Architecture*)

Y Kuasuma<sup>1</sup>, A S Munawaroh<sup>2</sup>

<sup>1</sup> Department of Architecture, Universitas Bandar Lampung, Bandar Lampung, Indonesia. yudhakuzuka7max@gmail.com

<sup>2</sup> Department of Architecture, Universitas Bandar Lampung, Bandar Lampung, Indonesia. aisiti.arch@ubl.ac.id

**Abstract** - The concept of green architecture that is identical to the natural shades is not limited to the design but the type and origin of building materials that were presented be part of the concept, as well as continuous innovation among which the industrial solid limbah processing tapioca into charcoal, as additives block making. By the nature of the charcoal pozzolan is a material containing silica, assists in the binding reaction between the cement with aggregate filler paste adobe. The test results obtained specimen strength - average of adobe around 711,5kg / cm<sup>2</sup>, equivalent to B1 quality, this quality brick is the standard used to carry the load in construction. While the tangible benefits gained from this product is more environmentally friendly waste utilization results potentially pollutant or tapioca as product innovation and applicable for the construction of green architecture. Keywords: additive, solid waste, cassava,

## 1. Introduction

Cassava (*Manihotesculenta*) is an industrial raw material production of starch, the result of the grinding process cassava produce starch cassava, but the process can also produce solid waste or more often called "cassava", by the general public. With their solid waste (cassava) cause environmental problems in the industrial area of cassava processing (production of tapioca), the field condition showed adverse implications for the environment, an example of which occurred around ponds of solid waste (cassava) with open conditions containing waste solid and liquid continuously, resulting in a fermentation process that occurs, within a short time. Thus causing pollution include pencemara air, which is caused by a chemical reaction which produces gas with a foul smell as a result of fermentation, while the potential for groundwater contamination due to the construction of reservoirs which are generally ground pools, so that the liquid waste has the potential to seep into the ground with fermented participate substances contained in the process waste water to seep in the aquifer. Soil contamination that occurred is in an excellent shelter dindinng pool and poolside impacting changes in soil characteristics include changes in the shape and color. In a research program focused on treatment and solid waste management (cassava), processing and utilization of early as a solution in minimizing solid waste disposal or onggok all holding pond.

Considering the fact that the field of character onggok difficult to unravel briefly trigger the fermentation process menghasilkann gas among others *Carbondioksida* (CO<sub>2</sub>) and *methane* (CH<sub>4</sub>), which became a major issue in the global warming as well as the impact on the greenhouse effect, general waste types are distinguished by characteristics physically and chemically. to sample cassava research is based on observations and analysis of pollutants or waste can be categorized as indicated B3, which is the waste of potentially B3 with a certain dose, solid waste or cassava can be used method inseneration incineration or waste processing or combustion is a waste treatment technology that involves the combustion of organic materials incineration and other high temperature waste treatment is defined as waste as thermal processing [1] a reference in the analysis of test samples with indicators keterolahan aware of the possibility and potential of recycling, that charcoal is residue a black containing carbon impureproduced by removing the water content and components of animal or plant votalit.

Charcoal is generally obtained by heating wood, sugar, bone, and other objects. Charcoal black, light crumbly and resembles coal consists of 85% to 98% carbon, the remainder is ash or other chemical

items [2]. Charcoal or carbon is not pure, in use was so far just for specific industries such as for the absorption of toxins, but charcoal also has other potential benefits such as containing *pozzolan*, namely the content of charcoal which is a material that is *siliceous* will react chemically with *calcium hydroxide* as well as the reactive nature of the cement. So that this potential can be as a thesis in the use of charcoal as an additive brick, *Pozzolan* a material that contains compound *Silica* and *Almunia* where material *pozzolan* itself does not have a cement-like properties, but with a smooth shape and the presence of water, the compounds will -senyawa chemically react with calcium hydroxide (compound of a reaction between cement and water) at room temperature to form calcium compounds *Almuniat hydrates* that have properties such as cement [3]. Type *Pozzolan* according to the constituent process (origin) in ASTM 593-82 is divided into two, namely *pozzolan* natural and *pozzolan*. artificial *pozzolan* Naturalis a natural material which is sedimentation of volcanic ash or lava containing *active silica*. While the *pozzolan* artificial one of which is the residue of combustion. That comes from the furnace, as well as the results of the utilization of waste processed into ashes or charcoal, rice husk ash, silica fume and others.

The term mineral additive is known as *additive* (in English) or additives, namely mineral materials are intentionally added to the concrete mix to alter the properties and characteristics as desired. The main purpose of the use of additives is to improve the compressive strength ability possessed by the concrete, while the brick is the innovation and development of red brick, brick or Conblok. Started in 8000 sm, precisely in the area of human Mesopotamia find the first time that the clay can be in the form and the drying to produce building materials, obtained in the watershed. Ancient Egyptian civilization shows have used a brick for construction of houses and places of worship, which had in the area of the river that have content suitable for loading mud brick. Significantly make brick as a material commonly as a common building material in the civilization. In perkembangannya brick keberbangai quickly spread throughout the world, starting from mainland Europe to America, and in line with the development of civilization and age, a lot of innovation in developing brick as a building material as well as with the familiar cement. Bricks are made from clay began in innovate with concrete materials qualitatively more strength in featuring. According to SNI 03-0349-1989 [4] is building components made from a mixture of portland cement or *pozzolan* with stuffing materials of sand, water and additives. In the printing process such that it is eligible to be used as wall pair. The use of lightweight concrete (Conblok) as a building material, generally used by the public. In addition to faster execution and installation of the power brick wall pair (Conblok) more robust to measurement using test equipment hammer test, generally used to test the strength of concrete by using a blow on the concrete surface. Objective testing concrete compressive strength scale generated by providing intact load (collision). the inference result is to find value - average compressive strength of the test specimen, Quality bricks have been assigned under PUBI 1982. In accordance with the usage. Adobe classified in several classes based sfesifikasi of each function, as follows:

1. adobe with A1 quality is in the allotment for the construction does not bear the burden, as well as the partition wall construction spared from the weather outside.
2. brick with the quality of A2 is functioning properly with the A1, but just only the surface of the construction of adobe may not be in plaster.
3. brick with B1 quality, generally used for the construction of the burden, but the usage is limited to the construction that is protected from the weather outside (construction under the roof).
4. brick with B2 quality is generally used for load bearing construction

#### *1.1 methods and results of research*

experimental tools used in such as mold tools, the size of a standard common in the set with dimensions of length 23, width 11 and a height of 5 cm [5]. Spoon species to assist in the making of pasta, as well as a plastic as the cover of the test specimen. While the materials used in the sampling of portland cement as a binder paste sand as filler paste, water serves as a binder additive the results of further processing of solid wastes (cassava). By working procedures, the selection of locations that are not in direct contact with sunlight (shade), materials and mixing (mixing the ingredients in dry conditions), with the addition of water to the scale of  $\pm 13\%$  of the total weight of the paste material

evenly stirring adobe. And checking the pasta with the method (sample sphere) is the retrieval of pasta and form a circle, with an indication of pasta stable if no cracks in the remainder of the sample pasta balls less than a period of 120 minutes. This effort is intended to reduce the risk of connective power stability of pasta brick, specimens with age  $\pm$  48 hours do penyusuna and storage. By condensation with water treatment in order to maintain the moisture sample and closing with plastic strived to keep the test object is not affected by the weather outside and keep moisture. Conditioning field (drying and watering) adobe. And specimen (brick with additives charcoal onggk) which has been aged  $\pm$  21 days was examined by means of *the hammer test* to determine the compressive strength, but still peru in the continued development to meet kriterian as product innovations in the construction of green architecture, which prioritizes the concept of natural and environmentally friendly.

## 2. Method

### 2.1 Table Analysis

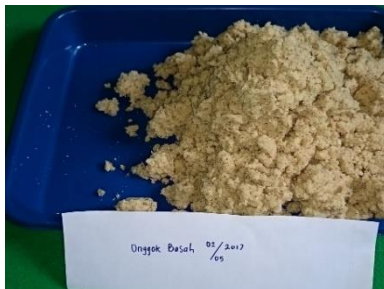
**Table 1.** Composition of pasta adobe with additives Waste Cassava

Materials	Cement	Sand	Charcoal	Total
Cassava	625	937.5	937.5	2.5 Kg
Waste	Gram	Gram	Gram	

**Table 2.** Of test results by means of the hammer test

Sample Type	Sample 1	Sample 2	Sample 3	Average - Average
brick	14.5 N / Cm2	12.5 N / Cm2	11.5 N / Cm2	12.8 N / Cm2

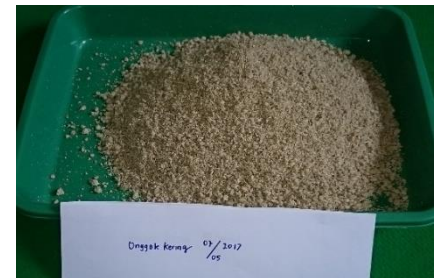
### 2.2 Research Documentation



**Figure 1.** Sample (Wet Cassava)



**Figure 2.** Sample Drying Process



**Figure 3.** Samples Dried Cassava



**Figure 4.** Samples Waste Cassava



**Figure 5.** Sample Waste Cassava Additive



**Figure 6.** Sample brick

## 3. Results And Discussion

Specification bricks made are of standard size bricks with the long dimension of bricks 23 cm, width 10 cm and 5 cm thick, with the texture of the brick is more dense because of the aggregate Waste Cassava smooth, thus helping dalamproses binding and compaction of the material goes perfectly.

The resulting color is blackish-gray because of the concentration of cassava charcoal color black, and load compressive strength brick with charcoal additive cassava, which has been tested by means of a blow performed on a flat surface or the surface of the concrete blocks are averaged. The results obtained from the three samples tested average figures ranged 12,8n / cm<sup>2</sup> equivalent compressive strength of 102 kg / cm<sup>2</sup> on the reading scaletool *hammertast* with interpolation of 609.5 kg / cm<sup>2</sup> and a compressive strength test results, namely : batting averages 12.8 n / cm<sup>2</sup> is equivalent to 102 kg / cm<sup>2</sup> + 609.5 = 711.5 kg /. From the research disimpulkan.Penggunaan onggok charcoal that serves as an additive in lightweight concrete or brick can improve the strength of concrete because the content of silica compounds and properties *pozzolan* that help in the reaction process in mengikatan material with cement.

The advantages of this brick is brick with the addition of charcoal cassava in the manufacturing process has a relative strength ranging from 711.5 kg / cm<sup>2</sup>. As well as having heavy lebh generally mild adobe, adobe product is more environmentally friendly because these products utilize solid industrial waste tapioca. As products for construction Green architecture is also called architecture ecological architecture or environmentally friendly, is one approach to the design and development based on the principles of ecological and environmental conservation, which will result in one of the building works that have the quality of the environment and create a better life and sustainable [6].

#### 4. Conclusion

Waste Cassava is a tangible benefits gained. That is more environmentally friendly waste utilization results potentially pollutant or tapioca as product innovation and applicable for the construction of green architecture.

#### References

- [1] <http://id.wikipedia.org/wiki/insenerasi>,
- [2] <https://id.wikipedia.org/wiki/arang>.
- [3] <https://radianto.wordpress.com/2010/09/09/pozzolan/>.
- [4] SNI 03-0349-1989, is(*concreatblock*)or lightweight concrete
- [5] [https://id.wikipedia.org/wiki/Batu\\_bata](https://id.wikipedia.org/wiki/Batu_bata)
- [6] <http://arsitekturdanlingkungan.wg.ugm.ac.id/2015/08/27/arsitektur-green/>