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Utilization of Ironwood Waste and Husk Charcoal to Produce Lightweight Concrete

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Abstract

Lightweight concrete is concrete with heavy contents m^3 of 1,900 kgs, maximum range of how to do to get the weight of the concrete contents of the maximum of 1900 kgs, among others, by using a pumice stone, adding air, and others. Ulin wood is the first-class wood with strong and durable, and resistant ulin wood in various weather. Indonesia's high rice production raises the number of waste from processing paddy rice into one rice husk. This study used waste ulin wood, which comes from renovation building waste, and wood waste ulin wood, which comes from processing crude into ready-made wood, charcoal, and husks rice milling took from around the University campus area Muhammadiyah Kalimantan Timur, ulin wood waste is used instead of the rough aggregate 75% rice husk, and processed into charcoal is a substitute for sand 100%, the biggest cut to ulin wood 20 mm and customized gradations, rice husk burned into charcoal. The test object is created 12 fruit test objects, with plans for a powerful hit of 25 MPa. The weight of the concrete results obtained an average of 1,879 kgs and strong hit at 28 days, gained strong press average 22.81 MPa, from those results do not reach the target despite the strong press plans 25 MPa concrete, but by using these two materials, These would've been categorized lightweight structural concrete.

Keywords — *coarse aggregate, fine aggregate ulin wood husks charcoal, light concrete.*

I. INTRODUCTION

Concrete has a maximum weight of 1,900 kgs/m^3under SNI 03-3449-2002. It can be made in various ways. A mild aggregate pumicemay be used. It can also be made without sand in the mixture (i.e.,non-sand concrete).Various quantities of air cavities into the concrete mixture. Light concrete structures can be classified into lightweight concrete as structural elements, lightweight structural elements, non-structural elements, and architectural elements. Floored buildings generally use concrete walls because it has several advantages. It is resistant to shock caused by strong winds and to earthquakes with adding reinforcement it is. Resistant to termites can dampen sound, do not require special care, and are easy to install (using precast walls or concrete blocks). However, using concrete as a wall for constructing buildings will add to its structure's weight because of the many wall portions. To address this, the alternative is to use light concrete. Lightweight concrete can be applied as a non-structural element, such as as a partition wall. A partition wall only carries its load; it does not accept the load of other structural elements, and it functions as a separator between rooms. research on concrete light with various types of materials and variations of the mixture has already been done on mild concrete Styrofoam, concrete, lightweight sand pumice, and soft concrete foam (foam concrete). [1].

Eusideroxylon zwageri (*teijsm & binn*), known as ulin, is an original tree species of Borneo Island [2]. Borneo's ironwood has been used by indigenous Borneo tribes for hundreds of years, especially in traditional houses such as Betang in central Kalimantan and Lamin in East Kalimantan. The utilization of ulin includes roofs, floors, window frameworks, bridges, statues, ornament in front of traditional buildings and offices, and Turus pepper plants. Unfortunately, the spread and potential of natural forests have decreased significantly in the past three decades due to excessive logging and a lack of effective law enforcement. Various regulations have been applied by the central and local governments to maintain their sustainability. Some aspects of associated with eusideroxylon *zwageri*arespread, potency, the utilization of ulin wood, the procurement of seedlings, and planting. Policies are required, including planting ulin in indigenous forests, protecting forests, national parks, and the original growing areas. The obligation to plant the original types of trees, including eusideroxylon zwageri, needs to be driven by the government [3].

Eusideroxylon zwageri ulin (also called bulian or ironwood) is a woody tree typical to Borneo. Ulin has an average height of 30.35 m. Its diameter at breast height (dbh) is 60-120 cm. Straight Rod is Berbanir. Its heading is round and tightly shaped and has a flatter resistance to water and heat [3]. Ulin is used in making houses, furniture, and so forth, while the waste is used only as wood materials or as firewood brick making. However, other than that, Ulin wood is a grade I (relatively strong). In the region of East

Kalimantan, before the year 2000, the majority of residential buildings and offices used wood; 70% of them were ulin wood. Besides that also for the work of It was used in projects such as bridges.

Rice husk is the waste of rice processing into the rice. Based on data obtained from the Ministry of Agriculture, production in Indonesia in 2017 was81.3 million tons [4], that the weight of rice 10% is the record of 2% is Bran 88% is rice. The waste is still less than 10% used as planting media and fertilizer mixture while the remaining 90% more just discarded and burned by Rice Grinder's owner, see figure 1. The introduction should be succinct, with no subheadings. Limited figures may be included only if they are introductory and contain no new results.

Many of these Ulin wood waste in East Borneo, and also rice husk in East Kalimantan or other areas, both waste needs to be made to avoid underlying pollution environment we make the idea to research to produce light Concrete with a bot H waste, with its use is expected to reduce pollution and able to improve the economy of people in the garbage area, when both materials can produce light concrete both waste It's worth the economy.

II. A REVIEW OF THE LITERATUR

A. Ulin Wood And Rice Husk Charcoal

In this research, material substitute, partially abrasive aggregate, is derived from the waste of wood ulin, and for the overall subtle aggregate, replacement is waste husk processed into charcoal.

B. Ulin Wood (Eusideroxylon zwageri Teijsm &Binn.)

Ulin wood is much used in the East Kalimantan area both as a wood building material and instead of reinforcement iron and until now around that still difficult in reaching the vehicle of six wheels still use Ulin wood as a stick, column, Iron substitute reinforcement, and others.

Ulin Wood is a very common wood used as a building material in the East Kalimantan because Ulin Wood is very strong and resistant to all weather in line with expensive and old housework with wood materials [2], [3], causing the wood to start replaced with concrete material this leads to several home restorations of offices and others, causing a growing number of wood's ulin wastes, other than that the growing order of wood Ulin molding increasingly multiply waste from the wood, so far the waste only in

the burn and thrown into the river so that the potential to make a pollution environment and air should be sought to reduce environmental pollution.

Fig: 1 Ulin wood waste

C. Rice Husk

The public food of Indonesia is rice with a population of over 200 million people cause the rice demand recorded in the year 2017 data sources from the Ministry of Agriculture of Rice production Indonesia of 81.3 Million Tons [4] where the grain weight 10% chaff, 2% bran, and 88% is rice, while East Kalimantan itself according to data from BPS [5] year 2015 East Kalimantan rice production of 408,782 tons. The same is the case with Ulin wood that the rice milling plant has an environmental impact

of mass combustion and disposal and other places that cause environmental and air pollution because it is still a not many husk Rice on planting media and fertilizer, to reduce pollution caused we try to do research rice husk made into charcoal and use as a substitute for sand in manufacturing lightweight concrete, according to [6] rice husk Charcoal has Chemical content. See figure 2.

Fe2O3	0,1 - 2,54
SiO2	62,5 - 97,6
CaO	0,1 – 1,31
MgO	0,01 – 1,31
Na2O	0,01 – 1,58
P2O5	0,01 – 2,69
SiO3	0,1 – 1,23
Carbon	2,71 – 6,42

Fig: 2 chemical content of chaff charcoal

With silica's presence is expected, the charcoal husk will harden when mixed with cement and be a strong and lightweight sand substitute material. Previous research once experimented by using the sand of wood [7], and there is also Use of charcoal as a substitute for sand [6], [8], using copper slag waste used as a fine aggregate substitute can add to the strength of concrete [9].

Fig: 3Rice husk waste

D. Concrete Masonry

The material technology of the building materials flourished, the lightweight concrete (LWC) has been successfully used since Roman times and has gained its popularity due to its lower density and superior thermal insulation properties. Compared to normal weight (NWC), LWC can reduce the death of structural load elements, which make it highly attracted in terraced buildings. However, many studies on LWC about concrete "semi-mild," namely concrete with a rough aggregate lightweight gate and naturalsand to be manufactured one of the lightweight aeration concrete (Aerated Lightweight Concrete/ALC) or often called also (Autoclaved Aerated Concrete/AAC). Other designations of Autoclaved Concrete, Cellular Concrete (cement with air bubble-producing chemical fluid), Porous Concrete, and in the UK are called Aircrete and Thermalite [10], [11].

The AAC lightweight concrete was first developed in Sweden in 1923 as an alternative to building material to reduce deforestation. The AAC light concrete was later redeveloped by Joseph Hebel in West Germany in 1943. He developed a better building system with a more economical cost. The brilliant innovations it performs, such as the cutting process using wires, open new possibilities for developing this product. This generation of lightweight concrete is considered perfect, including environmentally friendly building materials made from abundant natural resources. They are strong, durable, easy to set up, efficient, and high-powered. Hebel's success in Germany was soon seen by other countries. In the year 1967, working with Asahi Chemicals was built the first Hebel factory in Japan. To date, Hebel has been in 29 countries and is the largest producer of aeration concrete worldwide. In Indonesia, light concrete began to be known in 1995 when establishing PT Hebel Indonesia in Karawang Timur, West Java [12].

III. MATERIAL AND METHODS

A. Research location

The implementation of research, which includes examination and Testing of materials, making of test objects, maintenance, and Testing of concrete conducted in the Faculty of Science and Technology Laboratory, Department of Civil Engineering of the Muhammadiyah University of East Kalimantan, and Public Works Laboratory setup and housing of the people of UPTD infrastructure maintenance Public Works area II East Kalimantan.

a). Material selection

Material that we use in this research to produce light concrete is the waste of wood Ulin as a substitute for a part of crude aggregate and charcoal rice husk as a substitute for the smooth aggregate or that we call Concrete Plants aggregate Smooth here only as a material for the planning mix design while in the manufacture of fine aggregate test objects are not.

Ulin Wood In this research is derived from the waste demolition Rehabilitation building C on Campus I Universitas Muhammadiyah Kalimantan Timur. In addition, we also take waste from the raw wood processing place into the wood so (ready to use).

Rice husk was taken from the milling of Mr. Ahmad in Maluhu Subdistrict District Tenggarong District of Kutai Kartanegara East Kalimantan, and we are doing our own to be used as charcoal.

The cement used in this research is PCC cement brand Tonasa, weight 50 kg

b). Material Testing

Coarse and delicate, aggregate material using ex Palu Supplier PT. BORNEO Both materials are the two materials that always used the civil Engineering study Program of Muhammadiyah University of East Kalimantan in conducting concrete research and has been conducted Testing to SNI [13], [14], [15], [16], while other materials we do testing are Ulin wood and charcoal husk include:

- The aggregate gradation is smooth and coarse.
- Coarse aggregate wear and crude aggregate wood Ulin
- Heavy contents of loose and solid aggregate coarse/fine charcoal husk and ulin wood
- The type weight and absorption of coarse/fine aggregate, charcoal husk, and ulin wood
- Rough and smooth aggregate mud levels

c). Coarse aggregate

The broken stone we use for this research is the broken stone ex Palu, the next broke stone we did the gradation testing, weight of the contents, the type weight, and mud content.

d). Smooth Aggregate

The sand we use to design mix design, this research is sand ex hammer, sand next we do the gradation, weight, fill weight, density and mud content of the sand.

e). Ulin Wood

The waste of wood ulin that we use in this research derived from wood ulin waste used in the rehabilitation of the C building of Muhammadiyah University of East Kalimantan, the waste of wood ulin pieces not used we collect and further Ulin Wood We cut the largest 20 mm and at least 5 mm, then the cut is most rapid Direndan 2 hours and heated ulin wood under the scorching sun for approximately 2 hours the purpose of immersion and drying is to remove stains such as fats or oils which may stick to ulinwood.

f). Husk Rice

The Rice husk we use comes from rice milling in Maluhu Village District Tenggarong Kab. Kutai Kartanegara, then rice husk in charcoal by stacking and making the next small mountain in a pile of husk made Hole and pull the counter wire the size 1.5 cm, next in the wire counter input the paper waste to taste and then the burn is carried out until all the seam blackened, after the husk, all becomes black immediately flatten husk thin To to avoid charcoal into ashes. Then husk that has become charcoal in the sieve with a sieve hole measuring 4.5 mm, the charcoal that escapes the sieve is used to substitute the sand. Husk charcoal is a test of heavy content, density, and water absorption.

g). Cement

In this study using PCC cement brand Tonasa [15]

h). Planning Mix Design

Mix design Using SNI [14] in designing mix design, the first thing done is to determine the whole material to be used, stone break ex. Palu maximum 20 mm, cement PCC, waste wood Ulin, waste husk rice (charcoal husk), and ex. Palu (to determine the need for subtle aggregate mix design designs), and water. The strong press Plan (MPa) is 25 MPa at 28 days, the slump used is 10cm.

To SNI 03-2847-2002, the maximum weight of light concrete is 1,900 kgs/ m3, then in this study, the need for rough aggregate replaced partially with the aggregate of wood ulin waste of 75% of the necessity/m3, and fine aggregate replaced entirely with waste husk rice (charcoal husk).

IV. RESULTS AND DISCUSSION

A. Test Objects

The test objects are constructed in a cylinder diameter of 150mm, and a height of 300mm [16] materials used are cement, coarse aggregate, ulin wood, charcoal husk, and water.

Research Tools

- Scales function to measure the mass of an object
- Container
- Shovel/Hoe
- Spoon
- Abrams Cone and Perojok steel rod to measure slump value
- Printed cylinder test object diameter 15 cm and 30 cm
- Tub soaking test objects to treat Test objects
- Mold Opening Equipment
- Compression testing

B. Test Materials

- The cement used is PCC cement
- Rough aggregate/Broken stone ex Hammer
- Wood Ulin waste.
- Waste Rice husk Charcoal
- Water used is clean water from the laboratory network of the Muhammadiyah Kalimantan Timur.

C. How to build

Cut wood Ulin – cut with the largest variations of 20mm with adjustable gradations such as coarse aggregate gradation, after the wood ulin cut into pieces followed by cleaning with water and drained under the scorching sun for approximately 2 hours so that the wood ulin properly clean from dirt or oil attached, and the pores of the wood ulin open so the cement paste will be strong sticking to the aggregate Ulin wood.

Rice husk is processed into charcoal by accumulating rice, and while being pierced and given the wire counter size of the 15mm hole after that in the wire, the counter is fed waste paper and burned after the rice husk turned into black immediately flatten the pile The husk to avoid charcoal to ash.

After Ulin wood and charcoal are finished, the process is continued by weighing the entire material used according to the mix design's weight.

Input cement, charcoal husk, and sand. After that, stir the material until blended, after the three ingredients have been well-blended input Ulin wood, stone rupture and stir again until completely evenly after evenly the material is In the middle To include water, followed by closing the hole that contains the water little by little and put the ingredients into a perfect mix.

After all the ingredients are well blended with the slump test by entering the concrete into the slump test tool by means of input 1/3 concrete and do the pick as many as 25 times starting from the outermost and rotating terminated in the middle, Input again 1/3 flatten its surface and lift the slump test tool and measure the height of the collapse.

The concrete is inserted into the cylinder of contents with three layers, and each layer is carried out the number 25 times and hit-hit cylinder using rubber hammer until the holes of the closed.

Then flatten the cylinder surface using a spoon of cement.

After the cylinder surface gives the code in each cylinder.

Put the test objects in place spared from direct sunlight and rain.

D. Methods of Concrete treatment (Curing)

Test object treatment for SNI [16] After the finished test object is made, let the test objects for 48 hours; after that, open the test objects from the cylinder and let the test objects opened for 24 hours, on the third day of the test objects views into the tub containing water. For test objects that will be carried out strong test press at 14 days is done immersion for 8 days and dried for 3 days before in the intense test, and for test items that will be tested at the age of 28 days is done immersion for 22 days. The results and discussion may be presented separately or in one combined section and may optionally be divided into headed subsections.

E. Test result

The strong Testing of the concrete press was implemented in the Public Works Laboratory for the general workspace and housing of the UPTD maintenance infrastructure Public Works area II East Kalimantan with two Tests, namely concrete test object's age 7, 14, and Testing at 28 days including concrete weighing, dial reading, and strong concrete.

F. Slump Test Results

In the slump test, we have done after the mixing process obtained a slump value of 10cm calculated from the height collapses to the upper end of the Abrams cone reversed.

G. Concrete Weight

Weighing is done before the test object is carried out a strong test press by weighing each of the test objects and take the third average value of the test objects and the average weight value of the test objects divided by the volume of cylinders then obtained the weight of concrete/m^3, 1880 kg.

Strong test press is calculated with the formula:

$$\text{Strong Concrete Pres} = \frac{P}{A} \qquad (1)$$

Where:*fc* = Strong Concrete Press (MPa)

P =Maximum Load (N)

A =The section area of the test item (mm^2)

The section size of the test body is 176.786 cm^2.

TABLE 1
The results of the compressive strength

The test object's age (days)	Weight (kg)	Strong Press (MPa)
7	1.891	15,77
14	1.811	18,19
28	1.879	22,81

V. CONCLUSION

The tests conducted, which include the weight of the test object and strong press, obtained an average content weight of 1879 kg/m^3, with the results of the concrete made already included in the category of lightweight concrete under SNI 03-2847-2002. The maximum lightweight of concrete 1900 kg/m^3 strong press generated at 28 days of 22.81 MPa. Then this lightweight concrete can already be categorized as structural concrete. Ulin wood waste and charcoal can be an alternative ingredient of coarse and smooth aggregate to produce light concrete.

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