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Batako Quality Optimization with Addition of Palm Oil Stem Fiber from Kampar District and Dumai City

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Abstract: The waste of dry palm oil produced by 148 trees per hectare is 3,108 ton/month or 37,296 ton/year as calculated. Riau province has oil palm plantations covering an area of 2.399.172 hectares (BPS Riau Province, 2014). It can be estimated the amount of waste generated. Palm stem waste can be utilized, one of which is the utilization of midrib fiber as an added material in the manufacture of batako. Batako-fiber that is made still must be examined feasibility as building materials. The purpose of this study was to determine the optimization of the quality of batako works by the addition of palm stem fiber originated from the districts of Kampar and Dumai. This research used experimental method with laboratory research. Batako-fiber with the addition of palm fiber stem 1% of the weight of cement can increase the value of compressive strength above the normal batako and a batako with first quality according to SNI 03-0349-1989 standard. The use of palm stem fiber originating from the Kampar district resulted in better batakos with higher average compressive strength values than the dumai-derived fibers, especially in the addition of 1% fiber by weight of cement. The finding of this research is that the batakos originating from Kampar district are better than those from Dumai city. The most optimal addition of palm fiber burrs to batako-fiber products is 1% of the weight of cement.

Keywords: batako, fiber, compressive strength.

1. Introduction

Innovation of the product is always done for refinement. Innovation is done through a series of trials with testing of products. Innovating by utilizing waste is quite often done with hope that waste can still be utilized with a new look as an innovation. Batako-fiber is one of innovation products by utilizing waste of fiber that has not been utilized optimally. In this case the used fiber is palm stem fiber. The waste of dry palm oil that produced by 148 trees per hectare is 3,108 ton/month or 37,296 ton/year as calculated. Riau Province has oil palm plantations covering an area of 2.399.172 hectares (BPS Riau Province, 2014), it can be estimated by how much palm oil waste is produced continuously. The oil palm stems until now have not been optimally utilized and left to accumulate in oil palm plantations, so if it stays there, it will potentially to be pollutants such as smoke due to people's habit of burning garbage.

The palm oil stem has a straight fiber and more strong than the fiber from the coconut husk. Coco fiber has been used as raw material for some products. It may also be imposed on palm fiber. With a series of trials of palm stem fiber will be as efficient as any other organic fiber. The problem raised in this research is how to optimize the quality of the batako work with the addition of palm stem fiber coming from Kampar district and Dumai city. With these problems, the palm oil stem fiber is tested as an added material in the manufacture of batako which is used as building material/construction. The purpose of this study was to determine the optimization of the quality of batako works by the addition of palm stem fiber originated from the districts of Kampar and Dumai. The addition of palm stem fiber to different origin or place of growth. With a certain portion, palm fiber can be selected which have better quality to be used as an added ingredient in the manufacture of batako. The origin of palm-oil stem fiber that is studied is palm-oil stem fiber originating from Kampar district (26 - 100 m asl) and Dumai city (average 3 m asl).

2. Research Method

This research was conducted by experimental method with laboratory research. The first step in the preparation of oil palm stem fiber is to prepare the fiber to be cleaned from the bonding network. The palm oil stem is first processed to obtain the desired palm-oil stem fiber. Separation of fiber is done using chemical method by soaking the midrib into NaOH solution for 4 - 5 days. The palm oil heap has been gently brushed with an iron brush to separate the fibers from the bonding tissue, the fibers are washed and dried. In the dry conditions of palm stem fiber ready to be used as an ingredient added to the batako maker. Batako made with size 20 cm x 10 cm x 6 cm, job mix design batako with ratio 1 : 5 from weight of material which then modified to 1 cement : 3 sand cast : 2 sand pile. Comparison of materials based on the weight of the material is used with the consideration that the product to be made in small size and calculated instead of basket based on cultivation as prevalent for concrete calculations. The number of batakos required for each group of at least 6 pieces with the details of 5 pieces as a sample of test specimens and 1 piece for the prototype of the product being made. To print 6 pieces of batako-normal made job mix design as shown in table 1 below.

Table 1. *Job mix design*

Material	Amount of Material	Information
Cement	2,7168 kg	Semen Padang
Concrete sand	8,1510 kg	District Kampar
Sand pile	5,4342 kg	District Kampar
Water	0,1000 lt	Pekanbaru
Fiber : 1% 3% 5%	 0,0272 kg 0,0815 kg 0,1358 kg	Kampar and Dumai with dried condition

(Source: The design of the batako, 2017)

Batako made can be grouped on solid concrete batako material in accordance with the requirements of SNI. Physical requirement of solid concrete batako according to SNI 03-0349-1989 is seen in table 2 below.

Table 2. The physical requirements of solid concrete batako

Quality	Gross Press Strength Minimum Average* (Kg/cm^2)	Average water absorption (%)
I	100	25
II	70	35
III	40	-
IV	25	-

(Source: SNI 03-0349-1989)

*) By area the real size of the batako includes the width of the hole as well as the edge basin.

3. Results and Discussion

The quality of a product is usually determined by the quality of the ingredients used. The cement used is portland cement produced by PT. Semen Padang. Concrete sand and sand pile originated from Kampar district. Water used from clean ground water without pollutants.

The oil palm stem fiber used comes from two different places namely Kampar district (26 - 100 m asl) and Dumai city (average 3 m asl). To know the quality of palm fiber is done by tensile and elongation test to calculate fiber strength and elasticity. The test results are listed in table 3 below.

Table 3. physical properties of palm-oil palm fiber

Origin of Fiber	Test Result		
	Tensile Strength (gr/hl)	Elongation (%)	Diameter (mm)
Kab. Kampar	4400	4,23	0,81
Kota Dumai	3890	6,85	0,74

(Source: Bandung textile testing laboratory, 2017)

Tensile strength and elongation are tested according to SNI 7650: 2010 standard. The value of tensile strength of palm fiber from Kampar district is better than fiber originating from Dumai city with value of 4400 gr/strand and 3890 gr/strand respectively. This figure shows that palm fiber from Kampar district is stronger than fiber originating from Dumai city.
The value of elongation obtained places the city of Dumai at a higher value than fiber originating from Kampar district. The palm-oil palm fiber from Dumai can flourish up to 6,85%, while the fiber from Kampar district has a 4,23% grade. These values indicate that palm fiber from Dumai city is more elastic than fiber originating from Kampar district.
The oil palm fiber used is separated according to their respective portions and cut into lengths of ± 2 cm. All the ingredients are stirred and mixed evenly and then put into the mold and pressed. The batakos are made up of normal batako and fiber. Batako is dried at room temperature, after 28 days or more of compressive strength test. The results of the compressive strength test of the batako as sample are shown in the following table.

Table 4. Mean compressive strength value

Origin of Fiber	Percentage of Fiber (%)	Tensile Strength Mean (kg/cm^2)	Quality Standard SNI
Normal	0	104,24	I
Kampar District	1	111,34	I
	3	70,61	II
	5	68,93	III
Dumai City	1	110,80	I
	3	79,30	II
	5	57,57	III

(Source: Concrete laboratory PT. Riau Mas Bersaudara, 2017)

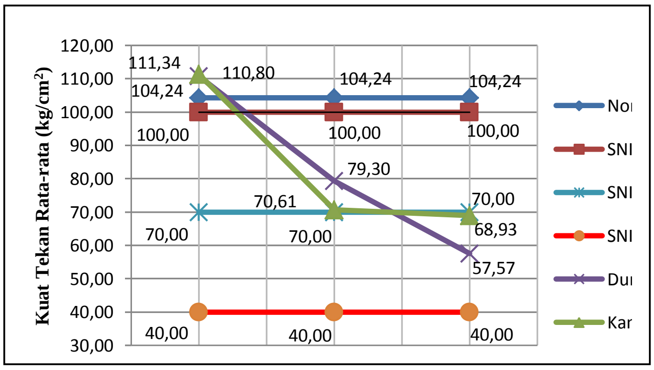

Figure 1. Comparison of compressive strength of batako

Batako-normal made to achieve quality I SNI 03-0349-1989 for solid concrete batako with tensile strength value 104,24 kg/cm^2. The addition of palm oil fiber as much as 1% of the weight of cement has a positive impact with the increase of the compressive strength value of the batako-normal. The 1% strength of the 1% fiber-reinforced concrete batakos originated from Kampar district was higher than the 1% dampai batako-fiber compressive strength value of Dumai city with an average value of 111,34 kg/cm^2 and 110,80 kg/cm^2 respectively. The addition of palm-oil stem fiber around 3% of the weight of cement causes the value of batako-fiber press down and lower than the batako-normal and is in the range of quality II according to SNI. Likewise with the addition of fiber 5%, causing the value of batako-fiber suppressive strength continues to decline to the level of quality III of SNI standards. Although it still meets the SNI quality standard, but the decline in the value of the compressive strength of the batako-fiber as the increased portion of fiber used as an additional material for building the batako-fiber must be considered and adjusted to the needs in the field.
In addition to the compressive strength test, to determine the quality of batako-fiber made then also test water absorption. The results of water absorption test are listed in table 5 below.

Table 5. The average water absorption test

Origin of Fiber	Percentage of Fiber (%)	Water Absorption (%)	Information
Normal	0	4,50	Maximum water absorption according to SNI quality I = 25%
Kampar District	1	3,50	
	3	4,80	
	5	5,70	
Dumai City	1	3,00	
	3	3,60	
	5	4,10	

(Source: Concrete laboratory of Civil Engineering Unilak, 2017)

The percentage of water-absorption of batako-fiber that is sampled is all below the maximum allowed value of SNI. The value obtained ranges from 3,0%-5,7% less than 25% of the maximum value of water absorption test of SNI of quality I. Several tests conducted on batako-fiber with 1%, 3% and 5% additional fibers from two different sources of oil palm fiber origin, namely Kampar and Dumai show that the resulting fiber batakos are still in accordance with the standard Quality set by SNI 03-0349-1989. The more palm fiber stem added, the resulting compressive strength showed a downward trend. The addition of midrib fiber up to 5% of the weight of cement is still acceptable because it entered the quality of III SNI. Some conducted experiments on materials and finished products batako-fiber are made to show some of the things that become product superiority. In addition to the use of palm oil stem fiber to contribute to the maintenance of the environment, the resulting product was proven to be more powerful when compared with conventional batako without fiber. Lower water absorption will have an impact on product durability. The strength and durability of the products are the consideration of consumers in choosing the materials to be used in construction projects.

The compressive strength test of the batako samples made show another advantage of the batako-fiber product. In the presence of fibers spreading inside the batako, when the value of compressive strength has been maximum and the test object is broken, the broken batako-fiber is not immediately destroyed, but still hanging on each other tied to the fiber contained in the product. This suggests that batako-fiber have a higher level of security when compared to non-fiber batako. Can be imagined if an earthquake with a scale that can undermine the building. The use of non-fiber batako will immediately collapse with a strong vibration and can override all the objects around it. With the same shock force, the walls that use the batako-fiber will be more durable and will not collapse immediately because the fibers are still tied to other elements. These advantages can be highlighted and to be more convincing can be done a series of trials on the resistance of batako-fiber products to earthquakes. In this study it has not been studied in depth, but at other times and other studies, it can be done.
The advantages of batako-fiber found in a series of studies are strength, durability and safety. These advantages can attract consumers to choose the product. With proper socialization, the batako-fiber can be commercialized so that the bricklayers will be interested to produce it. Thus, palm oil stem fiber that were not valuable to sale and even potentially become waste, with batako-fiber produced that has several advantages, the palm oil stem

fiber into a commodity that is worth selling. Furthermore, it is possible to estimate coconut palm oil stem fiber separation centers even very likely later on there will be machines that can separate the fiber as well as the coco fiber separator machine.

Continuous innovation done as a step of product improvement is a plus of a research and its application. Product innovation which is the finding of this research is that the batako-fiber originating from Kampar district are better than those from Dumai city. Where the most optimal addition of palm fiber burrs to batako-fiber products is 1% of the weight of cement.

4. Conclusions

The palm-oil palm fiber that is represented by the sample of the test specimen is a batako size of 20 cm x 10 cm x 6 cm with the design job mix defined and after going through several tests, it can be concluded as follows:

1) The fibers with the addition of 1% of palm oil stem fiber increase the value of compressive strength above the batako-normal (104,24 kg/cm^2) and is a bracket with quality I according to SNI 03-0349-1989 standard with strong average value Press obtained 111,34 kg/cm^2 batako-fiber originating from Kampar district and 110,80 kg/cm^2 of batako-fiber originating from Dumai.
2) The use of palm oil fiber from Kampar district resulted in better batako-fiber with higher average compressive strength values than the Dumai-derived batako-fiber, with optimal addition of 1% of the weight of the cement.

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