American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-7, Issue-3, pp-23-29
www.ajer.org
Research Paper Open Access

Utilization Of Palm Oil Stem Wastes From Pekanbaru And Dumai As Added Materials Of Making Brick-Fibert

Zainurizainuri[1], Gusneli Yanti[2], Shanti Wahyuni Megasari[3]
[1,2,3]*(Civil Engineering, University Lancang Kuning, Pekanbaru-Indonesia)*
Corresponding author: Zainurizainuri

ABSTRACT: *Riau Province has a vast palm plantation of 2,399,172 hectares (Statistics of Riau Province (BPS), 2014). Potency of dry waste of palm oil stem can reach 89.479.518,912 tons/year. Fiber can be used as an added material to make building materials such as brick. The purpose of this research is to find variation of mixture of brick-fiber maker with additional material of palm oil stem fiber to value of compressive strength and water absorption according to SNI quality standard. This research uses experimental method. The conclusion is jobmix brick-fiber which composition of cement 2,7168 kg; 8,1510 kg of concrete sand; and urug sand 5,4342 kg; water 0,1000 lt; fiber 1% (0,0272 kg), 3% fiber (0,815 kg), fiber 5% (0,1358 kg).Brick-fiber Dumai with average compressive strength value on 1%, 3% and 5% fiber additions were 110,80 kg/cm^2; 79,30 kg/cm^2 and 57,57 kg/cm^2. Brick-fiber Pekanbaru has an average compressive strength value on the addition of fiber 1%, 3% and 5% respectively is 77,13 kg/cm^2; 66,26 kg/cm^2 and 67,89 kg/cm^2. The absorption of brick-fiber water from Dumai is lower than 3,00%; 3,60% and 4,10% on the addition of fiber 1%, 3% and 5%. Absorption of brick-fiber water of Pekanbaru for the addition of fiber 1%, 3% and 5% respectively 4,20%; 6,10%; and 5,70%. The finding of this research is that the value of compressive strength and water absorption of Dumai brick-fiber is better than Pekanbaru brick-fiber.*

KEYWORDS *-Brick-fiber, compressive strength*

Date of Submission: 17-02-2018 Date of acceptance: 05-03-2018

I. INTRODUCTION

Riau Province has a vast palm plantation of 2.399.172 hectares (Statistics of Riau Province (BPS), 2014). Almost all parts of the plant are utilized today, only the stem is not yet utilized. The oil palm fronds from harvesting activities are allowed to accumulate and become waste that has great potential as a pollutant. Leaves that are allowed to dry are highly flammable and can be a trigger of the smoke disaster that often happens lately.

The potential of dry waste of palm oil is very large can reach 89.479.518,912 tons/year with the calculation of each hectare of palm oil 148 trees and if the age old enough, plantation owner will do harvesting twice a month and every cutting usually abort the 2 palm stem. The weight of dry palm heap waste per hectare is 3,108 ton/month as calculated. Thus, it can be estimated that the amount of waste of palm oil in one year with 2.399.172 hectares of plantation area in Riau Province.

In order for palm oil waste have no adverse impact on the environment as a cause of forest fires and plantation land, the appropriate solution to overcome them is to find ways to utilize the palm oil waste. In the construction world, fiber is used as an additional raw material to make building materials such as plasterboard and fiber concrete, such as research (Parbhaneand Shinde, 2014) using coconut fiber on concrete manufacture and research (Harle and Dhawale, 2014) using palm fiber rod as a concrete mix.

Other studies (Hermanto, et al., 2014)that support this research are using organic material in the form of fiber fibers on the manufacture of brick. The result of this research is the compressive strength of brick with added fibers of 0%, 2%, 4% and 6% by 25,47 kg/cm^2, 28,55 kg/cm^2, 30,33 kg/cm^2 and 33,36 kg/cm^2. The result of Adibroto research (2014) found that the addition of fibers of compressive strength of maximum average is only obtained at 323,98 kg/cm^2 in addition of fiber of 3 cm long fibers with percentage of fiber addition 2%.

(Kristiawan and Suwandi, 2015) examined the effect of the addition of lime and coco fiber in the manufacture of bricks with the result of compressive strength values obtained to meet SNI 03-0349-1989 requirements for IV quality bricks. Thus it is possible to use palm oil as an additional material in the manufacture of construction materials which one of them is a brick and for it still needed research for the palm fiber fiber is efficient and the resulting bricks have the advantage of similar products.

The purpose of this research is to find variation of mixture of brick-fiber maker with additional material of palm oil fiber from Pekanbaru and Dumai to the most optimal value of compressive strength and water absorption according to SNI quality standard. Selection of fiber-based areas with consideration of differences in fiber characteristics based on the place of growth which includes height of place and type of soil. Pekanbaru is located at an altitude of 5 - 50 m asl with plantation land most of clay, while Dumai altitude is 3 m asl with peat soil type as place to grow oil palm.The introduction of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents of each section may be provided to understand easily about the paper.

II. RESEARCH METHODS

This research method is quantitative by using experimental approach and laboratory research. The results of laboratory research that includes the manufacture of brick products, measuring the value of compressive strength and absorption of brick water described in accordance with the results obtained from research conducted. Making brick is done in a laboratory or a special workplace to make products that are maintained from various disorders and technical obstacles.

Palm oil is derived from plantations in Pekanbaru and Dumai. The separation of fibers is done manually using NaOH solution. Then, separation in this way can produce intact (not chapped) and rigid fibers with slightly reddish color. The dry sheath fibers are cut into pieces of ± 2 cm before use in the brick mix.

III. MATERIALS AND RESEARCH TOOLS

The palm oil stem is separated by soaking the stem in the NaOH solution. For the needs of the separation of fiber, it is required the tools for boiling, soaking and separating. The boiler uses a large metal stove and pot. After the palm stem is boiled with ordinary water, then the stem is soaked in NaOH solution for about 4 days or until the stem is soft and for this activity it needs a bucket. To separate the fibers from the tissue that binds it is used a cutting board and an iron brush.

Brick materials consist of cement with type PCC (Portland Composite Cement) type I production of PT. Semen Padang, fine aggregate in the form of concrete sand and urug sand originating from Kampar district, and the water used comes from groundwater contained in the area around the laboratory/work place with good water quality and free from pollutants. Fiber palm oil is used as an added material. The portion of the fiber is adjusted to the weight of the cement used.

The tools used in this study can be separated according to the stages of making the brick. The equipment can be grouped as follows:

1. The manufacture equipment of fiber consists of wooden hammer, bucket, wire comb, machete, knife.
2. Brick making consist of mixing equipment/molen machine, wheelbarrow, shovel, hoe, cement spoon, aggregate separator screen/sieve based on size, concrete pressing tool, measuring cup for water dosage, Sieve shaker machine, scales with a precision of 0,1% of the sample weight.
3. Laboratory equipment is Concrete Compression Machine, bath tub, oven, piknometer with capacity 1000 ml.

1.1 Jobmix Design and Test Performed

Before the brick-fiber were made, tests on fibers were used based on physical and chemical properties. The dry fiber test of palm oil stem is done in a special fiber laboratory in Balai Besar Tekstil located in Bandung to see the characteristics of the fibers used as a mixture of the batako making.

Brick-fiber is made using a specific jobmix. Conventional brick is only made of concrete cement, sand and a little water. In this study, the sand used consists of 2 types of sand that is sand concrete and urug sand. From previous experiences of the brick makers, it is found that the use of urug sand is very helpful in the process of printing and cost savings without decreasing the quality of the brick. These considerations are also used in this study. The addition of fiber considers the weight of cement used in the mixture. The basic composition used is 1 cement : 5 sand. Fiber palm oil used are with 3 different doses of 1%, 3% and 5% of the weight of cement used respectively.

After the brick-fibers were made and allowed to dry completely at room temperature for 28 days and special treatment with daily water spraying in the first week was subsequently tested for water absorption and test of the compressive strength of the brick-fiber used as a test object.

1.2 Formulation

The quality standards used to measure the feasibility of the product is SNI 03-0349-1989. The physical requirements of solid concrete bricks in accordance with SNI 03-0349-1989 can be seen in the following table.

Table 1. Terms of physical solid concrete brick

Physical Requirements	Quality of Concrete Brick			
	I	II	III	IV
Average compressive strength min. (kg/cm^2)	100	70	40	25
Compressive strength of each specimen min. (kg/cm^2)	90	65	35	21
Water absorption, miks. (%)	25	35	-	-

Some formulations which formulas in calculations are used to obtain test results. The physical and chemical properties of the fiber, the compressive strength of the brick and the absorption of brick water can be known by conducting laboratory testing. The physical and chemical properties of fiber, the compressive strength of the brick and the absorption of brick water to be examined are :

1. Robust strength testing

$$\sigma = \frac{8.P.L}{3.14D^3} \quad (1)$$

2. Absorption testing

$$W_a = \frac{M_j - M_k .100\%}{M_k} \quad (2)$$

Where :
Wa = Water absorption (%)
Mk = Mass of objects in the air (gram)
Mj = The object mass is in saturated surface condition (gram)

3. Testing of heavy water content type
4. Brick that has been prepared for testing the compressive strength of the formula :

$$fc' = \frac{p}{A} \quad (3)$$

5. Testing of water absorption of brick by formula :

$$Absorption(\%) = \frac{M_b - M_k}{M_k} x100\% . \quad (4)$$

IV. RESULTS AND DISCUSSION

4.1. Research Result

The final result of this research is composition of palm oil stem fiber with indicator value of compressive strength and water absorption of brick-fiber that meet SNI quality standard. Several tests were performed and the results of the tests were discussed in the following sections.

1.2.1 Results of Laboratory Test of Palm Oil Fibers

The physical properties of palm oil stem fiber which were tested included tensile strength, strength of elongation and fiber diameter of the 2 samples of fiber tested. The chemical properties of palm fiber stems tested were specific gravity, Moisture Content (MC) and Moisture Regain (MR).

Table 2. Physical properties of stem

Fiber Origin	Tensile Strength (gr/hl)	Stretching (%)	Diameter (mm)
Pekanbaru City	4890	9,58	0,78
Dumai Cityf	3890	6,85	0,74

The tensile strength of palm oil stem is tested following SNI 7650: 2010. The value of tensile strength of palm fronds originating from Pekanbaru was higher by 4890 gr/hl and 3890 gr/hl for palm fiber from Dumai. The elastic ability of palm oil stem fiber originating from Pekanbaru is also better able to reach 9,58% and fiber derived from Dumai has 6,85% elasticity. This may be due to the difference in diameter of the fiber measured, the fibers of Pekanbaru have a larger diameter of 0,78 mm and the fibers derived from Dumai 0,74 mm.

The specific weight of palm-oil palm fiber which is sampled ranges from 0,087 – 1,199 gr/cm^3 of fibers originating from 2 different places. It seems that the specific gravity did not differ significantly even though the fiber source was obtained from different places. Thus, there will be no visible difference in the weight of fiber usage of each sample with the same portion of material seen from the results of laboratory tests on the chemical properties of palm stem fiber.

Tabel 3. Chemical properties of stem fiber

Fiber Origin	Specific Gravity (gr/mm^3)	Moist (MC) (%)	Moist (MR) (mm)
Pekanbaru City	< 0,087 – 1,199	9,4	10,4
Dumai City	< 0,087 – 1,199	9,8	10,9

Moisture level or fiber-absorbing ability of fiber which is berarsal from Dumai bigger than fiber from Pekanbaru with the ability to absorb water with the range of 9,8% - 10,9% of fiber from Dumai and 9,4% - 10,4% fiber originating from Pekanbaru. Dumai oil palm fiber can bind more water so that concrete products that use cement as a binder will produce better products. Although the tensile strength value of fibers derived from Dumai is lower but with higher water absorption capacity is expected to assist in increasing the compressive strength of brick-fiber made fabric products.

1.2.2 Sand Test Results

There are 2 types of sand used in the manufacture of brick with palm oil stem fiber which are concrete sand and urug sand from Kampar regency. The addition of sand is done with the consideration of the experience of several brick entrepreneurs and trials to support the experience. Sand containing clay helps the binding of the material so that once the safe brickwork is removed immediately without the risk of broken. When used only concrete sand, sometimes brick broken when transferred shortly after printing. The results of laboratory tests are shown in the following table.

Table 4. Results concrete sand and urug

Description	Unit	Concrete Sand	Urug Sand
Zone	-	Zona 3	Zona 3
Organic content	-	No. 2	No. 2
Sludge levels	%	0,31	0,31
Bj dry	gr/cm^3	1,76	1,65
Bj SSD	gr/cm^3	1,79	1,21
Bj fake	gr/cm^3	1,82	1,22
Water content	%	5,77	4,30
Absorption	%	1,70	0,98

1.2.3 Job Mix Design

The main ingredient composition is 1 : 5 between cement and sand. There are 2 kinds of sand used is concrete sand and urug sand, determined the ratio of 3 concrete sand : 2 urug sand. The composition of the main ingredients into 1 cement : 3 concrete sand : 2 urug sand plus a little water. Comparisons are made on the basis of the weight of the material and not the weight of the material volume.

Table 5. Job mix design

Ingredients	Amount of Material	Information
Cement	2,7168 kg	Cement Padang
Concrete sand	8,1510 kg	Kampar District
Urug sand	5,4342 kg	Kampar District
Water	0,1000 ltr	Pekanbaru City
Fiber : 1%	0,0272 kg	Pekanbaru and Dumai
3%	0,0815 kg	in a dry state
5%	0,1358 kg	

The size of the mold used is 20 cm x 10 cm x 6 cm. Jobmix for 1 mold without fiber is cement 0,4528 kg, concrete sand 1,3585 kg, urug sand 0,9057 kg, water 0,0167 liter. Jobmix designed tailored to the needs of research with the calculation of each sample required at least 6/7 pieces of brick. The addition of fibers causes the quantity of the brick over the normal range, for example for 6 normal molds to be 7 molds or more when added with palm oil stem fiber.

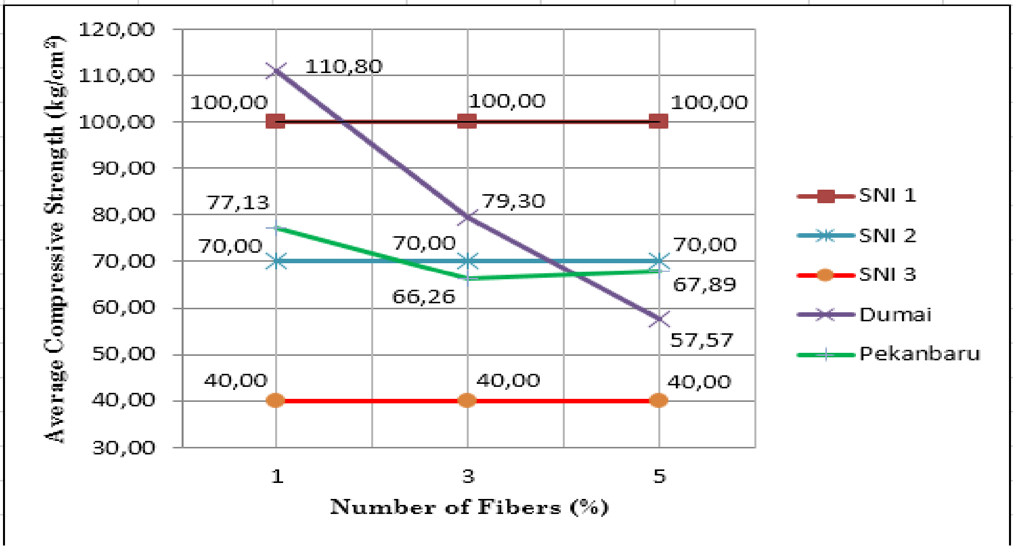
1.2.4 Compressive Strength Test Results

The compressive strength test was performed on the sample specimen of each group consisting of 5 samples. Brick is cut in the shape of a cube measuring 6 cm in size according to SNI rules that implies a compressive strength test carried out on a cube-shaped specimen or cylinder.

Table 6. The value of the compressive strength of the cube brick

Fiber Origin	Percentage of Fiber (%)	Compressive Strength (kg/cm^2)	Quality Standards SNI
Dumai City	1	110,80	I
	3	79,30	II
	5	57,57	III
Pekanbaru City	1	77,13	I
	3	66,26	II
	5	67,89	III

The low-achievement value of the compressive strength of the concrete results of the laboratory examination will be evident when described in graphical form. The average value of compressive strength obtained from each group and the achievement of SNI quality of solid concrete brick is shown in the following graph.



Picture 1. The average compressive strength of the cube brick

The average compressive strength value of batako-fiber by using palm oil stem fiber derived from Dumai is higher than that of fiber originating from Pekanbaru specifically on the addition of fibers of 1% and 3%. The addition of fibers as much as 1% of the weight of cement on the sample of Dumai brick-fiber exceeds the I SNI quality standard with a compressive strength value of 110,80 kg/cm^2. In the addition of fiber as much as 3% quality of brick-fiber produced into the quality II with a strong value of press 79,30 kg/cm^2. The value of compressive strength continues to decrease and the addition of 5% fiber entry in the quality of III SNI of 57,57 kg/cm^2.

The average compressive strength value achieved by brick-fiber Pekanbaru 1% is 77,13 kg/cm^2 place the sample on the quality of II SNI. Addition of fiber 3% and 5% put brick-fiber Pekanbaru are at quality III with value of compressive strength 66,26 kg/cm^2 and 67,89 kg/cm^2. Thus, the good brick-fiber originating from Dumai and from Pekanbaru have good quality according to the limit given by SNI 03-0349-1989.

1.2.5 Water Absorption Test

Water absorption test is done to find out how big brick-fiber can absorb water. The greater the water that can be absorbed less well the impact on the quality/durability of the brick due to excess water in the material can accelerate the damage process on the brick. According to SNI 03-0349-1989 about permitted absorption of water to solid concrete bricks, for permeable water quality I maximum of 25% and maximum quality II 35%. The results of the water absorption test are recorded in table 7 below.

Table 7: Test the absorption of brick water

Fiber Origin	Percentage of Fiber (%)	Water Absorption (%)
Dumai City	1	3,00
	3	3,60
	5	4,10
Pekanbaru City	1	4,20
	3	6,10
	5	5,70

Based on the water absorption test on the brick-fiber sample made, the obtained absorption value can be categorized as small, well below the maximum allowed by SNI 03-0349-1989 for 25% for quality I. The highest absorption rate only 6,1% in samples from Pekanbaru city with 3% fiber composition. Thus it can be stated that the resulting brick is a brick with a good quality in terms of water absorption. Water absorption from batako-fiber originating from Dumai is lower than that of Pekanbaru fiber. In terms of theoretical resilience, the Dumai brick-fiber are probably better than the Pekanbaru brick-fiber, but they still require proof.

V. DISCUSSION

The compressive strength test on the brick sample made made the product superiority of the brick-fiber. In the presence of fibers that spread to the brick, when the compressive strength is maximized and the test object is broken, the broken brick-fibers are not destroyed immediately but still survive each other tied to the fibers contained in the product. This suggests that brick-fiber have a higher level of security when compared to non-fiber brick. Can be imagined if an earthquake with a scale that can undermine the building. The use of unbranded batako will immediately collapse with a strong enough vibration and can override all the objects around it. With the same shock force, the walls that use the brick-fiber will survive, indirectly collapse because the fibers are still tied to other elements.

The presence of fiber in the brick also contributes to the absorption of water. However, as with the presence of clay (sludge) in the urug sand, it does not affect much water absorption in brick-fiber products produced. Thus, it can be said that the addition of palm-oil palm fiber and sand substitution did not negatively affect the product resistance to water and weather which is a destructive factor of concrete products.

The oil palm stem fiber from Pekanbaru has a higher tensile strength than fiber from Dumai. In addition to tensile strength, the highest elongation is 9,58%. With higher tensile strength and higher elongation, it is expected to increase the strength value of brick-fiber press. Apparently the allegations are not proven. After the coconut palm fiber is included in the mixture of brick and brick-fiber the resulting fiber is 28 days old enough to test the value of the compressive strength of the product, it is found that the use of palm fiber from the city of Pekanbaru produces products with a lower compressive strength value when compared with products using palm fiber from Dumai.

The allegation that caused the brick-fiber hard compressive value of Pekanbaru no higher correlated with chemical properties is lower water absorption of fiber than fiber samples originating from Dumai. In the concrete mixing process, water serves to help binding between fellow materials contained in a concrete product. The slow release of water to the concrete making causes the attachment process to continue to the maximum extent of adhesive ability which in this case is cement. Higher absorption of water by the fibers causes more water to be stored in the fibers and will release slowly in the drying process resulting in a stronger bond between the binder and the bonded material. Fiber samples from Dumai have higher water absorption so that the material attachment process is getting solid and ultimately contributes to the strength of the resulting product. Thus, although the fibers originating from Pekanbaru have higher tensile strength and elongation values than the fiber samples derived from Dumai, the lower absorption of palm fiber water causes the resulting fibers to be no stronger than brick-fiber using fiber Dumai oil palm buckling.

Brick for wall is sufficient with the range of IV quality of SNI because the load/weight is borne by the reinforced concrete structure. Samples of brick-fiber products with the addition of palm-oil palm fiber up to 5% of the weight of cement have exceeded the IV quality of SNI. It shows that the brick-fiber oil palm can be used as material for building walls. Even with the high value of compressive strength surpassing the quality outlined by SNI, material endurance, and safety in terms of binding of materials, it is proper that the construction material entrepreneurs, especially the batako entrepreneurs, think to produce fiber as innovation products that have more advantages than conventional products.When compared with a level of product that is a brick with a mixture of paper fibers such as recent researches(Suganya, 2012), (Arshad, 2014), (Anandaraju et al., 2015), (Subramani, 2015) examining the use of paper fibers in brick making, the palm-oil palm fibers have a compressive strength value which is better to achieve the quality of I SNI. The quality achieved by palm-oil palm fiber is commensurate with the fly ash bricks studied by (Kumar et al., 2014), which used a little cement as much as 5% brick strength produced 63% higher than the strength of conventional bricks with the entry category on quality I.

The differences in prior brick-fiber research lie in the difference in the origin of palm-oil stem fiber used as an addition to brick-fiber fabrication. The finding of this research is that the value of compressive strength and water absorption of Dumai brick-fiber is better than that of Pekanbaru brick-fiber.

VI. CONCLUSION

After the research is done and the data obtained is analyzed, it can be concluded that:

1. Jobmix brick-fiber with cement composition 2.7168 kg; 8.1510 kg of concrete sand; sand urug 5.4342 kg; water 0.1000 lt; 1% fiber (0.0272 kg), 3% fiber (0.815 kg), 5% fiber (0.1358 kg) can produce 7 pieces of size (20x10x6) cm
2. The fibers derived from Dumai have a higher compressive strength value than brick with fibers derived from Peknbaru.
3. The addition of palm fiber as much as 1% of the weight of cement is better than the addition of 3% and 5% fiber.
4. The greater the portion of the addition of palm-oil palm fiber so the water-fiber absorption of fiber will be greater.
5. All samples of palm-oil palm leaves originating from Dumai and Pekanbaru are included in the quality of I, II and III in accordance with SNI and better than IV quality commonly used as building material for building walls.

ACKNOWLEDGEMENTS

Thank you the author say to DRPM Dikti and LPPM University Lancang Kuning for the provision of research funds as well as a team of technicians Concrete Laboratory Unilak Civil Engineering Program, PT. Riau Mas Bersaudara and Bandung Textile Testing Laboratory for the assistance given.

REFERENCES

[1]. Statisticsof Riau Province (BPS), Area of plantation by type of plant(Pekanbaru, 2014).
[2]. D.M. Parbhane, and P.B. Shinde, Strength properties of coir fiber concrete, International Journal of Civil Engineering And Technology (IJCIET), 5(2), 2014, 20-24.
[3]. S. Harle, and V. Dhawale, Comparison of different natural fiber reinforced concrete: review,International Journal of Engineering Sciences&Research Technology, 3(2), 2014, 605-607.
[4]. D. Hermanto,Supardi, and E. Purwanto, Strong press brick with variations of fiber-added material, e-Jurnal Matriks Teknik Sipil, 2014, 491-497.
[5]. F. Adibroto,The effect of adding various types of fiber to the compressive strength of the paving block, Jurnal Rekayasa Sipil, 10(1), 2014, 1-11.
[6]. A. Kristiawan, and P.A.P. Suwandi, The effect of adding lime and coconut husk to the weight and absorption of brick water, Jurnal Ilmiah Teknosains, 1(1), 2015, 29-35.
[7]. Indonesian National Standard (SNI 03-0349-1989), Concrete brick for wall pairs(National Standardization (BSN), Jakarta, 1989).
[8]. Indonesian National Standard (SNI 7650:2010), Textile-yarn from roll-test of tensile strength and stretch per piece(National Standardization (BSN), Jakarta, 2010).
[9]. Ms.S. Suganya, Lightweight bricks – madeup of waste papers,International Journal of Computer & Organization Trends, 2(2), 2012, 29-40.
[10]. M.S. Arshad, and Dr. P.Y. Pawade, Reuse of natural waste material for making Lightweight bricks,International Journal of Scientific & Technology Research, 3(6), 2014, 49-53.
[11]. T. Subramani, and V. Angappan, Experimental investigation of papecrete concrete,International Journal of Application or Innovation in Engineering & Management, 4(5), 2015, 134-143.
[12]. R. Kumar, V. Patyal, B. Lallotra and D.K. Ashish, Study of properties of light weight fly ash brick,International Journal of Engineering Research and Applications,, 2014, 49-53.

Zainurizainuri.“ Utilization Of Palm Oil Stem Wastes From Pekanbaru And Dumai As Added Materials Of Making Brick-Fibert” American Journal of Engineering Research (AJER), vol. 7, no. 3, 2018, pp. 23-29.