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Original Paper

Utilization Of Tobacco Stem (Nicotiana tabaccum L) As Tray Egg Filler

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***Abstract*— Generally only used the leaves of tobacco plants as raw material for cigarettes and stems discarded as waste. The use of waste tobacco rod has the potential to be converted into primary packaging such as trays range chicken eggs because it has a high cellulose content. Tobacco rod contains a relatively high amount of cellulose, reaching 56.10 percent of dried tobacco stalks. The process is done in making pulp fiber or tobacco stem through process of alkali (NaOH) with specific concentration to produce pulp that is good. The use of NaOH aims to degrade lignin by means of partial overhaul of bond. The existence of lignin in the pulp generally unfavorable effect on the quality of pulp for fiber becomes rigid, Statistical data analysis using ANOVA If treatment showed differences do a further test using Duncan's Multiple Range Test (DMRT) at significance level of 5 percent. The data generated is the highest grammage at 5 percent NaOH treatment amounted to 201.1 g.m-2 and the lowest 15 percent NaOH treatment 132.8 g.m-2, the highest thickness of 5 percent NaOH treatment of 2.509 mm and the lowest 15percent NaOH treatment of 1,835 mm. The highest density of 5 percent NaOH treatment of 80.81 kg.m-3 and the lowest at 10 percent NaOH treatment of 57.61 kg.m-3. While the highest tensile resistance in the treatment of 10percent NaOH 76.27 N.m-1 and the lowest at 5 percent NaOH treatment is 45.82 N.m-1, the highest thickness of 5percent NaOH treatment of 2.509 mm and the lowest 15 percent NaOH treatment of 1,835 mm. The highest density of 5 percent NaOH treatment of 80.81 kg.m-3 and the lowest at 10 percent NaOH treatment of 57.61 kg.m-3. While the highest tensile resistance in the treatment of 10 percent NaOH 76.27 N.m-1 and the lowest at 5 percent NaOH treatment is 45.82 N.m-1, the highest thickness of 5 percent NaOH treatment of 2.509 mm and the lowest 15 percent NaOH treatment of 1,835 mm. The highest density of 5 percent NaOH treatment of 80.81 kg.m-3 and the lowest at 10 percent NaOH treatment of 57.61 kg.m-3. While the highest tensile resistance in the treatment of 10 percent NaOH 76.27 N/m and the lowest at 5 percent NaOH treatment is 45.82 N.m-1.**

Keywords*— Tobacco stems, local chicken eggs, NaOH dan egg tray

I. INTRODUCTION

One of the superior commodities in Jember is tobacco. Utilization of tobacco only relies on the leaves while the tobacco rod is not utilized optimally. Tobacco rod is a waste of tobacco plants with plentiful amounts. Tobacco rod contains a relatively high amount of cellulose, reaching 56.10 percent of dried tobacco stalks. Tobacco rod contains 42.1 percent cellulose, 23 percent hemicellulose, and lignin 20.8 percent [1]. Opportunities to make a tobacco rod waste paper pulp according to the study [2].

The use of waste tobacco rod has the potential to be converted into primary packaging such as trays range chicken eggs because it has high cellulose content. The development of the egg tray of the tobacco rod has never been done in Indonesia, especially in areas that have an abundance of high waste tobacco rod. The existence of tobacco plantations in Indonesia with 1.97.507 ha plantation area has reached [3], can be a source of papermaking or primary packaging tray of eggs are very valuable if processed properly, but otherwise will be environmental problems if not treated. Protective packaging is the design of a product with the aim of preventing the occurrence of damage. It can protect the product, as well as physical disturbance (friction, impact, pressure).

Range of chicken egg packagings generally use a wooden crate and given a straw mat with a dimensions of 43,5cm x 35cm x 19 cm for a capacity of 15 kg. This research aims to design the primary packaging in the form of free-range chicken egg tray by utilizing waste tobacco rods. Selection of primary packaging tray-shaped due to the possible friction between the egg and the friction between the eggs and the packaging is very small because there are barriers in each egg packaging arrangement. The process is done in making pulp fiber or tobacco stem through the process of alkali (NaOH) with specific concentration to produce fine pulp. Tobacco rod has abundant cellulose that can be used as packaging filler material to reduce vibration during delivery. Tobacco rods are also easy to get and relatively cheap. Utilization of waste as a filler tobacco rod wooden crate egg packaging is expected to reduce damage significantly, so that the egg damage during delivery to customers can be brought down using the alkali extraction process, which will produce cellulose which varies depending on the raw material.

II. METHODOLOGY

A. *Materials and tools*

Materials used in this study were: tobacco stems, NaOH (sodium hydroxide), tapioca flour, water, distilled water. The tools used in this study were: digital scales (Acis BC-500), an analytical balance, blender (National), thickness gauge (Mitutoyo), tensile strength, glass beaker, flask 1000 ml,

spatula glass, pipette, ruler, mould shaped tray, drum capacity of 10 L, knives, basins, and stove.

B. Research methods

This research was conducted by the method of complete randomized design with three treatments, different concentrations of NaOH at 5 percent, 10 percent, and 15 percent. The old uniform cooking time was 60 minutes. Each treatment was performed three times, followed by two observations (Duplo).

C. Research procedure

The first phase was the downsizing of the tobacco rod with an average length of 5 cm to simplify the cooking process. The next phase was drying the rod in the sun until the moisture content remains 10-15 percent. This aimed to extend the storing period of tobacco rod and reduce the water content in the material. The highest amount of cellulose in the dried tobacco stalks were kept at around 30-51 percent. The tobacco rod needed to weigh 250 grams for a capacity of one layer tray of eggs. The ration between the tobacco rod and NaOH solution was 1:20. The rod was then put into the NaOH solution in accordance with the treatment drum and then heated to 100 °C. Tobacco rod weighed mixed with a solution of sodium hydroxide has been boiling (100 °C). Pulping process was carried out for 60 minutes. Furthermore, tobacco stems washed with running water to reduce the content of NaOH were attached to the tobacco rod as a result of the cooking or pulping process. Clean tobacco rod was milled using a blender to smooth so malleable. 600 ml of water was added into the mixture while grinding the tobacco rod to facilitate the grinding process. The water was drained to reduce the water content contained in the material. After that, the tobacco stem pulp which had been drained was added with tapioca equal to 3 percent of the weight of raw material. 2 ml of tapioca mixed with water was used as an adhesive and as a power base tray of eggs produced. The tobacco rod was added with 600 ml of water to facilitate the grinding process. The mixture was then drained to reduce the water content in the material. After that, the drained tobacco stem pulp was mixed with equal to 3 percent of material. 2 ml of tapioca mixed with water was used as an adhesive and as a power base tray of eggs produced. The tobacco rod was added with 600 ml of water to facilitate the grinding process. . The mixture was then drained to reduce the water content in the material. After that, the drained tobacco stem pulp was mixed with equal to 3 percent of material. . The mixture was added with 2 ml water as an adhesive..

Egg tray moulding was done by pressing the tobacco rod manually using simple tools to shape the tray measuring 22cm x 22cm x 5cm (length x width x height). Fillers range chicken egg carton-shaped tray with a capacity of 1 kg, was formed with the content of ± 16 eggs every single layer tray. After printing the egg tray dried tobacco rod using sunlight for 7 hours, drying aims to strengthen the packaging shape after the printing or stamping process. Flowchart of manufacturing egg trays from tobacco rods can be seen in Figure 1.

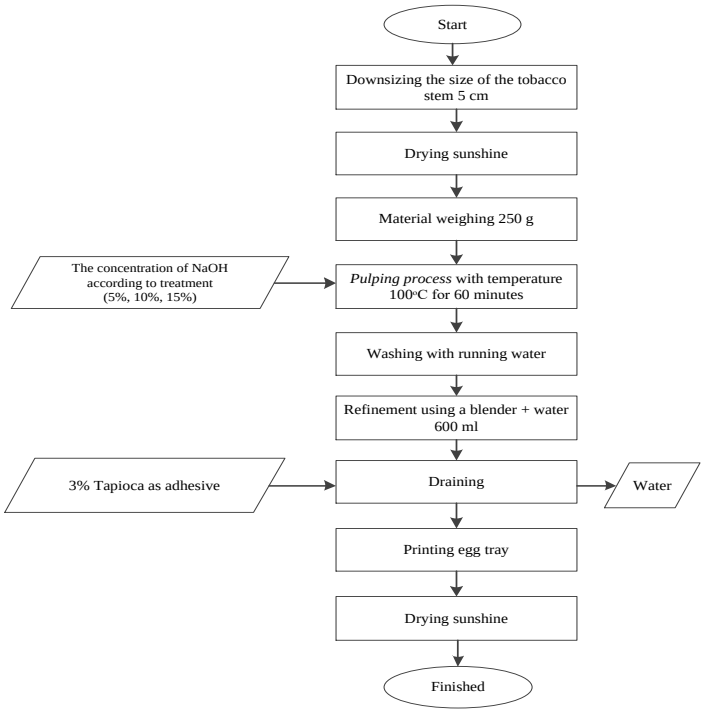

Figure 1. Flowchart of egg tray production

D. Parameters of observation

Parameters measured were grammage, thickness, mass meetings, tensile strength (resistance pull the paper), and Endurance Egg endurance.

E. Data analysis

Data were processed using SPSS 16 with ANOVA to determine whether there is a difference of treatment on the level of $\alpha = 0.05$. If treatment was confirmed to demonstrate significant differences, further tests using Duncan's Multiple Range Test (DMRT) at significance level of 5 percent were carried out. Furthermore, to determine the best treatment was investigated by considering the value of grammage, thickness, density, and tensile resistance. Data were presented in the form of tables and histograms later described descriptively.

III. RESULTS AND DISCUSSION

A. Grammage

Grammage sheet is defined as the total weight of pulp, paper or paperboard in grams divided by the cross sectional area of the paper in square meters, measured under standard conditions with ISO 536-2010 method on how to test the grammage of paper and board. Grammage grades of tobacco stem pulp sheets arrange in a variety of additional concentrations of NaOH 5%, 10%, and 15%can be seen in Figure 2.

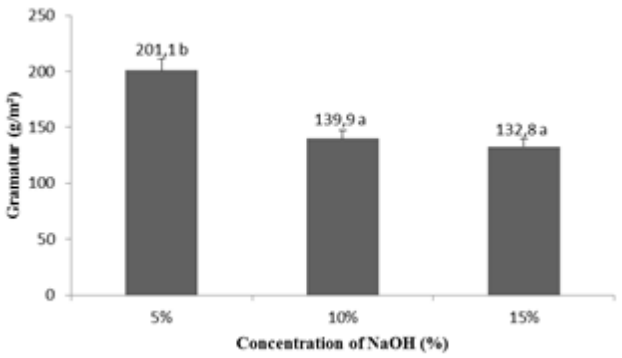

Figure 2. Grammage of pulp sheet

Based on Figure 2, the highest grammage obtained from the addition of NaOH treatment with 5 percent concentration was 201.1 g.m^{-2} and the lowest grammage obtained from the addition of NaOH treatment concentration of 15 percent amounting to 132.8 g.m^{-2}, while the grammage value in the treatment of the addition of NaOH 10 percent is moderate with a value of 142.2 g.m^{-2}. Different notations can also be seen in Figure 4.1, so this shows that the difference in each treatment. 5 percent NaOH concentration notation is b. The concentration of NaOH 10 percent is a, and the concentration of NaOH 15 percent is a. It means that the interaction of the grammage of paper is significantly different. The decline in pulp sheet grammage tobacco rod is in line with the addition of NaOH concentration. The use of NaOH aims to degrade lignin by means of partial overhaul of bonds. The existence of lignin in the pulp generally generates less influence. The quality of pulp for fiber becomes rigid. The high content of lignin also causes the colour of the pulp to be darker, and that increases the consumption of chemicals cookers . As a result, it requires longer grinding time [4]. This leads to the thickness of the paper, which is still stiff with different grammage. Grammage pulp sheet produced tobacco rod ranges from 132.8 to 201.1 g.m^{-2}. Pulp sheet grammage value in the market of this type generally ranges between 130-450 g.m^{-2}. Grammage affects all paper properties such as tensile resistance[5].

Grammage value generated in this research has met the target grammage is 130-450 g.m^{-2}. There are several factors that affect the value of grammage of them, which include the concentration of the adhesive, the mass of material, moisture content, thickness uneven and manual printing. Grammage measurements are hardly influenced by the moisture because the paper has been conditioned to certain humidity so that the moisture content of the paper remains homogeneous [6]. States that the grammage of paper is not only affected by the sample of raw materials, namely fiber mass, but also influenced by adhesive presence. Another factor that may affect the value of the thickness of the paper grammage is uneven because of the manual printing. It resulted in the pulp sheet mass varieties. Therefore, measurement and calculation of grammage are repeated three times with twice observations to determine the average of the pulp sheet [7].

B. Thickness

Thickness is the straight distance between the surface of the pulp sheet as measured under standard conditions with ISO-140435-1998 method on how to test a thick pulp sheet, paper, and cardboard. Testing the egg tray thickness tobacco rod is done by using a thickness gage. Pulp sheet thickness measurements are carried out at three different points with a size of 7x3 cm pulp sheets on flat surface. Egg tray thickness values tobacco rod on a variety of additional concentrations, comprising of NaOH 5%, 10%, and 15%can be seen in Figure 3.

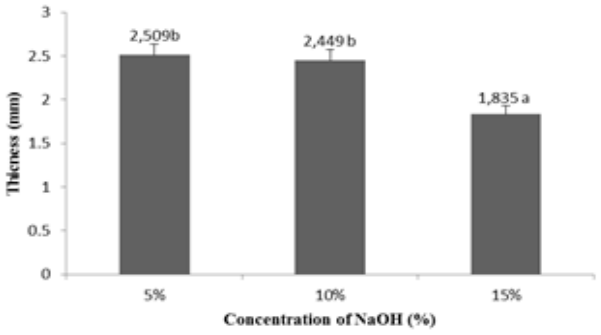

Figure 3. Thickness of egg tray

The thickness of the egg tray tobacco rod produced ranges from 1.835 to 2.509 mm. The results of the analysis signify the highest thickness in the treatment with 5 percent NaOH concentration with the addition of 1,835 mm. The higher concentration of NaOH in the manufacture of pulp sheets has resulted in a decrease in grammage which causes the pulp sheets become thin. In addition, it can also be caused by manual manual printing, resulting in paper with uneven or variant thickness. The addition of alkali bases such as NaOH will break the bond of lignin compounds [8]. The use of high concentrations of NaOH will cause poor quality paper because it will produce pulp rigid texture, in addition to the concentration of NaOH. Extensive cooking will also affect the quality of the paper. Long ripening optimum delignification process is approximately 60-120 minutes with constant lignin content after that time [9]. The longer the cooking time is, the higher the lignin content in pulp will be This is because the lignin which has been separated from the raw pulp with a reduced concentration of NaOH will be reunited with the raw pulp, and it is difficult to separate them again.

Figure 3. shows a decrease in the thickness of the sheet thickness tobacco stem pulp. A decrease in the thickness occurs along with the addition of NaOH concentration. Differences in paper thickness which is greatly influenced by the addition of an adhesive (starch) and water content of the pulp. The water content contained in the pulp is also a factor affecting the differences in the thickness and surface of the pulp sheet. The

amount of moisture will affect the mechanical properties and the surface of the paper, and that will affect the dimensional stability.

C. Density

Mass density is the amount of the stated ratio between the mass of the pulp sheet in kilograms (kg) divided by the unit volume in the pulp sheets cubic meter (m^3) as measured under standard conditions. Testing mass density pulp sheets can also be done by calculating the grammage divided by the thickness of a pulp sheet. Mass density measurements carried out for three days in a row. The calculation demonstrates average results. Measurement of mass density ($kg.m^{-3}$) aims to determine the density of the paper produced. Mass density value of tobacco stem pulp sheets on a variety of additional concentrations of NaOH at 5 percent, 10 percent and 15 percent. The data is presented in Figure 4.

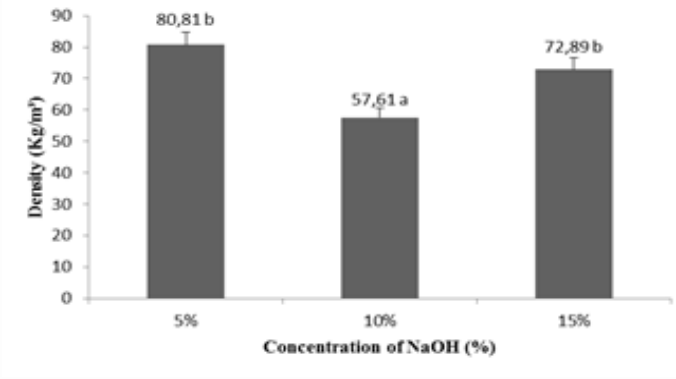

Figure 4. Density of tray egg

Based on Figure 4. density value in the treatment of 5 percent concentration of 80.81 $kg.m^{-3}$, at a concentration of 10 percent amounting to 57.61 $kg.m^{-3}$, whereas the addition of NaOH at 15 percent concentration results in pulp sheet mass density value that is equal to 72, 89 $kg.m^{-3}$, as well as pulp sheet grammage value. The value of mass density is also different in each treatment. Mass density value is closely related to the value of grammage and thickness. This is because the formulation of the mass meeting can be obtained from the comparison grammage ($g.m^{-2}$) with a thickness (mm). Therefore mass density, grammage and thickness are interrelated in determining the quality and nature of the pulp sheet [10].

D. Tensile Strength

Endurance pull a pulp sheet resistance to tensile force is given on each pulp sheet (horizontal or vertical) to the test material is broken. Durability testing on tobacco rod pull the tray eggs done by using a tensile tester in which the tensile resistance values involves the comparison between maximum traction and the surface area. Tensile resistance values at different concentrations of NaOH addition of 5%, 10%, and 15%can be seen in Figure 5.

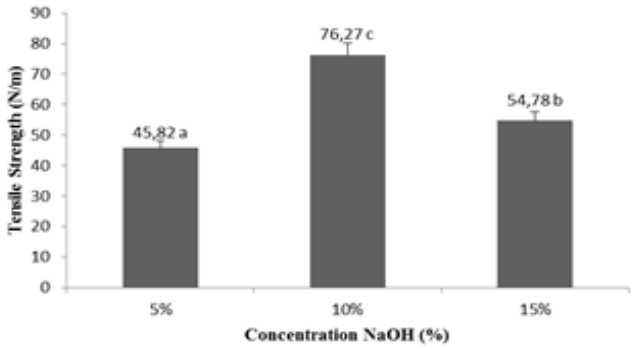

Figure 5. Tensile resistance of egg tray

Based on Figure 5. it is clear that endurance the highest endurance to pull is obtained with treatment involving 10 % NaOH amounting to 76.267 $N.m^{-1}$. The lowest endurance is obtained with endurance treatment administering 5 % NaOH amounting to 45.817 $N.m^{-1}$. because the results indicate that the thickness of a pulp sheet, reaching 2.509 mm, where the thicker the pulp sheet will be more easily broken when a tensile test, By contrast, 15 % NaOH concentration obtained tensile resistance of 54.743 $N.m^{-1}$. Low grammage value will result in thin pulp pulp sheet, so that the value of tear resistance and tensile resistance are also low. The average tensile endurance of pulp sheet from tobacco rod ranges from 45.817 to 76.267 $N.m^{-1}$. Tensile endurance of pulp sheet is influenced by several factors such as different thickness of each pulp sheet caused by manual printing. The findings demonstrate that the factors affecting the endurance of the attraction is the strength of individual fibers, fiber length, the bonding between the fibers which rely on the process of suppression, pressing and surface structures of pulp sheet during the printing process. In addition to the factors affecting the tensile resistance is the addition of an adhesive. The addition of an adhesive in the manufacture of paper intended to strengthen the bonds between the fibers with tensile and tear resistance is high [11]. Tobacco stem fiber cannot bind well with each other because the tobacco stem pulp mill imperfect experience. This causes the bonds between the fibers not formed properly, resulting in lower print quality of pulp sheet. Milling aims to improve the bonding between the fibers.

E. Eggs Resistance

Egg endurance test aims to determine the percentage of egg cracks caused by friction and collision after replacing straw filler tobacco rod using egg tray. Testing is done using a bike with a speed of 40 $km.h^{-1}$ and 60 $km.h^{-1}$ to cover a distance of 9 km. Percentage of cracked eggs at various concentrations of NaOH addition of 5%, 10%, and 15% can be seen in Figure 6.

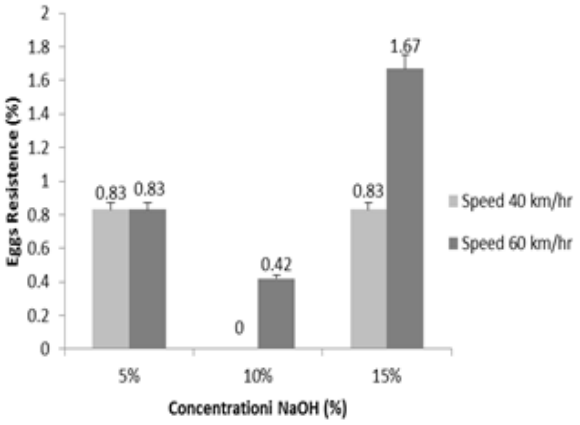

Figure 6. Percentage of cracking eggs

Physical damage eggs are packed with wooden crates with fillers or absorbers of waste tobacco rod on the addition of NaOH treatment concentration of 5 percent at a speed of 40 km.h^{-1} and 60 km.h^{-1} to get the same percentage of cracking eggs is 0.83 percent, and the NaOH concentration of 10 percent at a speed of 40 km.h^{-1} no cracks eggs. By contrast, at a speed of 60 km.h^{-1} the test signifies 0.42% crack. This can occur because the mass density in the egg tray 10% NaOH results in wek texture. In addition, the treatment with the highest tensile resistance is equal to 78.27 N.m^{-1} so that the tray is resistant to bending with a low density and strong with high tensile resistance. The percentage of cracking eggs produced at a speed of 40 km h^{-1} at a concentration of 15% NaOH is equal to 0.83% and 1.67% at a speed of 60 km.h^{-1}. This value is lower when compared to the old packaging. The bumpier the road, the more vibration occurrs. During the distribution, the eggs are very vulnerable to physical damage due to shock, friction, impact or pressure due to excessive load [12]. The data on egg damage can be seen in Table I

TABLE I The Appearance of Egg Damage

NaOH Concentratio	40 km.h^{-1}	60 km.h^{-1}
5%		
10%		
15%		

This proves that the packing filler material replaced with an egg tray of the tobacco rod has better protective properties and durability better compared to the egg tray made of hay. It also shows that with the use of filler tobacco rod egg tray on a wooden crate as egg containers capable of suppressing the rate of physical damage to the eggs caused by vibration. Packaging is designed to address some of the vibration and shock during transportation. The selection of materials and packaging design prioritizes material that can protect the product from physical damage during transport

(A) (B) (C)

Figure 7. Eggs tray tobacco stems (a) NaOH 5 percent,(b) NaOH 10 percent, (c) NaOH 15 percent

This proves that the packing filler material replaced with an egg tray tobacco rod has better protective properties and durability press compared to the tray made of hay. It also shows that the use of filler tobacco rod egg tray on a wooden crate as egg containers is capable of suppressing the rate of physical damage to the eggs caused by vibration. Packaging is designed to address the vibration and shock during transportation. The selection of materials and packaging design prioritizes material that can protect the product from physical damage during transport [13].

F. Selection of best treatment

Testing the physical and mechanical properties of paper is the main indicator in determining the best behavior for physical and mechanical properties of paper. This can help to determine the quality of the paper produced. The test results of physical and mechanical properties of the paper indicate that the best treatment is at a concentration of 10% NaOH. The selection of the best treatment based on grammage, thickness, density, tensile resistance and durability eggs are presented in Table II

TABLE II The average value of whole Parameter Observation

No	Treatment	Average Value		
		5% NaOH	10% NaOH	15% NaOH
1	Grammage (g.m^{-2})	201.1^{b}	139.9^{a}	132.8^{a}
2	Thickness (mm)	2.509^{b}	2.449^{b}	1.835^{a}
3	Density (kg.m^{-3})	80.81^{b}	57.61^{a}	72.89^{b}
4	Tensile Strength (N.m^{-1})	45.82^{a}	76.27^{c}	54.78^{b}
5	Eggs Resistence (%)	0.83	0.21	1.25

Grammage produced in this study has complied with the grammage required in the market. ranging from 130 to450 g.m^{-2}. Grammage at a concentration of 5% NaOH with the notation

(b) generates a value equal to 201.1 $g.m^{-2}$ compared to grammage generated by the treatment with 10% NaOH concentration of 139.9 g/m^2 and 15 percent NaOH concentration of 132 $g.m^{-2}$ both have the notation (a). This happens because the thickness of the paper is uneven so the value of the paper grammage is also diverse. The best treatment was obtained in treatment to increase the concentration of NaOH 5 percent due to the treatment resulted in the highest grammage paper.

The thickness of the paper in the notation (b) generates a value significantly different from the thickness of the paper in the notation (a). where the notation (b) demonstrates that the treatment concentration with 5% NaOH 10% yield paper thickness of 2.509 mm and 2.449 mm. respectively. At a concentration of 15% NaOH the test produces a thickness value of 1.835 mm. The selection of the best treatment in the thickness test is obtained in treatment to increase the concentration of NaOH 5 percent because it has the highest thickness value that is equal to 2.509 mm.

The desired density in this study is the addition of NaOH concentration treatment that results in the lowest value. due to the low density tends to have a cavity inside the paper so that it can hold the eggs when shocks. The best treatment is obtained in the group notation (a) that the treatment adding 10 percent NaOH concentration at which these treatments produce the lowest density value that is equal to 57.61 $kg.m^{-3}$.

The best treatment is obtained at a concentration of 10 percent NaOH with a high tensile strength of 76.27 $N.m^{-1}$. The resulting pulp sheet corresponds to being used as a tray of eggs. The paper quality is very important from the drop resistance and tear resistance [14]. The higher value of tensile resistance and tear resistance of a paper. the quality of the resulting paper. the better. Increasing concentrations of NaOH causing solvent penetration grows. the higher the NaOH absorbed by the fiber. making it even easier fragments of lignin out of the cell wall and the lower lignin remaining in the pulp. The higher the concentration and the stronger chemicals are used then the yield will be smaller because lignin and cellulose were degraded more and more. The results of the endurance test of eggs at a concentration of 10 percent NaOH shows the percentage of eggs lowest rift is 0 to 0.42 percent. then at a concentration of 5 percent the percentage obtained egg cracks of 0.83 percent. while the highest percentage of cracks eggs at a concentration of 15 percent. ie 0 . from 83 to 1.67 percent. That is because the tray of eggs produced at a concentration of 10 percent NaOH is slightly elastic so that when the shock eggs can withstand the friction that occurs.

Selection of the best treatment for the concentration of NaOH 10 percent. States that high concentrations of NaOH (more than 10 percent) causes the resulting lignin content increases [15]. Most low lignin content obtained at a concentration of 10 percent amounting to 11.96 percent. where the results of the analysis meet the criteria of a good pulp for non-wood raw materials. while at the concentration of NaOH 5 percent lignin has not degraded completely. the presence of lignin in the pulp generally give effect poor the quality of pulp for fiber becomes rigid. so that the mechanical strength of the pulp to be low [16]

IV. CONCLUSION

1. In the process of making the egg tray of the tobacco rod with a variation of the addition of alkali concentration of NaOH influence to improve the characteristics and quality of the paper or pulp sheet is generated based on the grammage. thickness. density. and tensile resistance. Grammage produced ranged from 132.8 to 201.1 $g.m^{-2}$ grammage in accordance with the existing market that is 130-450 $g.m^{-2}$. Paper thickness ranging from 1.835 to 2.509 mm. Mass density value ranging between 57.61 to 80.81 $kg.m^{-3}$. As for the tensile resistance values ranging from 45.82 to 76.27 $N.m^{-1}$. the higher the drag resistance of the paper quality is getting better.
2. The best treatment is obtained from the treatment of NaOH 10 percent. Egg endurance test proved that the egg tray tobacco rod at a concentration of 10 percent NaOH to restrain and reduce cracking eggs that occurs due to shock and friction.

REFERENCES

[1] Juliano. Daniela. Boaretto. Luis Felipe Segato. Fernando. Labate. Carlos A. 2016. Bioenergia em Revista. Dialogos. Ano Vol 6 (2):47-61.

[2] Pesevski. M.D.. Iliev. B.M.. Zivkovic. D.J.. Popovska. V.T.J..Srbinoska. M.A.. Filiposki.B. 2010. Possibilities for utilization of tobacco stems for production of energetic briquettes. Journal of Agricultural Sciences. 55(1):45-54.

[3] Direktorat Jenderal Perkebunan. 2015. Tembakau 2014-2016. Statistik Perkebunan Indonesia. 2015.

[4] Fitriasari W. Ermawar RA. Falah F. Yanto DHY. Hermawati E. 2009. Pulping soda panas terbuka bambu betung dengan prapelapukan fungi pelapuk putih (Pleurotus ostreatus dan Trametes versicolor). Jurnal Ilmu dan Teknologi Hasil Hutan. 2(2): 45-50.

[5] Suskiyatno. Bambang. 2011. Bata Pulpy Granule Limbah Kertas-Tapioka Sebagai Dinding Ekologis. Jurnal Penelitian. Semarang : Fakultas Arsitektur dan Desain. Unika Soegijapratama.

[6] Namsai. Sripak. 2013. Effect of Packaging System On Shelf-Life Stability of Thai-Style Fried Rice Crackers. Vol. 1. No. 2.

[7] Malau. Hermayanti. 2014. "Daur Ulang Sampah Kertas HVS Hasil Cetak Tinta Print dengan Variasi Konsentrasi Surfaktan dan Perekat". Skripsi. Pekanbaru : Universitas Riau.

[8] Sucipto. Wijana. 2009. Optimasi Penggunaan NaOH dan Tapioka Pada Produksi Kertas Seni Dari Pelepah Pisang. Teknologi Pertanian 10(1) : 46-53.

[9] Surest AH. Satriawan D. 2010. Pembuatan pulp dari batang rosela dengan proses soda (Konsentrasi NaOH. temperatur pemasakan dan lama pemasakan). Jurnal Teknik Kimia. 3(17).

[10] Nurminah. M. 2002. Penelitian Sifat Berbagai Bahan Kemasan PLastik dan Kertas Serta Pengaruhnya

Terhadap Bahan Yang Dikemas. Medan : USU digital library.
[11] Monica E. Gellerstedt G. Henriksson G. 2009. Pulp and paper chemistry and technology. Vol. 4. paper product physic & technology. Berlin (DE): Walter de Gruyter GmbH & Co.
[12] Broto. W. 2013. Teknologi Penanganan Pasca Panen Buah dan Telur untuk Pasar. Jakarta : Agromedia Pustaka.
[13] Bo Rundh. 2009. Packaging design: creating competitive advantage with product packaging. British Food Journal. 111(9):988-1002
[14] Sugiarto. E.. S. Wijana. dan N. L. Rahmah. 2012. "Pemanfaatan Serat Pelepah Nipah (Nypa fruticans) Sebagai Bahan Baku Alternatif Pembuatan Kertas Seni (Kajian Proporsi Bahan Baku Dan Perekat)". Malang : Universitas Brawijaya.
[15] Saleh. A.. M.D. M.. Pakpahan & Angelina. N.. 2009. Pengaruh Konsentrasi Pelarut. Temperatur dan Waktu Pemasakan Pada Pembuatan Pulp dari Serabut Kelapa Muda. Jurnal Teknik Kimia. Vol 16 : 35 – 44.
[16] [16] Fitriasari W. Ermawar RA. Falah F. Yanto DHY. Hermawati E. 2009. Pulping soda panas terbuka bambu betung dengan prapelapukan fungi pelapuk putih (Pleurotus ostreatus dan Trametes versicolor). Jurnal Ilmu dan Teknologi Hasil Hutan. 2(2): 45-50.