Journal Innovation and Dissemination Research
Jurusan Teknik Kimia,Politeknik Negeri Lhokseumawe
Vol. 01, No. 01, Desember, 2024 ISSN xxx-xxx

PENERAPAN TEKNOLOGI *ROTARY SCREENING MACHINE* UNTUK KOMERSIALISASI PRODUK COCOFIBER DAN COCOPEAT DI LHOKSEUMAWE

Satriananda [1*], Muhammad Nasir[2], Ibrahim[1], Muhammad Haikal[1], Nurhanifa[3], Isra Adelya Izzati[1]

[1]Teknik Kimia, Politeknik Negeri Lhokseumawe, Jl. Banda Aceh-Medan Km. 280,3, Buketrata, Mesjid Punteut, Blang Mangat, Kota Lhokseumawe, Aceh 24301, Indonesia
[2]Tata Niaga, Politeknik Negeri Lhokseumawe, Jl. Banda Aceh-Medan Km. 280,3, Buketrata, Mesjid Punteut, Blang Mangat, Kota Lhokseumawe, Aceh 24301, Indonesia
[3]Teknik Energi Terbarukan, Universitas Malikussaleh, Tengku Nie, Cot Rd, Reuleut Tim., Muara Batu, Kabupaten Aceh Utara, 24355, Aceh, Indonesia.
*Email: snanda1.pnl@gmail.com

Email: abdulharissalam.pnl21@gmail.com

ABSTRACT

Utilization of coconut coir consisting of Cocopeat and Cocofiber can be processed into crafts and planting media. Cocofiber can be processed into household appliances, flower pots, industrial raw materials for carpets, car seats and dashboards. Meanwhile, cocopiet itself can be used as a planting medium that is able to fertilize plants that can replace the use of fertilizers that are more expensive, more environmentally friendly and renewable. Rotary screening machine technology was created with the aim of utilizing the potential of local coconut coir that is abundant in the coastal areas of North Aceh and Lhokseumawe into products that have a high selling value so as to increase export potential. This increase in economic potential is expected to help increase the income of the community or coconut farmers as producers. Rotary Screening machine works by replacing human hands or traditional chopping tools as a shredder of coconut fibers while at the same time sorting or separating the cocopeat. Rotary screening is installed horizontally using a straight gear transmission which functions as a distribution of rotation from the motor. The material is poured directly from the funnel of the mixer truck and separated in a screening tube which has a diameter of 83 cm. Run volume / production capacity one time is as much as 70 kg in 1 hour. using an 8 HP diesel engine as a substitute for an electric motor, the sieving length is 3.5 m, using a UCF 50 reducer to reduce the rotation speed to 50 rpm, using a sieve net with a size of 5 mm so that the short fiber sieving is faster. On the inside of the screening tube there is a spiral plate that is useful for draining the material up to the output side of the material. The tilt angle of the screening tube makes it easy for the material to dismount. The rotation of the screening tube is obtained by a direct relationship between the driving motor and the shaft that is on the axis of the screening tube. Materials that pass fall and are stored in the outlet under the screening tube according to the type of each material. Material is evacuated by opening the gate on the outlet easily. The resulting mixture of materials that have been separated is then stored in a portable tub under the screening tube so that it can then be evacuated easily.

Keywords: *Coconut coir, Rotary Screening Machine, Cocofiber, Cocofiber, Separation*

INTRODUCTION

Indonesia is a tropical country with agroclimatic conditions that are very supportive for the growth of coconut trees. Based on world statistics, of the 11.6 million hectares of land owned by 32 member countries of the Asia Pacific Coconut Community (APCC), Indonesia is recorded to have the largest productive land in the world of 3.7 million hectares with a total production estimated at 14 billion coconuts per year (Bambang Setiaji, 2011). North Aceh Regency is one of the main coconut producers in Aceh Province. Of the total land area of 60,696 hectares spread across 22 districts/cities in Aceh, the area of coconut plantations in North Aceh reaches 32.63% or 19,808 hectares (BKPM, 2015). However, this huge potential has not been utilized to the fullest. Tapeh u (coconut coir) has only been burned into charcoal or burned so that it has no selling value. Tapeh u (coconut coir) can be developed into a variety of products, including cocopeat, cocofibre, cocomesh, cocopot, coco fiber board and cococoir. These materials are raw materials in the mattress industry, pots, dry compost and so on. If you only focus on coconut processing on the pulp, the highest coconut price is still a very low income for farmers to live a decent life. One of the efforts to increase the income of coconut farmers is to process all fruit components into high-value products, so that the value of coconut fruit will increase.

For example, coconut shells, if processed into shell charcoal and activated charcoal, can increase the economic value of coconuts. So that the economic value of coconut is no longer based on copra (fruit pulp), as in the Philippines, of the total exports (US$ 920 million) 49% of which comes from non-CCO. The price of coconut fiber in the export market is currently USD 385 per ton, while the price of cocopeat is USD 185 per ton. The processing of coconut coir into cocofiber and cocopiet has a high selling value because for cocofiber, it can be used as a manufacture of household appliances and raw materials for the carpet industry, upholstery, etc.

As for cocopiet, it can be used as a planting medium to replace soil that is safer, cheaper, lighter and environmentally friendly. The price of cocopeat and cocofiber in the online market is for cocofiber Rp. 15000 per kg and cocopeat Rp. 10,000 per kg. Currently, the need for cocopeat for ornamental plants in households and agriculture is quite high. When viewed from the potential price of products, this business has great profit potential for the community considering the availability of abundant and cheap raw materials. From the data collected by the Asia Pacific Coconut Community (APCC, 2001), the consumption of fresh coconuts from around 220 million Indonesians reached 8.15 billion grains (52.6%), with a per capita consumption per year of 37 grains. The remaining 7.35 billion grains (47.4%) were processed into 1.43 million tons of coconut pulp (copra). as in the Philippines, of the total exports (US$ 920 million) 49% of them come from non-CCO. The price of coconut fiber in the export market is currently USD 385 per ton, while the price of cocopeat is USD 185 per ton. The processing of coconut coir into cocofiber and cocopiet has a high selling value because for cocofiber, it can be used as a manufacture of household appliances and raw materials for the carpet industry, upholstery, etc.

As for cocopiet, it can be used as a planting medium to replace soil that is safer, cheaper, lighter and environmentally friendly. The price of cocopeat and cocofiber in the online market is for cocofiber Rp. 15000 per kg and cocopeat Rp. 10,000 per kg. Currently, the need for cocopeat for ornamental plants in households and agriculture is quite high. When viewed from the potential price of

products, this business has great profit potential for the community considering the availability of abundant and cheap raw materials. From the data collected by the Asia Pacific Coconut Community (APCC, 2001) that the consumption of fresh coconuts from around 220 million Indonesians reached 8.15 billion grains (52.6%), with a per capita consumption per year of 37 grains. The remaining 7.35 billion grains (47.4%) were processed into 1.43 million tons of coconut pulp (copra). Of the 1.43 million tons of cobra, more than 85-90% is processed into crude coconut oil (CCO) and the rest (10-15%) is for further processing. From these figures, it shows that the uses of coconut fruits are diverse with users who are also scattered. This causes coconut by-product raw materials to be scattered, so it requires the right strategy, institutions and implications to build the downstream industry.

The Indonesian Coconut Coir Industry Association (AISKI) estimates that Indonesia loses potential revenue from coconut coir reaching Rp13 trillion per year. This figure was obtained from the calculation of the number of Indonesian coconut fruit production which reached 15 billion grains per year, and can only be processed around 480 million grains or 3.2 percent per year. Each grain of tapeh u (coconut coir) produces on average coconut fiber or in international trade called cocofiber as much as 0.15 kilograms, and coconut coir powder or cocopeat as much as 0.39 kilograms. In developed countries, cocofiber is widely used as a substitute for foam and other synthetic materials. For example, for industrial raw materials for spring beds, mattresses, sofas, pillows, car seats, carpets and ropes.

Meanwhile, coco peat is more widely used as a planting medium to replace soil and organic fertilizers. Tapeh U (coconut coir) is the outermost part of the coconut that wraps the coconut shell. The thickness of coconut coir ranges from 5-6 cm which consists of the outermost layer (exocarpium) and the inner layer (endocarpium). Endocarpium contains fine fibers that can be used as materials for making ropes, sacks, pulp, carpets, brushes, mats, heat and sound insulators, filters, seat/car seat fillers and hardboards. One coconut produces 0.4 kg of coir containing 30% fiber. The chemical composition of coconut coir consists of cellulose, lignin, pyroligneous acid, gas, charcoal, ter, tannins, and potassium (Rindari et al., 1995) India and Sri Lanka are the largest producers of coir products with export volumes in 2000 of 55,352 tons and 127,296 tons respectively and consist of 6 and 7 kinds of products respectively.

At the same time, Indonesia only exports one type of product (in the form of raw fiber) with a volume of 102 tons. This figure decreased sharply compared to the highest export in 1996 which reached 866 tons (Ditjenbun, 2002). The primary product of the processing of tapeh u (coconut fiber) consists of cocofiber which can be processed into rubber fibers, mattresses, geotextiles, carpets, and handicraft products/household industry. Rubber mats and fibers are widely used in the upholstery, mattress, and hot upholstery industries. Coir dust can be processed into compost and cocopeat, and particle board/hardboard. Cocopeat is used as a natural peat substitute for the flower industry and golf course coatings. In addition, together with bristle can be processed into hardboard (Indahyani, 2011). The demand for cocopeat is expected to increase sharply because in addition to the pressure of environmental issues related to the use of natural peat, it is also due to the quality of the product which turns out to be better than natural peat. Indonesia's coir fiber exports once reached 866 tons, while in the last 2 years it only reached 191 tons/year. Meanwhile,

the cocopeat data is not yet available, but as an illustration, every production of coir fiber as much as 1 ton is produced at the same time as 1.8 tons of cocopeat. In most industries, because the type of fiber (cocofiber) varies greatly and due to equipment limitations, long fibers and short fibers are usually inseparable, unless there is a special treatment (combing). In traditional processing equipment, the processing of tapeh u (coconut coir) is carried out by soaking it in water for several days, with the intention of softening and rotting cocopeat (Agustian, et al. 2003). Cocofiber will be able to be easily separated from cocopet.

The product produced in this way is only in the form of fiber, even with a color that is not good (somewhat blackish). Now with the development of technology, cocofiber does not need to be soaked but is directly processed by machine and produces two products at once, namely cocofiber and cocopeat. For this reason, in this PTPPV we try to apply the research results that have been obtained for the production of tapeh u (coconut coir) produced from the processing process by the Rotary Screening method into cocofiber which can be used for the manufacture of household appliances and cocopeat which can be used as a planting medium to replace soil that is safer, cheaper and environmentally friendly and also has a high export value. The purpose of the implementation of the product through the Domestic Applied Scientific Research Program - PT Vocational is the first is to utilize the potential of tapeh u (coconut coir) that is growing in the coastal areas of North Aceh and Lhokseumawe into products that have a high selling value so that they can increase export potential. This increase in economic potential is expected to help increase the income of the community or coconut farmers as producers. The limitation of this research is that Rotary Screening technology will be used in this research to see the effectiveness of the cocopeat and cocofiber production process. Rotary Screening machine works by replacing human hands or traditional shredders as a crusher of coconut fibers as well as being able to sort or separate cocopeat. Another technology that will be added as a support for this technology is a press tool for cocopeat. The technology of the funds The products produced will be tested to ensure excellence in terms of effectiveness, quality and market requirements that are the object of research. The research will be carried out with the help and cooperation of DUDI Partners which is a startup company called PT. Fugha Pratama Mandiri. This company is also pioneering a business in the field of coconut coir processing with the aim of increasing its selling value.

METHOD

Material The raw material used is coconut fiber which is still mixed between the cocopeat dana cocofiber. The tool used is a self-assembled rotary screening machine. The material is poured directly from the hopper of the mixer truck and separated in a screening tube that has two sizes of 5 mm holes, using a 5 HP diesel engine drive instead of an electric motor, a sieving length size of 3.5 m, using a UCF 50 reducer to reduce the rotation speed to 50 rpm. The angle of inclination of the screening tube makes it easier for the material to go down. The rotation of the screening tube is obtained by the direct relationship between the drive motor and the shaft located on the axis line of the screening tube. The material that escaped fell and was stored in the outlet under the screening tube. Testing the measurement of cocofiber quality, cocopeat, separation time and power efficiency of the Cocofiber and cocopeat tools was obtained by weighing the output results in the form of

fibers from coconut coir and powders from coconut coir processed using a fiber sieving machine, while the time was obtained from calculating using a stopwatch when the coconut coir was put into the fiber sieving machine until the coconut coir came out of the sieve in the form of fibers (cocofiber) and powders (cocopeat). The unit of time is minutes. In measuring the quantity of cocofiber and cocopeat, only the mass is measured. The efficiency of machine performance is calculated by comparing the capacity used with the Rotary Screening Machine and the capacity of the manual tool (sand sieve). How to Test Using a Sand Sieve Manually The testing steps are as follows: First prepare the coconut coir first, at this stage the coconut coir is divided into two parts. One part with no soaking and another part with 1 day, day and 6 day soaking variations, then beat the coir before putting it into the decomposition machine. Second, prepare a coconut coir decomposing tool, before turning on the machine, first put the tube into the tube whether the tube is empty, set the on button on the machine and then turn it on. After the engine starts, put the coir that has been prepared earlier into the tube. When it has been completely disassembled, turn off the engine by turning the button to the off position on the engine.

Open the tube by turning the lock on the side of the tube. Lift the tube and then take the remaining fibers in the tube. The fibers remaining in the tube are the cleanest fibers because the fibers are not mixed with the powder, because the powder has fallen first into the outlet funnel. Meanwhile, the powder and fiber that comes out through the tube are still in a mixed state and the fiber can be taken by hand. How to Test Using a Rotary Screening Machine Scales are provided, Dry the coconut coir until the moisture content is ± 20%. Coconut coir from decomposition with a defibring machine that is still mixed between cocopeat and cocofiber is provided for testing as much as 30 kg. Each is placed in a sack weighing 10 kg/sack. Turn on the Rotary Screening Machine by connecting the drive motor with electricity. Then turn on the stopwatch. Put a total of 10 kg of coconut coir into the machine through the input hopper slowly. The coconut coir will be separated into cocopeat and cocofiber. Cocofiber will come out through the cocofiber output hopper and cocopeat will come out through the screen on the tool tube through the pores of the screen and will be accommodated at the bottom. After the separation process is complete, record the time, and take each cocopeat product from cocofiber and weigh the mass. Testing Indicators The testing process to determine the success of a tool or machine designed based on the purpose and function of the tool being manufactured.

In this coconut fiber decomposition machine, testing is needed to determine the capacity of the machine. So, this engine test is carried out by taking into account several factors, namely:

a. The mass of cocofiber produced

b. The mass of cocopeat produced

c. Separation time

d. Efficiency The expected achievement indicator of this study is a greater level of productivity than the manufacture of cocopeat and cocofiber products Manually.

RESULTS AND DISCUSSION

Machine Test Results

A coconut fiber separator machine (Rotary Screening Machine) is a machine that functions to decompose or separate coconut fruit fibers from a sponge or

powder layer, so that the two products produced can be used as desired. The working principle of this machine is to rotate until the raw materials of the fiber and powder parts of the coconut fruit that have been fed to the hopper of the coconut fiber decomposition machine. This separation process aims to separate coconut fiber from the outer shell of the coconut (coco peat), where each type of material has its own function and selling value. The processed product is in the form of coir and outer bark that has decomposed, but the product is still mixed into one. The processed product is in the form of coir and outer bark that has decomposed, but the product is still mixed into one.

The main drive of the electric motor. A Rotary Screening Machine whose main drive uses electric power is a machine that in its operation does not use any fuel to trigger the operation of the driving engine, but uses a strom (electric power) to be able to start the machine. Machines like this work automatically without needing extra power to turn them on. It's just that machines like this are dependent on electricity and cannot be used in areas that do not have electricity. The noise level is lower than that of shredders that use gasoline engines and diesel engines, besides that such machines do not cause pollution because no exhaust emissions are emitted.

Gambar 4.1 Alat Rotary Screening Machine

Diesel Motor is a type of piston combustion motor that is usually called Compression Ignition Engine. The use of coconut fiber choppers using diesel engine driving machines on the market has not been able to increase consumer comfort and efficiency. This is because it emits combustion products in the form of CO2 and NOx and causes air pollution and noise pollution, is relatively large in size and also requires periodic maintenance so it requires space and costs a lot of money. This will worsen the surrounding environment and interfere with the user's comfort and efficiency when operating the machine. Therefore, an efficient and optimal coconut fiber shredding machine is needed by reducing noise so that it is not noisy and pollution-free.

Coconut fiber chopper with electric motor drive is an innovation of coconut fiber chopper with electric motor as a solution for making household products and agricultural fertilizers to increase comfort and efficiency for consumers so that it is expected to increase economic value in the community. This test method begins with the manufacture of tools consisting of literature studies, measuring each component of the tool consisting of frames, screening tubes, filters, drive motors, pulleys and then designing design models. Test at 450 rpm unloaded blade shaft rotation. During the separation process, the shaft rotation is reduced to about 350-400 rpm and the linear speed of the V-Belt is 3.9 m/s. From this device, coconut fibers with an electric motor drive cause low vibration, do not cause pollution and are efficient.

a b c

Figure 4.2 Materials and Products: a) Coir Coir before decomposition, b) Coconut fiber after decomposition (Cocofiber), c) Cocoir powder (Cocopeat)

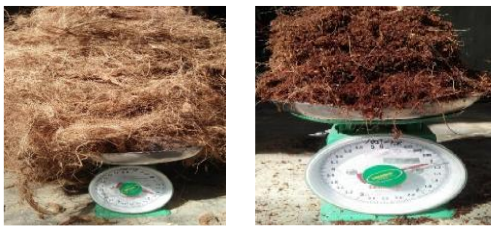

Figure 4.3. Weighing Materials and Products, a) Cocofiber, b) Cocopeat

In this test, the process of separating cocopeat and cocofiber was carried out by preparing 6 sacks of coconut fiber fiber mixed between cocopeat dana cocofiber with a weight of 10 kg each, then gradually filtering each sack, as well as the results of cocopeat and cocofiber produced. Table 1. and Table 2 will test the decomposition capacity of coconut fiber using manual tools and Rotary Screening Machine.

Table 1. Testing Data of Cocofiber and Cocopeat Separation Capacity Manually With Sand Sieve

Dengan Ayakan Pasir

Pengujian ke-	Massa Karung Sabut Kelapa (kg)	Massa Cocofiber (kg)	Massa Cocopeat (kg)	Waktu Pemisahan (menit)
1	10	8,2	1,8	40
2	10	8,5	1,5	38
3	10	8,3	1,7	40

Table 2. Manually Cocofiber and Cocopeat Separation Capacity Testing Data With Rotary Screening Machine

Pengujiann ke-	Massa Karung Sabut Kelapa (kg)	Massa Cocofiber (kg)	Massa Cocopeat (kg)	Waktu Pemisahan (menit)
1	10	8	2	8
2	10	7,5	2,5	10
3	10	7,1	2,9	10

Account

1. Manual Calculation of Cocofiber and Cocopeat Separation Capacity With Sand Sieve

Massa cocofiber rata-rata $= \frac{\text{Percobaan 1+Percobaan 2+ Percobaan 3}}{3}$

$= \frac{8{,}2\text{ kg} + 8{,}5\text{ kg} + 8{,}3\text{ kg}}{3}$

= 8,3 kg

Massa cocopeat rata-rata $= \frac{\text{Percobaan 1+Percobaan 2+ Percobaan 3}}{3}$

$= \frac{1{,}8\text{ kg} + 1{,}5\text{ kg} + 1{,}7\text{ kg}}{3}$

= 1,7 kg

Waktu pemisahan rata-rata $= \frac{\text{Percobaan 1+Percobaan 2+ Percobaan 3}}{3}$

$= \frac{40\text{ menit} + 36\text{ menit} + 40\text{ menit}}{3}$

= 39,3 menit

Kapasitas Pemisahan/hari $= \frac{\text{Massa Bahan (kg)}}{\text{Waktu pemisahan rata} - \text{rata } (menit)}$

$= \frac{10\text{ kg}}{39{,}3\text{ menit}}$ x 60 menit x 8 jam kerja

= 122 kg/hari

2. Calculation of Cocofiber and Cocopeat Separation Capacity With Rotary Screening Machine

Massa cocofiber rata-rata $= \frac{\text{Percobaan 1+Percobaan 2+ Percobaan 3}}{3}$

$= \frac{8\text{ kg} + 7{,}5\text{ kg} + 7{,}1\text{ kg}}{3}$

= 7,5 kg

Massa cocofiber rata-rata $= \frac{\text{Percobaan 1+Percobaan 2+ Percobaan 3}}{3}$

$= \frac{2\text{ kg} + 2{,}5\text{ kg} + 2{,}9\text{ kg}}{3}$

= 2,5 kg

Waktu pemisahan rata-rata $= \frac{\text{Percobaan 1+Percobaan 2+ Percobaan 3}}{3}$

$= \frac{8\ menit + 10\text{ menit} + 10\text{ menit}}{3}$

= 9,3 menit

Kapasitas Pemisahan/hari $= \frac{\text{Massa Bahan (kg)}}{\text{Waktu pemisahan rata} - \text{rata } (menit)}$

$= \frac{10\ kg}{9{,}3\text{ menit}}$ x 60 menit x 8 jam kerja

= 516,2 kg/hari

3. Separation Efficiency Calculation

$$\text{Efisiensi } (\eta) = \frac{Kapasitas\ \ per\ hari\ (Rotary\ \ Screening\ \ Machine)}{Kapasitas\ \ per\ hari\ (Manual\ )} \text{ x } 100\%$$

$$= \frac{516{,}2\ kghari}{122\ kg/hari} \text{ x } 100\%$$

$$= 423\%$$

or 4.2 times more production capacity using a Rotary Screening Machine than manually. To find out the performance of the coconut fiber decomposition machine, it is necessary to carry out tests. This test is compared to testing using manual equipment (sand sieve) that partners usually use for cocofiber production. The test was carried out with coconut fiber material weighing 10 kg for 3 tests. The results of weighing the materials and the results of the 2 products after separation were weighed respectively.

The test carried out with a sand sieve on 3 repetitions resulted in an average cocofiber period of 8.3 kg and cocopeat of 1.7 kg. Meanwhile, the average time required to separate 10 kg of material is 39.3 minutes.

Meanwhile, the test carried out with the Rotary Screening Machine on 3 repetitions resulted in an average cocofiber period of 7.5 kg and cocopeat of 2.5 kg. Meanwhile, the average time required to separate as much as 10 kg of material is 9.3 minutes.

Based on the results of the comparative calculation of the two tool methods used, it was found that the production capacity per day for the sand sieving tool is 122 kg/day if the work is carried out 8 hours non-stop. It is estimated that the most feasible estimate to carry out this manual separation is a maximum of 100 kg/day only due to the limited human labor factor. Meanwhile, the production capacity per day for the Rotary Screening Machine is 516.2 kg/day. This figure is much more efficient than the production capacity of manual tools. The results show that the performance of the Rotary Screening Machine which is planned to have a capacity of 500 kg/day has been proven to be met.

CONCLUSION

After going through the testing process on the cocopeat (powder) and cocofiber (fiber) separation machine from coconut coir, the Rotary Screening machine is proven to be able to separate cocopeat and cocofiber from coconut coir that is fed into the machine in a faster time than using manual tools. Cocofiber and cocopeat come out on each of the different channels. Cocopeat comes out at the filter channel and is accommodated at the bottom of the machine, while cocofiber comes out at the front channel (outlet) of the Rotary Screening Machine tube. Based on the test results, it was found that the Rotary Screening machine is much more efficient 4.2 times than using a manual tool. It is estimated that the most feasible estimate to carry out this manual separation is a maximum of 100 kg/day only due to the limited human labor factor. Meanwhile, the production capacity per day for the Rotary Screening Machine is 516.2 kg/day.

ACKNOWLEDGEMENTS

The author would like to express his sincere gratitude and appreciation to the Ministry of Research, Technology, and Higher Education of the Republic of Indonesia and the Lhokseumawe State Polytechnic.

REFERENCES

[1] Bambang Setiaji, A.H., 2011, Agricultural Post-Harvest Technology Bulletin, Volume 7, No.2.

[2] Investment Coordinating Board, 2015, Coconut Potential in North Aceh Regency. North Aceh in Numbers, 2012.

[3] Syakir, M. 2011. Technological innovation supports the development of national natural fibers. Retrieved January 30, 2013. Available in http://perkebunan.litbang.deptan.go.id/

[4] Purnomo, H., Janari, D. and Widananto, H. (2013). Design of a three-stage coconut coir breaking machine with a participatory approach. Proceedings of the 8th National Seminar on Mechanical Engineering. Petra Christian University Surabaya.

[5] Darmanto. (2011). Increasing the Strength of Coconut Fiber Fibers with Silane Treatment. Retrieved January 30, 2013. Available at http://eprints.undip.ac.id/

[6] Suriyadi & Yohanes. (2017). Design of Coconut Coir Decomposition Machine Based on Quality Function Deployment (QFD) Method. JOM FTEKNIK, 4(2).

[7] Hari Purnomo & Dian Janari. (2015). Design and Construction of Coconut Coir Peeling, Shredding and Sieving Machine. Sp

[8] Hardik Widananto & Hari Purnomo. (2013). Design of Coconut Coir Peeling Machine Based on Participatory Ergonomics. IENACO National Seminar, ISSN: 2337-4349.

[9] Putu Ananta Widhia Dharma, Anak Agung Ngurah Gede Suwastika, & Ni Wayan Sri Sutari. (2018). Study on the Utilization of Coconut Coir Waste into Local Microorganism Solutions. E-Journal of Tropical Agroecotechnology, 7 (2), ISSN: 2301-6515.

[10] Muh Amin & Samsudi R. (2010). The use of coconut fiber waste as a material for making helmets for two-wheeled vehicle drivers. Proceedings of the National Seminar, 314 – 318, ISBN : 978.979.704.883.9

[11] Enda Apriani. (2017). Analysis of the Effect of Variation in the Composition of Waste Materials from Young Coconut Fibers, Banana Stems and Waste Paper on the Bending Strength of Composite Boards. Jurnal Engine, 1(2), 38-46, eISSN 2579-7433.

[12] Sepriyanto. (2018). Coconut Coir Decomposer with Portable Blade to Produce Cocofiber and Cocopeat. Journal of Civronlit, 3(1).

[13] Priono Handoko, et al. 2019. Design of Coconut Fiber Chopper with Electric Motor Drive.Engine Journal Volume 3 No.1, E-ISSN: 2579-7433 , pp 23-28.

[14] Sato.G Takeshi & N.Sugiarto Hartanto. 2013. Drawing Machine According to ISO Standard. Jakarta: Balai Pustaka.

[15] Sepriyanto & Emmistasega Subana. 2018. The Effect of Machine Rotation Speed on the Yield of Coco Fiber and Coco Peat Coconut Fruit from the Jambi Region.Innovator Journal, Volume 1, Number 1, ISSN 2615-5052 (Online), pp 10-15.