p-ISSN: 2301-6663, e-ISSN: 2477-250X
URL: http://ojs.ummetro.ac.id/index.php/turbo

The effect of blade density variation to cocopeat mass that produce by Poltesa cocopeat machine

Pande Putu Agus Santoso[1*], Iklas Sanubary[2], Diah Mahmuda[3]

[1, 2, 3] Politeknik Negeri Sambas
Program Studi D-4 Teknik Mesin Pertanian, Politeknik Negeri Sambas.
Jl. Raya Sejangkung, Sambas, 79462, Kalimantan Barat, Indonesia.
*Corresponding author: pande.santoso@gmail.com

Abstract

Cocopeat machines that have been developed today, were carried out with variations in the speed of rotation, blade length, blade shape, and treatment of objects (coconut coir immersion). There has been no development of a cocopeat machine that focuses on variations of blade density. It is suspected that the blade density affects to the difference of cocopeat mass produced. This study was a true experiment. The dependent variable was cocopeat mass. The independent variables were blade density, consisting of σ_1 (84/210π), σ_2 (42/210π) and σ_3 (21/210π). For each variation of the independent variable was conducted 10 experiments. The study sample was 30 pieces of coconut coir. The mass of each coconut coir was 50 grams. The engine's spin speed, length and blade shape, are the same for all samples. The data was analyzed using the t test at a significance level of 5%. The average mass values of cocopeat were σ_1 ($\bar{y}_1$ = 16.5430; S_1 = 1.9674), σ_2 ($\bar{y}_2$ = 12.2650; S_2 = 1.8341) and σ_3 (μ3 = 10.0988; SD = 1.8943). The t test showed that the difference in the average value of cocopeat mass between groups were t_{o12} = 5,030; t_{o23} = 2,598; and t_{o13} = 7,462. If t-table value for ν = 18 was 2,101, so $t_o > t_{\alpha/2,\nu}$. H_o was rejected and H_1 accepted, so there was a difference of cocopeate mass that produced by poltesa cocopeat machine, which is effected by variations of blade density.

Keywords: blade density, cocopeat mass, machine, variation.

Introduction

Indonesia was a tropical country with a long coastline. One of the vegetation that grows in abundant quantities in Indonesia was coconut. Coconut coir is the largest part of coconut fruit, which was about 35% of the coconuts weight. Today coconut coir is still assumed to be residue. If calculated mathematically, there were about 6.4 million tons of untapped coconut coir waste [1]. Basically, coconut coir can be separated and produce coir fiber (cocofiber) and coir powder (cocopeat) [2]. Cocopeat is a good organic material used as a planting medium. The advantages of cocopeat when used as a planting medium was able to store water optimally, containing essential nutrients, such as calcium (Ca), magnesium (Mg), potassium (K), sodium (N), and phosphorus (P) [3].

Today the process of cocopeat production was carried out using a cocopeat machine. There have been many cocopeat machines developed in various regions. Parulian (2020) has successfully tested the performance of the coconut coir separating machine by performing variations in the speed of engine rotation. It was revealed that the effective capacity of the engine's rotary speed occurs at 1200 rpm (43.39 kg/h) to 1600 rpm (55.94 kg/h) [4]. Sepriyanto (2018) has developed a coconut coir separation with a portable blade (removable cut knife) to produce cocofiber and cocopeat. The number of blades varied were 5 blades and 10 blades, with variations in separation time is 1 minute, 2 minutes, 3 minutes, 4 minutes, and 5 minutes. The result recommended to use 10 blades with a separation time of 5 minutes [5]. Sepriyanto and Subama (2018) revealed that the longer of immersion, influence the percentage of coco coir separate into cocofiber and cocopeat [6]. Safii (2020) has developed a coconut coir separator machine with variations in the rotary speed and shape of the blade. The results showed that, the higher the engine's rotary speed, the shorter the time it takes to produce cocopeat. In addition, variations in the shape of the blade also affect the mass of cocofiber and cocopeat produced [7]. Lesmana and Rahman (2020) have designed and developed a coconut coir separator machine into a cocopeat using two sieves with mesh numbers 10 and 40. The sieve can swing automatically along with the rotation of the 0.5 HP electric motor [8].

Based on a number of cocopeat machines that have been developed above, it can be concluded that the development process is still done by varying the spin speed, number of blades, the shape of the blade, and treatment of objects (coconut coir immersion). There has been no research that focuses its attention on variations in the blade density of machine. The idea of the authors in this study was the development of cocopeat machines with variations in blade density. The purpose of this study was to describe the effect of blade density variations to cocopeat mass that produce by *poltesa* cocopeat machine.

Literature Review

Cocopeat was a by-product and constitutes the lion's share of coconut fruit, which is about 35% of the weight of coconut fruit [9]. Cocopeat has a high water shelf life. Coconut husk powder has a moisture content and water shelf life of 11.9% and 69.54% [10]. So it can be concluded that cocopeat was coconut husk powder, which is a by-product of coconut fruit and can be used as a planting medium, because it has good water storage. The illustration of cocopeat is presented in figure 1 below.

Figure 1. *Cocopeat*

Coconut husk decomposing machine was a machine that functions to decompose or separate coconut fruit fibers from a layer of sponge or powder, so that the two products produced can be utilized as desired. The principle of this coconut husk decomposer was to beat and tear until the fiber part is separated with powder from coconut husk that has been fed to the decomposing machine [2].

The decomposing rod (balnd) was the main component of the coconut husk decomposing machine which functions to beat and break the coconut husk so that the cocopeat attached to the coir fibers is released. The greater the density value of the decomposing rod, the greater the amount of cocopeat produced. The greater the density value of the decomposing stem, the higher the frequency of coconut husk being hit and torn apart by the decomposing stem. This has implications for the increasing quantity of cocopeat produced [11].

Methods

In general, this research consists of two stages, namely the manufacture of cocopeat machines and tests its performance through experimental research. The variables in experimental testing process were dependent and independent variables [9]. In this study, the dependent variable was cocopeat mass. The independent variables were the blade density, namely ($84/210\pi$), ($42/210\pi$) and ($21/210\pi$). The machine's spin speed, blade length, blade shape, and initial weight of each sample (50 g), were equalized to all data groups.

The data collection techniques in this study were as follows. (1) Preparing the samples, where group 1 ($\sigma_1 = 84/210\pi$): 10 samples x 50g, group 2 ($\sigma_2 = 42/210\pi$): 10 samples x 50g and group 3 ($\sigma_3 = 21/210\pi$): 10 samples x 50g coconut coir. (2) The process of collecting data (each sample was entered into a cocopeat machine for 1.5 minutes). (3) Measure research results (cocopeat and residual) with digital balance. (5) Analysis the data using t test.

This study investigated the effect of blade density (independent variable) to cocopeat quantities (dependent variables). The test process was conducted by comparing the average of cocopeat mass in each experimental group. The average was presented in equation 1.

$$\overline{\mu} = \frac{\sum_{i=1}^{10} \mu_i}{10} . [12] \quad (1)$$

The relative error value is calculated using standard deviations such as equations (2).

$$S_{\mu} = \sqrt{\frac{\sum_{i=1}^{10} (\mu_i - \overline{\mu})^2}{10-1}} . [12] \quad (2)$$

To ascertain whether the difference in blade density really affects to cocopeat mass, a statistical test was performed with the t test. Graphically the chart of the statistical analysis process was presented in figure 2.

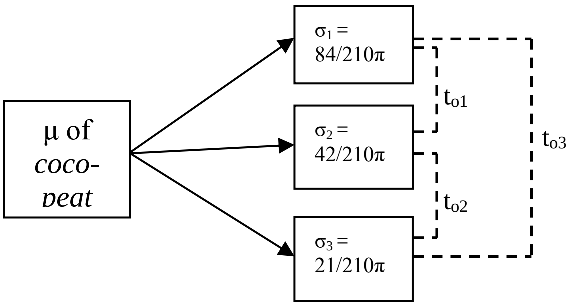

Figure 2. Statistical analysis process chart

The t-test was used because the study compared the mean between two data groups whose variants were not yet known [12]. T-test formula presented in equation (3).

$$t_o = \frac{\bar{y}_1 - \bar{y}_2}{S_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} , [12] \quad (3)$$

where $\bar{y}_1$ and $\bar{y}_2$ is mean of each cocopeat mass from each group was tested. n_1 and n_2 the amount of data on each sample tested (10 pieces). S_p^2 is an estimation of common variants formulated such as equations (4). (4).

$$S_p^2 = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}$$

and $S_p = \sqrt{S_p^2}$. [12] (4)

The form of test variations and statistical hypotheses were presented in Table 1.

Table 1. Variations in tests and research hypotheses

	Versus	Kinds	
		σ_1 = 84/210π	σ_2 = 42/210π
Kinds	σ_2 = 42/210π	H_o: $\mu_1 = \mu_2$ H_1: $\mu_1 \neq \mu_2$	
	σ_3 = 21/210π	H_o: $\mu_1 = \mu_3$ H_1: $\mu_1 \neq \mu_3$	H_o: $\mu_2 = \mu_3$ H_1: $\mu_2 \neq \mu_3$

Based on table 1, μ_1 is mean of cocopeat mass that produce by blade density σ_1 = 84/210π, μ_2 is mean of cocopeat mass that produce by blade density σ_2 = 42/210π and μ_3 is mean of cocopeat mass that produce by blade density σ_3 = 21/210π. Sign "=" it states "there was no difference" and the sign "≠" states "there was a difference". The criteria for rejection of the hypothesis was: reject Ho if $|t_o| > t_{\alpha/2}, v$. The value of $t_{\alpha/2}, v$ obtained from the statistical table where α that used in this research was 0,05 and $v = n_1 + n_2 - 2$ [12].

Results and Discussions

This research began with the manufacture of cocopeat machines in the Workshop of the Department of Mechanical Engineering of Sambas State Polytechnic, from July to September 2021. The process of machine manufacturing was presented in figure 3, 4, 5, 6, and 7.

Figure 3. Frame manufacturing.

Based on figure 3, the frame manufacturing was done by cutting the L iron, l = 55 cm x 2 pieces, l = 24 cm x 2 pieces, l = 40 cm x 4 pieces, and l = 75 cm x 4 pieces. Furthermore, the pieces of iron are put together using a welding machine.

Figure 4. Blade holder.

Based on figure 4, blade holder was made from pipe iron (hollow) with 21 cm of length and 10 cm of diameter. Blade holder was perforated 84 points symmetrically and evenly on all side. In each hole was installed bolts, as a blade. The number of these blades can be increased or reduced by removing or installing bolts.

The decomposing rod in this study was a 10 mm bolt. These bolts are evenly fixed on the available holes in the decomposing rod holder. The number of these decomposing rods can be reduced (by removable means) or increased (by installation) according to research needs. Based on this, this tool is also called "bland portable".

Figure 5. Assemble the drive components.

Figure 5 was the process of stringing shafts, decomposing rod holders and pilo. The shaft is joined by the middle point of the decomposing rod holder by welded. Next, the ends of the shaft are inserted into the pilo.

Figure 6. Stringing tools

Based on figure 6, the components of the tool, which were skeletons and decomposing rod mounts, were put together. Furthermore the mount end of the decomposing rod was joined with the engine-related pulley (dynamo 1/4 Hp; 1400 rpm; 220V; 2.6A; 0.18 kW).

Figure 7. Functional test of the tool.

Based on figure 7, Poltesa cocopeat machine has been produced with characteristics: length = 65 cm, width 50 cm, and height 78 cm. This machine has a portable blade, in the form of 10 mm bolts. This blade was attached to a hollow tube-shaped holder, with a length of 21 cm and a diameter of 10 cm. The surface area of the blade holder was 210π cm2. This engine is driven by a 1/4 Hp dynamo with a rotary speed of 1400 rpm. The diameter of a small pully (near the dynamo) was 2.5 in and the diameter of a large pully (near the blade holder shaft) was 5 in.

The research data was the mass of cocopeat obtained from the results of separation using the *poltesa* cocopeat machine. The process of collecting research data is presented in table 2.

Table 2. The process of retrieving research data

Activities	Documentation
Preparing research samples (inputs)	
Adjusts the density of the decomposing rod. Group 1 ($\sigma 1 = 84/210\pi$).	 Group 1
Group 1 ($\sigma 1 = 84/210\pi$).	 Group 2
Group 1 ($\sigma 1 = 84/210\pi$).	 Group 3
The process of collecting research data	
Output (cocopeat and residual)	
Measure using digital balance	

Based on the data collection process that has been done, the results of the study are presented in table 3.

Table 3. Research result

No	Initial mass (gr)	Group 1 (gr)		Group 2 (gr)		Group 3 (gr)	
		cocopeat	residual	cocopeat	residual	cocopeat	residual
1	50	15,12	34,88	15,61	34,39	9,06	40,94
2	50	15,29	34,71	14,64	35,36	7,69	42,31
3	50	18,61	31,39	12,47	37,53	7,70	42,30
4	50	16,23	33,77	11,13	38,87	10,33	39,67
5	50	13,13	36,87	11,55	38,45	10,22	39,78
6	50	18,13	31,87	11,77	38,23	13,88	36,12
7	50	17,69	32,31	11,58	38,43	9,37	40,63
8	50	17,31	32,69	12,83	37,17	10,34	39,66
9	50	19,24	30,76	12,06	37,94	12,28	37,72
10	50	14,68	35,32	9,02	40,99	10,13	39,87
$\overline{\mu}$	'a-ta”	16,54	33,46	12,27	37,73	10,10	39,90
S_{μ}	SD	1,97	1,97	1,83	5,53	1,89	7,81

Base on the value of $\overline{\mu}$ dan S_{μ} from each sample group at table 4, so we done t test. It aims to compare the average mass of cocopeat produced by the machine with the blade density variation of $\sigma_1 = 84/210\pi$; $\sigma_2 = 42/210\pi$; and $\sigma_3 = 21/210\pi$. As for the results of the t test analyst presented on table 4.

Table 4. Results of t-test analysis

No	t-tes	$\overline{\mu}_a$	$\overline{\mu}_b$	t_o	$t_{\frac{\alpha}{2},v}$	Decisiom
1	t_{o1}	16,54	12,27	5,030	2,101	H_o rejected
2	t_{o2}	12,27	10,10	2,598	2,101	H_o rejected
3	t_{o3}	16,54	10,10	7,462	2,074	H_o rejected

Based on table 4, it can be inferred that cocopeat mass produced by machines whose blade density was varied is different. This indicates that, blade density affects the quantity of cocopeat produced by the machine. It is known that, the engine's spin speed was 1400 rpm, the diameter of the small pully (near the engine) was 2.5 in and the diameter of the large pully (near the blade) was 5 in, so the blade spin speed for all three sample groups was 2800 rpm. The separation time for each sample of coconut coir, in all three groups, was the same as 1.5 minutes. The initial mass of each sample of coconut coir that is used as input in this machine was same as 50 gr. Since other variables such as engine rotary speed, separation time and initial mass of coconut coir were kept constant, it can be inferred that the difference of cocopeat mass exactly influenced by the difference of blade density.

In addition, when created a graph based on table 4 data, by comparing the average cocopeat and residual mass of each group, the graph is obtained as in figure 8.

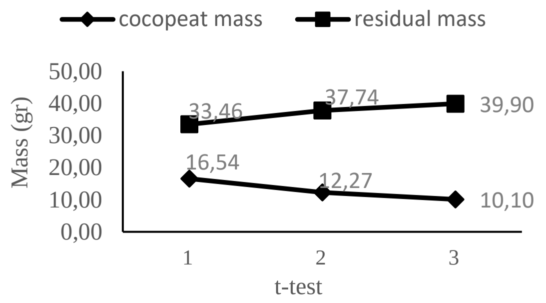

Figure 8. Cocopeat and residual mass comparison chart.

Based on figure 8, it was seen that the higher of blade density, the mass of cocopeat produced will also be greater. Based on the graph it appears that the highest average cocopeat mass produced by blade density group 1 (σ1 = 84/210π) produces 16.54 gr, followed by group 2 (σ2 = 42/210π) produces 12.27 gr and group 3 (σ3 = 21/210π) produces 10.10 gr.

The opposite occurs in residual masses (coconut coir that has not been separated). The higher the blade density, the lower the residual mass. Based on the graph it appears that the lowest average residual mass produced by group 1 (σ1 = 84/210π) with 33.46 gr, followed by group 2 (σ2 = 42/210π) produces 37.74 gr and group 3 (σ3 = 21/210π) produces 39.90 gr.

Basically, the higher the blade density has an impact on the higher the intensity of coconut coir separated by the blade. For example, in one engine rotation, blade density σ1 tore coconut coir 84 times, blade density σ2 tore coconut coir 42 times and blade density σ3 tore coconut coir 21 times. The number of separations experienced by coconut coir in one engine rotation we call by the term frequency. With another statement it can be inferred that, if the frequency was higher, the speed of coconut coir separation will also be greater. This fact was suitable with some previous research, which stated that the speed of separation was proportional to the quantity of cocopeat produced by the machine [4][7].

Blade density is also related to the distance between blades. If the distance between blades be smaller (high blade density) the mass of cocopeat produced be greater. The distance between blades, determined by their number indirectly. When the number of blades in a shaft increases, the distance between blades decreases. This is supported by the results of other studies, that if the number of blades increases then the quantity of cocopeat produced will also be greater [5].

Conclusions and Suggestions

Based on the results of research and discussions that have been done, it can be concluded that there was a difference in cocopeat mass produced by *poltesa* cocopeat machine, whose blade density was varied. With an initial mass of 50 gr and a separation time of 1.5 minutes, a machine with a blade density (84/210π) was able to produce a cocopeat with an average mass of 16.54 gr. Machines with blade densities (42/210π) produce cocopeats with an average mass of 12.27 gr. Machines with blade density (21/210π) produce cocopeats with an average mass of 10.10 gr. The t test showed that the difference in the average value of cocopeat mass between groups were t_{o12} = 5,030; t_{o23} = 2,598; and t_{o13} = 7,462. If t-table value for ν = 18 was 2,101, so $t_o > t_{\alpha/2, \nu}$ H_0 was rejected and H_1 accepted, so there was a difference of cocopeat mass that produced by *poltesa cocopeat* machine, which is effected by variations of blade density.

The suggestions that can be submitted, the further research was needed by developing machines with greater capacity. In addition, further research also needs to do variations in the speed of spin, blade length, separation time, and humidity of coconut coir. It is expected that if the ideal conditions of physical variables from cocopeat machines was discovery, in the future it can be developed an effective and efficient machine.

Acknowledgments

The author's thanks go out to Mr. Romabon, A,Md., who has assisted the author in the manufacture of this cocopeat machine. In addition, the author also expresses his gratitude to P3M Sambas State of Polytechnic, which has provided funding for the implementation of this research through an internal research program of lecturers.

Reference.

[1] Tyas, E. W. dan Zulaikha, E. 2018. Pengembangan material serat sabut kelapa untuk home decor. *Jurnal Sains dan Seni*. 7(2): 2337 – 3520.

[2] Supriyanto dan Subama, E. 2018. Pengaruh lama perendaman sabut kelapa terhadap hasil cocofiber dan cocopeat buah kelapa dari daerah jambi. *Jurnal Innovator*. 1(2): 22 – 25.

[3] Ramadhan, D., Riniarti dan Santoso, T. 2018. Pemanfaatan *cocopeat* sebagai media tumbuh sangon laut (*Paraserianthes falcataria*) dan merbau darat (*Intsia palembanica*). *Jurnal Sylva Lestari*. 6(2): 22 – 31.

[4] Parulian, R.H. 2020. Uji kinerja mesin pengurai sabut kelapa pada beberapa jenis bahan dan kecepatan putar mata pisau yang berbeda. *Skripsi*. Program Studi Teknik Pertanian, Jurusan Teknologi Pertanian, Fakultas Pertanian, Universitas Sriwijaya. Indralaya.

[5] Sepriyanto. 2018. Alat pengurai sabut kelapa dengan blade portable untuk menghasilkan *cocofiber* dan *cocopeat*. *Jurnal Civronlit Universitas Batanghari*. 3(1): 46 – 54.

[6] Sepriyanto dan Subama. 2018. Pengaruh lama perendalam sabut kelapa terhadap hasil *cocofiber* dan *cocopeat* buah kelapa dari Daerah Jambi. *Jurnal Inovator*. 1(2): 22 – 25.

[7] Safii. 2020. Pengaruh variasi kecepatan putaran dan bentuk mata pisau mesin pengurai sabut kelapa terhadap kapasitas produksi. *Skripsi*. Program Studi Teknik Mesin, Fakultas Teknik, Universitas Muhammadiyah Sumatera Utara. Medan.

[8] Lesmana, I G. E. dan Rahman, R. 2020. Perancangan mesin pengurai sabut kelapa menjadi *cocopeat*. *Seminar Nasional Rekayasa Teknologi (Semrestek 2020).* Jakarta: 25 – 26 November 2020. Hal. 41 – 50.

[9] Astuti, K. H. dan Kuswytasari N.D. 2013. Efektifitas pertumbuhan jamur tiram putih (*Pleurotus ostreatus*) dengan variasi media kayu sengon (*Paraserianthes falcataria*) dan sabut kelapa (*Cocos nucifera*). *Jurnal Sains dan Seni Pomits*. 2(2): 2337 - 3520.

[10] Hasriani, Kalsim, D. K. dan Sukendro, A. 2013. *Kajian serbuk sabut kelapa (cocopeat) sebagai media tanam*. Institut Pertanian Bogor. Tersedia pada: https://dedikalsim.wordpress.com/.

[11] Sepriyanto. 2018. Alat pengurai sabut kelapa dengan blade portable untuk menghasilkan *cocofiber* dan *cocopeat*. *Jurnal Civronlit Universitas Batanghari*. 3(1): 46 – 54.

[12] Montgomery, D. C. 2013. *Design and analysis of experiments eigth edition*. John Wiley & Sons, Inc: Arizona.

[13] Budiyanto, E., Yuono, L. D., & Farindra, A. (2019). Upaya peningkatan kualitas dan kapasitas produksi mesin pengupas kulit kopi kering. *Turbo: Jurnal Program Studi Teknik Mesin*, *8*(1).

[14] Setiawan, A., Dharma, U. S., & Budiyanto, E. (2020). Pengaruh jenis bahan dan jumlah gigi perontok terhadap kinerja mesin thresher sebagai perontok padi. *ARMATUR:*

Artikel Teknik Mesin & Manufaktur, *1*(1), 25-34.