Design For Devices Of Training Producing Oil Palm Empty Fruit Bunch (OPEFB) Fiber

Batumahadi Siregar, Nizwardi Jalinus, Sumarno

ABSTRACT: Job preparation skills of graduates of vocational education in particular Diploma Three mechanical engineering can be achieved through the development of a project-based training model. Output of project-based training in the form of application products. Producing application products would require the selection of effective and efficient projects and traine tools. Oil Palm Empty Fruit Bunch (OPEFB) is waste from the Palm Oil Mill (POM) which is still widely open to be developed as a reinforcing material in composite materials. To achieve the objectives of this study, a OPEFB decomposition machine was required. The design of this OPEFB decomposition machine includes the main components, namely the chopping knife, the retaining knife, the decomposition and the filter to produce the OPEFB fiber. The manufacturing technology chosen in the design of this tool includes several working steps, namely cutting technology, machining, forming, joining, and assembly. The result obtained from this research activity is in the form of a OPEFB decomposition tool unit in OPEFB fiber. From all series of tool design activities in this research, it can be concluded that the resulting tools can function optimally in the production of OPEFB fiber and can be used as a project-based training device.

Key Words: Training Tools, OPEFB, Breakers, Project Based Training

Introduction

Oil Palm Empty Fruit Bunch (OPEFB) waste is the strongest waste generated by the palm oil industry, which accounts for about 22-23% of total processed fresh fruit (FFB). The total amount of OPEFB waste throughout Indonesia in 2009 is estimated at more than 4.2 million tonnes (Wardani, 2012). Heat insulation is a method or process used to reduce the rate of heat / heat transfer. Heat or heat energy (heat) can be moved by conduction, convection and radiation or in case of change of shape. The heat flow can be controlled by a thermal insulation process, depending on the properties of the material used. The material used to reduce the rate of heat transfer is called insulation or insulation. The heat can escape despite efforts to cover it, but the insulation reduces the heat removed (Bergman, 2011: 156). In the development of technology, various types of materials can be used as thermal insulators and do not exclude that fibers and natural waste can also be developed as a composite material as a thermal insulator. From various issues of oil palm development, BAPPENAS, 2010 informs that one of the palm oil mines is the problem of technology. OPEFB is generally used for organic fertilizers. Untreated OPEFB can cause a bad odor and can cause fungi that can damage surrounding plants. To reduce the negative impact with the growing amount of Palm Oil Mill (POM) waste, a new breakthrough is needed using OPEFB as an alternative material in the thermal insulation composite materials industry. On the basis of the problems described above, the researcher considers it necessary to carry out research on the development of solid waste POM in the form of OPEFB which will be used as application of engineering products, that is to say of composite material thermal insulator.

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To carry out this research, research facilities and infrastructures such as OPEFB fiber processing equipment would be required, as it is necessary to design tools to break down OPEFB to OPEFB fibers.

Literature review

Oil Palm Empty Fruit Bunch (OPEFB)

OPEMFB is the most solid waste generated by the palm oil industry, about 22-23% of the total fresh processed fruit diet, OPEFB is a type of palm oil waste generally recycled to produce energy. The OPEFB waste treated the preliminary results of the POM survey in a POM-2 Tanjung Morawa Kuala Sawit POM-2 garden with a treatment capacity of 30 tonnes TBS / hour. As a waste containing a very high lignocellulosic material. OPEFB to date have not been used optimally. During this burnt OPEFB and ashes are used as fertilizer. In addition, the economic value is relatively low. OPEFB contain a lot of fiber in addition to other substances. Part of a lot of fibrous or rich cellulose makeup is the base and the sharp ends and hard. In general, the physical properties and morphology of OPEFB fibers are shown in Table 1.

Table 1. Physical Properties and Morphology of Oil Palm Bunches (Darnoko, 1995)

Parameters	Oil Palm Empty Fruit Bunch (OPEFB)	
	The base	The tip
Fiber length (mm)	1,20	0,76
Fiber diameter (mm)	15,00	114,34
Wall thickness (mm)	3,49	3,68
Fiber content (%)	72,67	62,47
Non-fiber content (%)	27,33	37,53

Fiber

Fiber is a material that is generally much stronger than the matrix and serves to provide tensile strength, while the matrix serves to protect the fiber from environmental effects and collision damage. Many fibers can be used to enhance composite properties. Natural fibers can become fillers in the composite due to their cellulose content, some natural fibers that contain cellulose such as kenaf, sugar cane, maize, abaca, rice, hemp and d 'other. (Goda, et. al., 2007 and Akil, et. al., 2011). Fiber Palm Oil (EPB) is chosen because it is in abundance. In addition, the use of EPB which is a by-product of POM that can alleviate the problem of POM solid waste disposal is known for its long history as an enhancer in polymeric composites (Akil, et al. , 2011). Although tensile strength and natural modulus of elasticity are not as good as fiberglass, tensile strength and modulus of elasticity are close to fiberglass, giving the opportunity to replace glass fibers by reinforcers (Goda et al 2007). In general, the mechanical properties of the thermoplastic reinforced natural fibers and the results of the thermosetting composite tests show an improvement by adding natural fibers as reinforcement. Polylactic acid (PLA) based composites showed significant improvements in both tensile and flexural strength while polystyrene (PS) and epoxy (EP) composites were virtually unchanged or only slightly improved observed mechanical properties. Natural fiber reinforced PLA composites have excellent adhesion leading to higher observed forces over PS and EP composites. (W.L. Ngo, et. al., 2014).

Counter Device for OPEFB

The crusher that is planned to build is a machine modified from a machine that has been there. Where there are differences in the machine that will be designed this time using the blade model composite comb. The comb has a cutting angle as an anchor when the core blade is operating. In addition to the comb becomes a barrier, the comb also makes uniform or uniform pieces. The function of the enumeration machine is to cut OPEMFB into a certain size or size that has been defined in the design of the point to be more easily decomposed on the ground.

Chopping knife

The enumeration knife is a component of the huge enumerator of empty bunching of palm oil. Where the enumerator blade a major priority that shows that the machine is used to the maximum. The knife can list the elongation into thin fibrous pieces that can speed up the process of emptying empty palm oil clusters to ensure that the organic fertilizer degrades easily into the soil. With the construction of blades that are intended to have a length of 350 mm, 70 mm wide and 10 mm thick. When the knife uses the ST 39 type with the following equations:

$$M_{pisau\ pencacah} = \rho \times V \quad (1)$$

$$M_{16\ pisau\ pencacah} = \rho \left[\frac{\pi}{4}\left(D^2 - d^2\right)t\right] \quad (2)$$

To achieve the cutting force needed to destroy the extension of palm oil, it is necessary to know the shear stresses that occur. Since there is no data to explain the shear stress of empty oil palm clusters, this equates to the maximum shear stress of the wood. The maximum stress of shearing wood (Felix, 1964:9):

$$(\tau g) = 20\ Kg/cm^2 \times g = 0{,}2\ Kg/mm^2 \times g \quad (3)$$

The amount of friction force needed to destroy palm oil, that is:

$$F = \tau g \times a \quad (4)$$

Knife holder

He retaining knife is part of the design of the OPEMFB enumerator which aims to keep the clusters empty at the time of cutting by the chopping knife.

Counter shaft

According to (Sularso, 1983; 7) the torque moment as the planning moment on the counting shaft is obtained by the equation:

$$T = 9{,}74 \times 10^5 \frac{P}{n2} \quad (5)$$

$$\tau a = \frac{\sigma B}{Sf1 - Sf2} \quad (6)$$

To determine the diameter of the shaft used (Sularso, 1997: 8) obtained:

$$dS = \left[\frac{5{,}1}{\tau_a} Kt \cdot Cb \cdot T\right]^{1/3} \quad (7)$$

The shear stresses that occur according to (Sularso, 1997: 236) on the blade drive are:

$$\tau g = \frac{16 .\ T}{\pi . ds^2}\ (Kg/mm^2) \quad (8)$$

Driving power

The nominal power or the total power of the driving motor output, and the existence of various factors that may affect the power change, is usually in the planning of the plan power value calculated for the correction factor (fc), so that the plan power (Pd) is formulated as (Sularso 1997: 78):

$$Pd = f c \times P\ (kW) \quad (9)$$

Method

The sketch of the OPEFB envelope motor that is planned to be designed can be seen in Figure 1. Which is a sketch of the OPEFB decomposition machine.

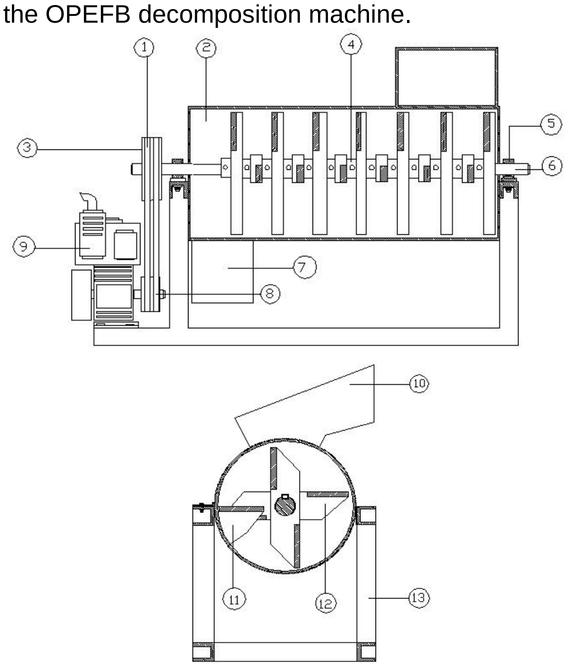

Figure 1. OPEFB Decomposer Sketch

In the design phase of the OPEFB decomposition machine using a blade blade model composed 100 kg / hour capacity. Discuss the calculations by adjusting the work steps according to the plan. The stages of the discussion are; Power Supply Power Planning, Feed Planning for Round Blade Movement, Power Planning for OPEFB Counting, Auxiliary Blade Design and Component Design of the OPEFB Decomposition Machine. To test the step of the tool performed, namely; the preparation of the OPEFB materials obtained from the POM (Figure 2), the placement of the equipment in the form of a single OPEFB decomposition unit (Figure 3), digital balance sheet, chronometer, and other devices. The test is performed by varying the rotation with three variations, namely 1250, 1150 and 1050 rpm.

Figure 2. OPEFB from POM

Figure 3. Set-up of OPEFB tools Stage-1

Results

Counter Device for OPEFB

OPEFB decomposers completed from design results with a capacity of 63 kg/h are shown in Fig. 4

Figure 4. OPEFB Stage-1 toolkit

Testing

In the experiments, it was performed several times by varying the rotation, namely 1000 up to 1250 rpm for several experiments and the results are shown in Table 2.

Table 2. Results of experiments recapitulation

No	Rotary (rpm)	Results of enumeration of OPEFB			
		capacity (kg)	Results of enumeration (kg)		
			Chopped up	Not Chopped	Efficiency (%)
1	1250	79,89	71,38	8,51	89,35
2	1200	78,50	71,35	7,15	90,89
3	1150	72,68	67,28	5,40	92,57
4	1100	68,73	64,26	4,47	93,50
5	1050	65,25	60,45	4,80	92,64
6	1000	62,80	56,54	6,26	90,03

With the results of the counts shown in Figure 5 to Figure 7.

Figure 5. The results of calculations on rotation 1250 rpm

Figure 6. The results of calculations on rotation 1100 rpm

Figure 7. The results of calculations on rotation 1000 rpm

Discussion

From a series of activities, the efficiency of the decomposers as shown in Figure 8 to Figure 10.

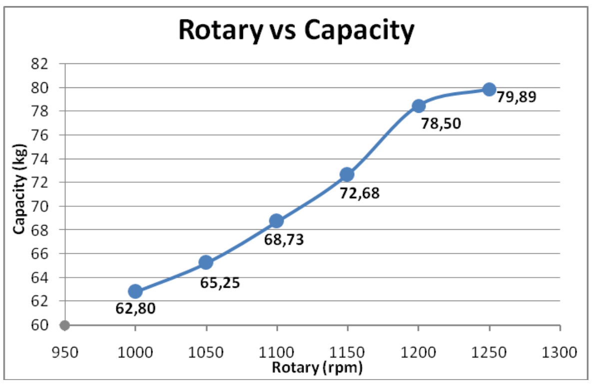

Figure 8. Analysis of the capacity with variation rotation

Figure 8 above indicates that at a rotation capacity of 1250 rpm of 79,89 kg, while the rotation was 1100 rpm, its capacity decreased to 68.73 kg and 1000 rpm capacity decreased to 62,80 kg. This happens because if the engine runs higher then empty packets that are chopped will be more and more.

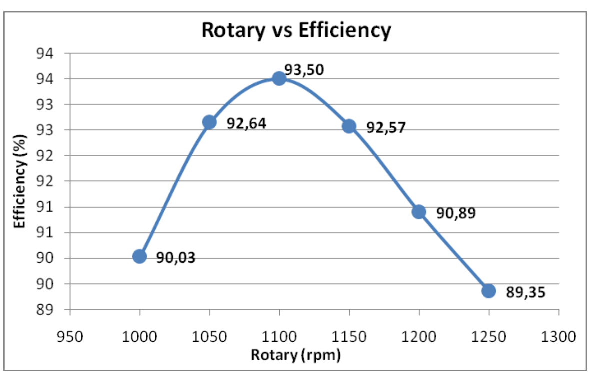

Figure 9. Analysis of the efficiency with variation rotation

Figure 9 gives the information that at 1000 rpm, the rotational efficiency is 90.3%, at 1100 rpm the rotational efficiency up to 93.50% and at 1250 rpm rotation efficiency decreased to 89.352%. This occurs because the lower the rotation, the more empty palm oil clusters will not be minced, and the higher the percentage of count efficiency will increase.

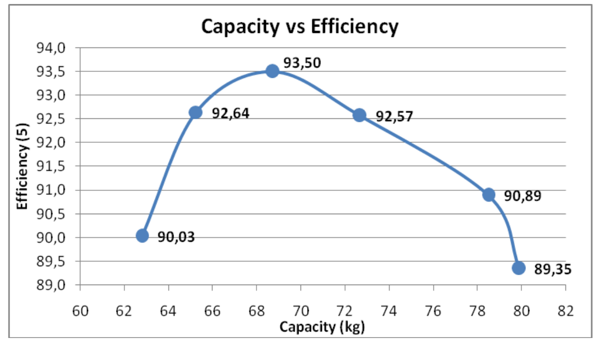

Figure 10. Analysis of efficiency based on capacity

Figure 10. Provides information indicating an efficiency of 62,80 kg to 90.3%, a capacity of 68.73 kg 93.5% efficiency of time and a capacity of 79.89 kg efficiency decreased to 89.35%. This happens because most motor rotation, its capacity decreases and the percentage will increase the efficiency of the enumeration.

Conclusion

From the results of the activities described above can be concluded that:

1. On the driven shaft 1000 rpm, the OPEFB capacity enumeration results is 62,80 kg, with a yield of 90.3%, rotation 1100 rpm, the performance ability of 68.73 kg, with a yield of 93.5% and rotation at 1250 rpm got enumeration capacities of 79,89 kg with a bad efficiency at 89,35%.
2. High Speed, will produce the quantity of chopped lot, but because of the high engine speed, resulting in yield losses account that much anyway. However, the smaller the number of engines, the fewer the number of counts and the lower the number of blocks, and the counting capacity decreases, but the percentage of shrinkage efficiency increases.
3. The results of three experiments, chopped palm oil clusters of empty fruit are not very different because it uses the same engine construction. But with the variation of the turn then it makes the capacity of different counters.

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