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Manufacturing of Milling Machine for Peanut Shell Powder for Youth Organization at Kacangan Hamlet, Kandangan Village, Kediri District,East Java

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ABSTRACT

Kediri is one of city located in East Jawa, with high production of peanut. During harvesting season, peanut processing results peanut shell waste. Meanwhile, peanut shell can be utilized as alternative livestock food source. Therefore, processing method is needed to create peanut shell powder which have economic value and that is grinding process. But, milling machine used by Karang Taruna which domiciled at Kacangan Hamlet is not suitable to produce fine peanut shell powder. This research is conducted to solve Karang Taruna's milling machine problem by designing an effective disk mill machine to produce fine peanut shell powder that can fulfil market demand on daily basis.

Key Words: Peanut Shell, Size Reduction, Disk Mill Machine.

1. INTRODUCTION

Kediri is one of city located in East Java on which is the third largest city after Surabaya (1st) and Malang (2nd) with 67,2 km^2 region are and consist of 3 districts and 46 sub-districts [1]. Kediri is also a region that produce peanut in East Java. Based on Kediri District's Central Bureau Of Statistics, in 2021 Kediri produce 1.562,6 tonnes of peanut [2].

Peanut (Arachis hypogaea L.) in economical context is the second highest economic value after soybean, therefore peanut has high potential to be developed and sold in the food market due to its high demand from society [3]. In peanut processing, it produces a waste which is the peanut shell itself. In the past, usually peanut shells are to be dumped because it has no economic value. But with the development of technology, peanut shell now able to go through some processing to produce a product on which have economic value. One of product that can be produce from peanut shell is peanut shell powder.

Peanut shell powder can be utilized as alternative livestock food source which contain crude protein 9,27% [4]. Therefore, utilization of peanut shell at Kediri creates new business opportunity for society. One of societal component that saw this opportunity is a Youth Organization or "Karang Taruna" on which founded at Kacangan Hamlet, Kandangan Village, Kediri District.

The Youth Organization domiciled at Kacangan Hamlet, on of region that produce peanut. When harvesting season arrive, The Youth Organization handle peanut shell waste to be processed and produce peanut shell powder. This process is using milling machine to grind peanut shell. But, the grinding process still not optimal due to unsuitable milling machine being used. It takes two stages to produce fine peanut shell powder that suitable for livestock food thus prolonged the grinding process duration. Based on interview which conducted with The Youth Organization Chief, they need a new innovation on the milling machine to optimize the process with the goal to reduce grinding process duration to produce fine peanut shell powder.

2. RESEARCH OBJECTIVE

Peanut shells are a waste product that occurred after peeling stage of peanut. Usually, it will be thrown away due to lack of information regarding peanut shells post-processing to produce a product which has economical value. Therefore, there are several studies conducted to utilize peanut shells waste as a material to create a product that has economical value.

Peanut shell can be used to create a biodegradable foam (Biofoam) combined with rice husk, and acts as an alternative to

Styrofoam [5]. Another use of peanut shell is as alternative source of nitrogen in producing *nata de coco* [6], and as furfural material with ohmic heating pre-treatment [7]. This shows peanut shells has potential to be reused to create a product or as an alternative source in certain process.

As one of region that produce peanut, Kacangan Hamlet have potential to boost its economic by utilizing peanut shells waste. Peanut shells can be grinded into fine peanut shells powder that can be used as an alternative livestock food which also has economical value. Therefore, this study is conducted to assist Kacangan Hamlet to increase productivity of fine peanut shells powder by designing a compact milling machine which is easy to move from place to place with little effort while still able to fulfil market demand on daily basis.

3. RESEARCH METHODS

3.1 Size Reduction Process

Size reduction process is a process which cut a raw material into large or small pieces of certain or random shapes. It can be performed by mechanical methods, thus usage of heat is unnecessary. There are several criteria that classifies the end product of size reduction process:

a. Final dimension of end-product of size reduction process.
b. Methods of forces applied during size reduction process.
c. Design of size reduction machines.

There are several methods forces being applied during the size reduction process, thus following criteria could be made such as:

a. Main forces such as compression, shear, and impact.
b. Implementation of forces acting during operation such as pressure and friction between material and tools, shear force acting on material, impact between material and tools, and friction between materials and tools.

Dimension of end product are also shown such as for breaking will result >0.15 cm ; crushing will result 0.15 cm–8 mm ; fine crushing will result 8 mm-750 µm ; milling will result 750 µm-50 µm ; and colloidal and fine milling will produce <50 µm [8].

3.2 Disk Mill Machine

Figure 1. Disk Mill Machine

Disk mill is a machine that utilizes plates to grind raw material into smaller particles. There are two types of plates that being used in disk mill machine, stationary plate and rotating plate. During its operation, when raw material being inserted into the disk mill machine, rotating plate will drag raw material. This dragging will cause raw material to hit milling wall with high speed, causing the material break into smaller particles. Once the particles are small enough to go through mesh installed around those plate, it will come out through lower side of the machine [9].

The screen plays an important role during grinding operation, and most end-product particle size depend on the screen used. As the screen holes diameter decrease, the grinding rate will decrease and required power will increase [10]. Based on the sample given to the researcher, it is planned to use screen with 0,125 mm holes which widely available at local stores.

Based on interview with The Youth Organization Chief, they stated that current disk mill machine that they usually use to grind peanut shell into peanut shell powder takes two stages to be able to produce fine peanut shell powder. Therefore, a new design of milling machine is proposed to solve Karang Taruna difficulties during production of fine peanut shell powder.

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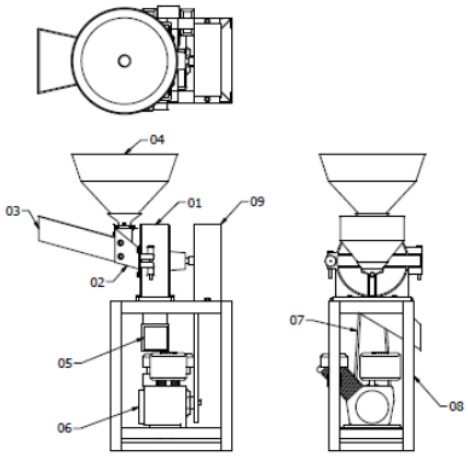

Figure 2. New Design of Disk Mill Machine

The new disk mill design consists of few main components that will be shown in table 1.

Table 1. Disk Mill Machine Components and Specification List

No.	Components	Specification
01	Disk Mill	250 kg/hour production capacity
02	Input Channel	Aluminium 304 thickness 3 mm
03	Input pan	Aluminium 304 thickness 1 mm
04	Input Cone	Aluminium 304 thickness 1 mm
05	Output Channel	Aluminium 304 thickness 0.5 mm
06	Driver Engine	Gasoline engine with 7 HP 2500 rpm
07	V-belt Transmission	A type V Belt
08	Frame	Structural Steel L Profile 40 mm x 40 mm x 3 mm
09	Transmission Cover	ABS Plastic

3.3 Disk Mill

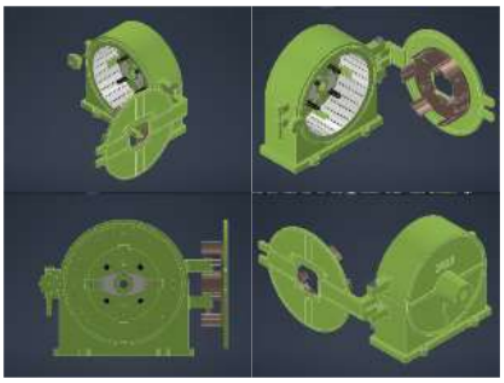

Figure 3. Disk Mill

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The new designed disk mill machine has length of 335 mm, width of 200 mm, and height of 280 mm. Compared to previous disk mill machine, this machine is designed to have 250 kg/hour production capacity. The new machine is also had new rotating plate addition such as four T shaped hammer, four hexagonal hammers, and a blade located at the centre of the rotating plate. This will ensure the milling machine to produce a fine peanut shell powder that will able to go through screen. The rotating plate will spin at a speed of 2800 rpm thus will ensure peanut shell to be grinded easily.

3.4 Input Channel

Figure 4. Input Channel

The input channel will be fabricated using Aluminium 304 plate with thickness of 3 mm. It is designed to be able to support input pan and input cone while being fixed at the disk mill machine door. Input channel will support the input pan with four M12 bolt and nut and will support input cone with three M10 bolt and nuts, while being fixed at the milling door with three M12 bolt and nut. The input channel also have doors at the top and back side to close the channel from input pan and input cone after the milling process has been finished.

3.5 Input Pan

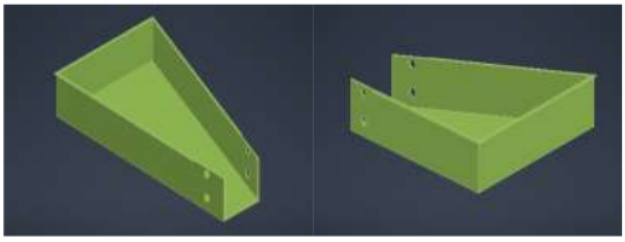

Figure 5. Input Pan

The input pan will be fabricated using Aluminium 304 plate with thickness of 1 mm. It is designed with an elevated side to ensure the material being inserted will fall into the milling machine. The input pan will be slotted inside the input channel and fixed with M12 bolt and nuts. The length of the input pan will be 330 mm, backside width of 324 mm, and front width of 86 mm.

3.6 Input Cone

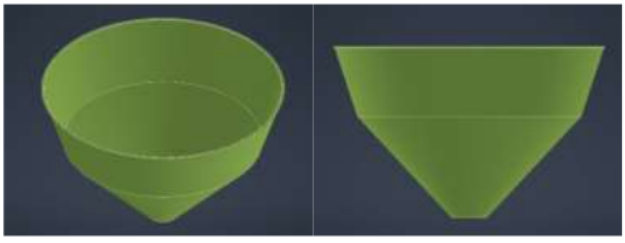

Figure 6. Input Cone

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The input cone will be fabricated using Aluminium 304 with thickness of 1 mm. It is designed to be able to transfer raw material from above the input channel into the disk mill machine. The input cone will be fixed at the top of input channel using three M10 bolt and nut.

3.7 Output Channel

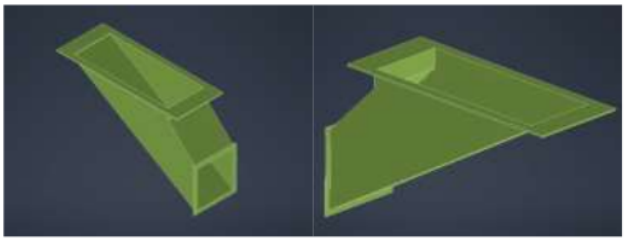

Figure 7. Output Channel

The output channel will be fabricated using Aluminium 304 with thickness of 1 mm. it is designed to catch fallen fine particles that got through screen. The hole at lower side of output channel is where the end product will exit the channel and enter container such as sack.

3.8 Driver Engine

Figure 8 Driver Engine

The driver engine is planned to use a gasoline engine with 7 HP and 2500 rpm. It is necessary to use high power engine due to reduced transmitted power to disk mill machine meanwhile the grinding process need as much power as possible to crush raw material. Gasoline engine is chosen because it is easier to find gasoline rather than diesel fuel.

3.9 V-Belt Transmission

Figure 9 V-Belt

It is necessary to choose appropriate v-belt type based on engine specification. With that in mind, it is planned to use a type V-belt that able to withstand 7 HP and 2500 rpm [11]. V-belt will transfer power and rotation from driver engine to disk milling machine with a help of two pulleys. In this transmission system, the driven pulley is smaller than driver pulley to ensure minimal torque loss during power transmission therefore the milling machine able to grind raw material.

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3.10 Frame

Figure 10. Frame

Whole components of disk mill machine will be attached to frame. Therefore, it is important to ensure the frame is able to support all loads applied to it. With that consideration, the frame will be made with L profile structural steel with the dimension of 40 mm x 40 mm x 3 mm. Once it's assembled, the frame's height will be 545 mm, width of 310 mm, and length of 445 mm. At the upper side of the frame, the disk mill machine will be attached with four M12 bolt and nuts. At the lower side of the frame, the driver engine will be attached with four M12 bolt and nuts. Although the dimension of the frame is relatively compact, but there is some clearance between attached components on the frame.

3.11 Transmission Cover

Figure 11. Transmission Cover

The transmission cover will be made using ABS plastic. The creation of this component is important to ensure machine's operator safety if some accident occurred and covering outside moving parts on the disk mill machine.

3.12 Disk Mill Machine Assembly

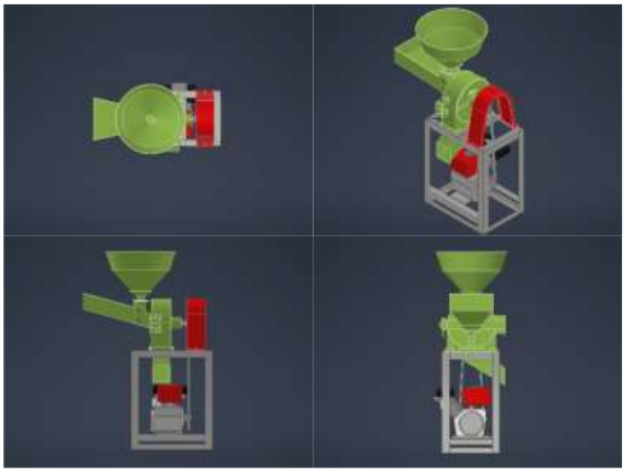

Figure 12. Disk Mill Machine Assembly Representation

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Figure 12 shows the final assembly of disk mill machine that will be used for grinding peanut shell. Approximate height of the milling machine will be 1086 mm, length of 706 mm, and width of 340 mm. This machine is designed to be able to operate only using one operator and safe to use on daily basis.

4. RESULT AND DISCUSSION

The design of disk mill machine prioritizes ease of use, durability, and effectiveness during peanut shell grinding process that will result a fine peanut shell powder. It is necessary to use high quality materials in its construction to ensure durability to achieve long service lifetime. In addition, it is easy to find driver engine spare parts at a local store. Nevertheless, it is important to maintain the disk mill machine after some time.

5. CONCLUSION

New designed disk mill has production capability up to 250 kg/hour, making it able to fulfil demand from the market on daily basis. The compact design makes this disk mill machine is easy to move from place to place with little effort.

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