Jurnal Edukasi Sebelas April (JESA) **E-ISSN 2548-8996**
Volume 8, No. 01, 01 Februari 2024

https://ejournal.unsap.ac.id/index.php/jesa

DESIGN TO BUILD A TUBER SKIN CLEANING TOOL BY USING DRUM PLAYER CILEMBU VILLAGE JATINANGOR DISTRICT SUMEDANG REGENCY

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Article Info

Article history:

Received Oct 12, 2023
Revised Oct 24, 2023
Accepted Dec 30, 2023

Keywords:

Motor Power,
Player Drums,
Cleaning Brush

ABSTRACT

As for the design of the tuber washing machine, where the drum is coated with rubber and the drive shaft is coated with nylon thread, there are several important things to consider in this design, including: designing the driving motor power, planning the main components and supporting components: electric motor , reducers, shafts, pulleys, belts, bearings, rubber, cleaning brushes, rotating drums, inlet and outlet funnels, opening and closing handles, engine frames, and machine working drawings. The results of the design are: The tuber playing drum is planned with a diameter of 60 (cm) and a length of 70 (cm), the motor power is used 1.0 (Hp), with a voltage of 220 volts and a frequency of 50 Hz with one phase, and uses a speed reducer with type 50 and a play ratio of 1:50. S35 CD shaft material with tensile stress 53 (kg/mm2), torque 778,504 (kg.mm), shaft diameter 20 (mm) and length 1000 (mm), drive shaft supporting bearing with No.6004VV diameter 20 (mm) , using 2 pulleys with a size of 57 (inches), cleaning rubber mounted on the sides of the drum 160 pieces, cleaning brushes made of nylon thread mounted on the sides of the drive shaft, engine frame with a length of 150 (cm) and a height of 80 (cm), a funnel top inlet length 30 (cm), back height 6 (cm), long funnel 80 (cm) front height 3 (cm), drum handle 700 (mm), opening handle width 300(mm), opening clamp length 600 (mm).

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1. INTRODUCTION

One of the potential agricultural commodities to support the direction of national development in agriculture is horticultural crops. One of the horticultural plants that have the potential to be developed is tubers (Allouhi et al., 2017); (Sözen et al., 2020) . Bulbs are subtropical plants that require cool temperatures (15-210C), moist, and enough sunlight (Li et al., 2017); (Sokhansefat et al., 2018); (Liu et al., 2020). In

Indonesia, such conditions are usually found in areas with an altitude between 1,200-1,500 m, as is the case in Jatinangor.

In Cilembu village, Jatinangor sub-district, which is located in the north, the production of vegetables is relatively large because some areas of Sumedang Regency are mountains which are suitable for growing vegetables. Thus, various kinds of vegetables can be cultivated in Sumedang Regency. The highest vegetable production in Sumedang district is tubers with 161,654 quintals, most local residents use rice sacks to wash the tubers, so it takes quite a long time. This program needs to be given a capital stimulant in the form of a tuber washing machine to farmer groups so that it can be utilized by its members. Based on this explanation, it is important to design a tuber washing machine, the time required is shorter compared to washing using rice sacks manually and the price is not too expensive, so that tuber farmers can use a tuber washing machine, as well as increasing productivity.

In Jatinangor, Cilembu village, Tiga Arrow District, Sumedang Regency, tubers are planted by local people, in this tuber farmer activity in Cilembu village, a farmer group is created to make it easier to run their business. In carrying out cultivation activities, the Bulb farmer group still applies traditional patterns (Garg et al., 2017). The low knowledge of the members of the Bulbs Farmer Group is one of the causes, this is because the education of members of the farmer group is only elementary school to high school, if the bulb harvest season arrives, there will be many Bulbs that are not sold due to damage to the Bulbs, whereas if the members of the farmer group have sufficient knowledge, these tubers can be processed into various food products that have a fairly high economic value. (Zlamparet et al., 2017); (Rustad et al., 2017); (SundarRajan et al., 2019). Apart from the technical management aspect of production, the aspect of product hygiene is still not considered by most tuber farmers, this can be seen from the process of handling tubers after harvest. (Gunes & Yesildal Yeter, 2018); (Hu et al., 2019); (Said et al., 2019); (Das et al., 2018).

The tubers that have just been harvested are usually washed directly in the sewers with rice sacks, even though washing using sewer water allows cross-contamination of the water used to enter the tubers, considering that sewer water is a place for waste disposal such as household waste. Not to mention if there are chemicals such as detergents that are not good for health, they stick to the tubers (Van Os et al., 2019); (Zhang et al., 2017); (Gan et al., 2017); (Jiang et al., 2018). In designing this tool, several main components and supporting components are needed which are often found in a series of tools or machines. The theory of these components serves to provide a foundation in the design or manufacture of tools. In planning a machine, safety factors must be considered both for the machine itself and for the operator. In selecting the elements of the machine, one must also pay attention to the strength of the material, the safety factor, and the resistance of the various components. The purpose of this design is to design a tuber washing machine with a rotating drum with a capacity of 150 (kg/hour).

PLANNING METHOD

Materials and Tools

The materials needed are divided into 2 parts, namely materials that already exist (finished) and materials that are made yourself. Tool making is carried out directly in the Mechanical Engineering Study Program laboratory and analysis is carried out after the completion of the tool manufacture.

2. RESULTS AND DISCUSSION

The analysis and discussion in this plan is more focused on what is written for a specific purpose, namely: design and build a tuber washing machine with a rotating drum with a capacity of 150 (kg/hour).
So that the discussion does not deviate, the order of the discussion is arranged as follows:

1. Designing a drawing sketch.
2. Determining the Dimensions of the Tubers Drum.
3. Determine power and rotation.
4. Design and determine the main components:
5. Shafts, reducers, drive motors, pulleys, belts, cleaning rubbers,Cleaning brush, Rotating drum.

1. Design and determine the supporting components:

Bearing, inlet funnel, Bulb outlet, opening and closing handle

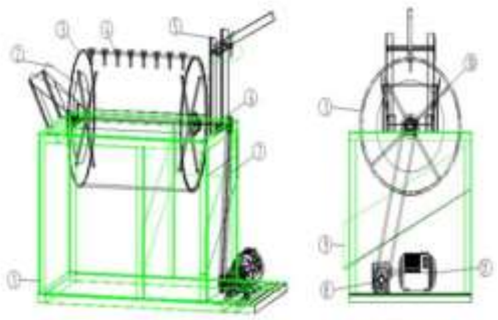

Figure 1. Sketch of tuber washing machine

Determining the Dimensions of the Tubers Drum

To determine the dimensions of the tuber washers, the following is determined:

1. Washed Bulb Capacity
2. Amount of washing media
3. The excess/freedom of space in the tuber washing drum (tolerance) is 75% of the total capacity.

Bulbs washed volume capacity (Vw) The density of tubers is 130 (kg/m3). So for capacity 150 kg/hour then 1 x 15 kg tuber washing process in 6 minutes, then the volume is: Volume 15 kg tubers = Vw = (15 : 130) x 1 m3 = 0.1153 (m^3).

Jumlah/Kapasitas volume pencucian(Vp)

After making observations in the field that the ratio of the number of tubers is the same. Then the volume of the medium is: Vp = 0.1153 (m^3). Where its function is as a washing on tubers.

Total volume (Vt).

The total volume (Vt) is the sum of the volume of tubers that are washed plus the volume of the media whose amount is:Vt = Vw + Vp

Vt = 0,1153 + 0,1153 = 0,2306(m^3)

The dimensions of the tuber washing drum are: Drum diameter d = 600 (mm)

Drum length L = 0.7 (m) = 700 (mm)

Determining power and rotation

The driving motor power needed to drive the machine (P1) is: 107.31 (watts) Determine the mass of tubers and water when washing. The number of tubers is included in the load on the washing of tubers of water that is entered in 10 liters.

So the driving motor power needed to wash Bulbs (P2) is: 77,132 (watts)

Power that occurs in the reducer (P3)

Then the power that occurs in the speed reducer:

$$P_3 = P_{wg} + P_g$$

where :

P3 = Power that occurs in reducer speed (watts)

Pwg = Power that occurs in the worm gear = 5.8 (watts)

Pg = Power that occurs in the gear = 139.7 (watts)

So that :

P3 = 5.8 + 139.7

P3 = 145.5 (watts) 146 (watts)

So the power to drive the reducer (P3) is = 146 (watts).

Total drive motor power (Pt)
So for the calculation of the total driving motor power of the tuber washing machine is:

Pt = P1 + P2 + P3
Pt = 107.31 + 77.132 + 146 (watts)
= 330,442 (watts)

Determine the design power of the driving motor (Pd)

Design power can be calculated by multiplying the total power (Pt) to be used multiplied by the correction factor (fc).

So :

Pd = Ptotal x fc Where :

Pd = design power (W)

fc = correction factor = normal power

(1,2 - 2.0), (Appendix 1) set fc = 2.0

Pd = 330,442 x 2.0 (watts) = 660,884 (watts)

Because 1 HP = 746 watts, then 660,884 watts = 660,884 : 746 = 0.885 (Hp)

Determine the motor power used (PR)

The motor power used is the motor power used which exceeds the design motor power or PR Pd. Due to the fact that there is no motor power available in the market as written in the power plan, the motor power used or used is chosen which is close to the standard motor power with 1 HP power with an actual rotation of 2800 (rpm) with a voltage of 220 Volts, 1 phase.

Design and determine the main components:

Axis

The shaft used is planned to be a shaft made of steel rods which are cold defined, namely S35C-D with a tensile strength of 53 kg/mm2. This material was chosen because it is easy to obtain in the market and the price is not too expensive (cheap).

Determining the size and strength of the drive shaft

a. Determine the allowable shear stress (τa)

shaft material, (Sularso, 1997, p. 8)

$$\tau a = \frac{\sigma b}{sf_1 x\ sf_2}$$

Where:

b = Tensile strength of shaft material = 53 (kg/mm2)

Sf 1 = Material safety factor = (5.6 – 6.0), 6.0 . is chosen

Sf 2 = factor of safety for keyed shaft = (1.3 – 3.0) , 3.0 . is selected

so :

$$\tau a = \frac{53}{6{,}0 \; x \; 3{,}0}$$

$$\tau a = 2{,}94 \; (kg/mm^2)$$

a. Determine the torsional moment or torque that occurs

The torque that occurs (T) on the shaft is: (Sularso, 1997, p. 7).

$$\tau = 9{,}74 \; x \; 10 \; (\frac{Pd}{n_1})$$

Where : T = Torque (kg.mm)

Pd = Design power = 0.746 (kW) n1= Drive shaft rotation = 2800 (rpm)

Then the torque that occurs is:

$$T = 9{,}74.10^5 \frac{0{,}746}{2800}$$

$$T = 778{,}504 \; (kg.mm)$$

a. Menentukan diameter poros (ds)

The shaft material in this design is steel rod which is cold defined S35C-D, and the tensile strength is 53 kg/mm^2.

So the shear stress that occurs is 0.496 (kg/mm2), while the allowable shear stress is a = 2.88 (kg/mm2). Then the shear stress that occurs is smaller than the allowable shear stress. Or 0.496 < 2.88 (kg/mm2). So this axis planning is declared safe.

Reduser

reducer speed with type 50 and rotation ratio 1: 50.

Pully

The pulley used is a driving pulley having a planned diameter (dp) = 3 (inches) mounted on the drive motor shaft with rotation (n_1) with a rotation of 2800 (rpm). While the pulley that is driven (Dp) , has a diameter of 3 (inches) so that the rotation can be determined as follows:$n_2 = \frac{n_1 x \, n_2}{d_2}$

$$n_2 = \frac{2800 \; x \; 3}{3}$$

n_2 = 2800 rpm

Belt

$$v = \frac{\pi . Dp_1 . n_1}{60 \, . \, 1000}$$

Where: Dp 1 = Diameter of the drive pulley = 3 (inches) = 76.2 (mm)

n 1 = Motor drive speed = 2800 (rpm)

Then the linear velocity is:

$$v = \frac{\pi . Dp_1 . n_1}{60 . 1000}$$

$$v = \frac{\pi . 76{,}2 \ x \ 2800}{60 . 1000}$$

$$v = 11{,}176 \ (^m/_s)$$

According to Sularso, 1997, p. 168, in the Standard V Belt Length Table, which approximates 1448,945 (mm) or existing belt lengths, is 1448 (mm) or 57 (inches), (see appendix 8).

Cleaner

The cleaner is planned to be made of a plastic brush, an elastic material, standard material from the store, which will be attached to the drum. Bulbs have 6 plastic brushes on the drum, according to the drum diameter of 60 cm and a length of 70 cm.

Cleaning brush

The cleaning brush is designed from a standard 150 mm nylon elastic material from the store which will later be assembled on its own on the shaft

3. CONCLUSION

After analyzing and discussing the planning of a tuber washing machine using a rotating drum with a capacity of 150 kg/hour. Based on the objectives of this plan, namely: Planning the working system of a tuber washing machine with a rotating drum (Zlamparet et al., 2017); (Oberloier & Pearce, 2018). Planned the power used by the tuber washer with the rotating drum, determined the rotation reduction system, determined the main materials and sizes. Shafts, reducers, electric motors, pulleys, belts, cleaners, cleaning brushes, turning drums, bearings, funnels, tubing outlets, opening and closing handles.

. To get the conclusions above, the results of the analysis or calculation are as follows: Motor power used:

1. The engine capacity, set is 150 (kg/hour).

2. Motor power to drive the machine (P1) = 107.31 (watts)

3. Motor power to rotate the tuber drum (P2) = 77,132 (watts)

4. Power at the reducer (P3) = 146 (watts)

5. Total drive motor power (Ptotal) = 330,442 (watts)

6. The motor power used is 1 HP with an actual rotation of 2800 (rpm) with a voltage of 220 Volts.

Main Components of Machine

1. Drive shaft
   a. The drive shaft material is S35C–D with a tensile strength of 53 (kg/mm2).
   b. The diameter of the drive shaft used is 20 (mm)
2. Pulley size
   a. Pulley diameter
      • Pulley on the output shaft of the reducer with a diameter of 3 (inches).

• Pulley on the drive shaft of the drum shaft diameter 3 (inches).

b. Round on pulley

• The rotation of the pulley on the drive pulley is located on the drive motor shaft with a rotation of n1 = 2800.

• The speed of the reducer output shaft (n2) is 168 (rpm)

• The rotation of the pulley driving the drum shaft (n3) is 56 (rpm)

3. Belt size

The powder driving the 57 (inch) Bulbs rotating drum drive shaft

4. Bearing planning

The bearings used to support the drive shaft of the tuber turning drum are

Bearing data is as follows:

• Bearing number : 6004VV
• Inside diameter (d): 20 (mm)
• Outside diameter (D): 42 (mm)
• Width (b) : 12 (mm)
• Ball radius (r) : 1 (mm)

Engine frame

Machine frame with elbow plate material (propyl "L") with a length of 150 (cm) , height 80 (cm), with a plate thickness of 4 (mm).

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