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Grain Drying Machine Design of Rotary Dryer 300

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ABSTRACT

The existence of climate change and weather is an obstacle for farmers from the planting stage to post-harvest. Especially in the district. Blitar, East Java, especially in terms of grain drying. The design and construction of a rotary batch type shelled corn drying machine has been carried out. The goal is to make the development of a corn drying machine using biomass fuel (corn cobs). This research was conducted to make a design for a dryer or machine that will be made, by looking at existing machine references and then looking for a more efficient design and of course saving in terms of production costs and fuel costs for the engine heating process, this machine is designed to be able to rotates statically to allow drying of materials such as corn, rice, coffee, etc. It can dry evenly and of course quickly. for the design process using the Autodesk Inventor Professional 2019 software. The advantage of this dryer is that it has a capacity of 300 kg, so it can increase the capacity of the corn drying process commonly used by traditional farmers, more efficient in the use of land area for drying, less labor is used and time The rainy season is not dependent on sunlight. This machine can dry materials such as rice and other grains for a maximum drying time of 300 kg. For the time it can be adjusted to the water content in the rice or other materials.

Keywords: Grain dryer, Autodesk Inventor, Rotary dryer

ABSTRAK

Adanya perubahan iklim dan cuaca menjadi kendala oleh para petani sejak dalam tahap penanaman hingga pasca panen. Khususnya di wilayah kab. Blitar Jawa Timur khususnya dalam hal pengeringan gabah. Perancangan dan pembuatan mesin pengering jagung pipilan tipe *rotary batch* telah dilakukan. Tujuannya adalah membuat pengembangan mesin pengering jagung menggunakan bahan bakar biomassa (bonggol jagung). Penelitian ini dilakukan unutuk membuat rancagan alat atau mesin pengering yang akan dibuat, dengan melihat referensi-referensi mesin yang ada untuk kemudian dicari desain yang lebih efisien dan tentunya hemat dari segi biaya produksi dan biaya bahan bakar untuk proses pemanasan mesin, mesin ini dirancang untuk dapat berputar secara statis agar pengeringan material seperti jagung, padi, kopi, dll. Dapat kering secara merata dan tentunya cepat. untuk proses mendesain menggunakan software *Autodesk Inventor Professional 2019.* Keunggulan mesin pengering ini adalah mempunyai kapasitas 300 kg, sehingga dapat meningkatkan kapasitas proses pengeringan jagung yang biasa digunakan petani tradisional, lebih efisien dalam penggunaan luas lahan tempat pengeringan, tenaga kerja yang digunakan lebih sedikit dan saat musim penghujan tidak ketergantungan terhadap sinar matahari. Mesin ini dapat mengeringkan material seperti padi dan biji-bijian lainnya untuk sekali pengeringan maximal yaitu 300 kg. Untuk waktunya dapat disesuaikan dengan kadar air yang ada di dalam padi atau material lainnya.

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Kata Kunci: Pengering biji-bijian, Autodesk Inventor, Rotary dryer

1. Introduction

The existence of climate change and weather is an obstacle for farmers from the planting stage to post-harvest. Especially in the district. Blitar, East Java, especially in terms of grain drying. Based on information from Mrs. Mahmudah, 2013, conventional drying methods that depend on sunlight (sun-drying) have a number of weaknesses. In terms of productivity, drying can take up to five days for cloudy weather. This has an impact on high operational costs of up to five hundred thousand rupiah per ton. Drying rice in the sun also requires large areas of land with heavy work because farmers have to turn the rice that is spread over the fields every hour so that drying is even. In terms of quality, when the weather is overcast, the moisture content of the dry rice produced is greater than 14% (PUSLITBANG standard of the Indonesian Ministry of Agriculture). This causes dry rice storage time (before milling) does not last long and the selling price drops to a thousand rupiahs per kilogram.[1]

In this case, the rotary dryer 300 drying machine was designed, built and designed as a rice drying machine with an electric drying method based on an automation system, which includes an automatic rotating system to stir the rice so that the drying process is more even and a temperature control system that can be adjusted as needed. In addition, this tool has sufficient rice capacity for a capacity of 300 kg for one time drying without the need for large areas of land for machine placement.

Drying rice is an effort to reduce the water content (water content) in rice after it is harvested. Freshly harvested rice has a high moisture content of around 20% - 26%, depending on

the weather at the time of harvest. Biologically it is also stated that it is still alive and continues to carry out respiration which produces water vapor, carbon dioxide gas, and calories in the form of heat. The emergence of heat in a pile of rice will speed up the biochemical processes that can produce yellow rice. Therefore, post-harvest rice needs to be dried first before being processed into rice or stored. This is done to reduce the existing water content, so as not to rot and avoid fleas. In general, drying is done until it reaches 14% humidity [2].

2. Methodology of Research

This research was conducted to make a design for a drying machine or tool to be made, by looking at existing machine references and then looking for a more efficient design and of course saving in terms of production costs and fuel costs for the engine heating process, this machine is designed to be able to rotates statically to allow drying of materials such as corn, rice, coffee, etc. It can dry evenly and of course quickly. for the design process using the Autodesk Inventor Professional 2019 software. The details regarding the design of the rotary dryer 300 machine can be seen in Figures 1, 2, 3, 4.

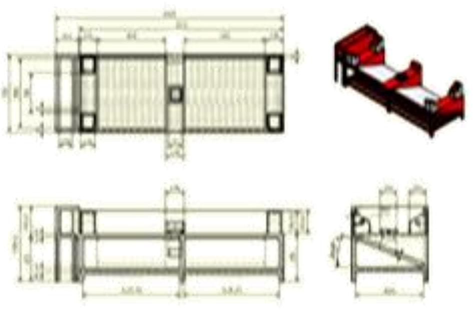


Figure 1 Chasis

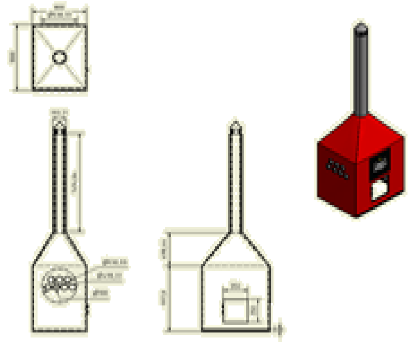


Figure 2 Furnace

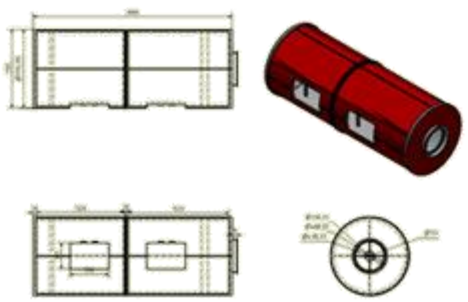


Figure 3 Spin dryer

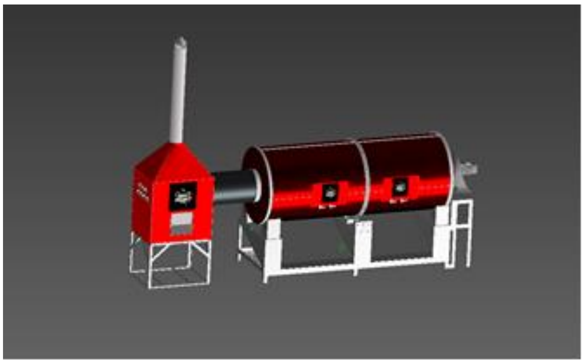


Figure 4 Rotary dryer machine

3. Result and Discussion

3.1 Design result

The results of the design of the rotary dryer 300 drying machine have a total length dimension of 4915 mm. can be seen in the working drawings. The main materials used are mild steel plate, steel, reducer/gear box, ac motor, stainless steel pipe, v belt, etc.

The design of the engine frame can be seen in Figure 1. This frame uses UNP5 iron material and mild steel plates. It is designed in a rectangular shape to make it sturdy and reduce vibration on the engine when the engine is turned on. For the design of the furnace can be seen in Figure 2. This furnace functions as a place of combustion to produce hot temperatures for the material using mild steel plates. Raw materials for combustion can use rice husks, coconut shells, and firewood, this is very cost efficient when compared to using LPG gas. The design for the rotary tumble dryer can be seen in Figure 3. It has a total length of 3000 mm. and an outer diameter of 1180 mm. Has two doors to open and close to enter the material to be dried. Then when the drying process is complete, the door can be opened and it can be moved directly to a sack or other container.

3.2 Driving system

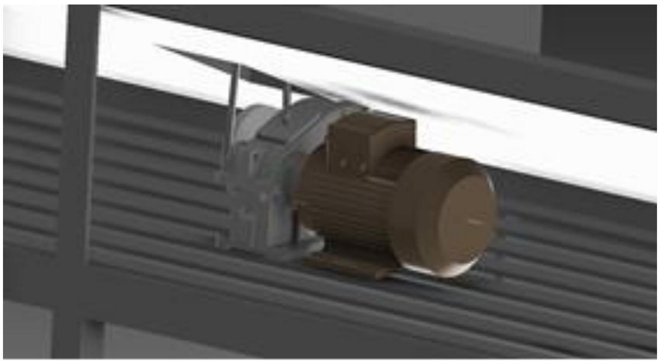
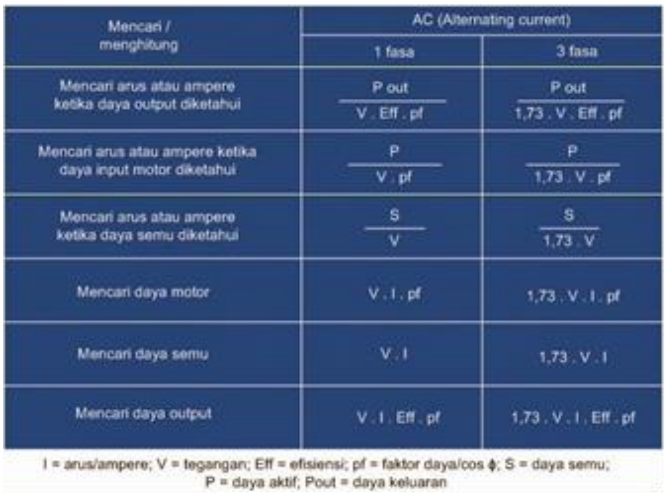


Figure 5 AC motor

An ac electric motor is used to rotate the drying container the propulsion system uses, the advantage is that it is easy to control (the torque on the motor is controlled by adjusting the field current on the stator or using a gear box). The specifications of the ac motor can be seen in Fig. 6



Mencari / menghitung	AC (Alternating current)	
	1 fasa	3 fasa
Mencari arus atau ampere ketika daya output diketahui	P out / V . Eff . pf	P out / 1,73 . V . Eff . pf
Mencari arus atau ampere ketika daya input motor diketahui	P / V . pf	P / 1,73 . V . pf
Mencari arus atau ampere ketika daya semu diketahui	S / V	S / 1,73 . V
Mencari daya motor	V . I . pf	1,73 . V . I . pf
Mencari daya semu	V . I	1,73 . V . I
Mencari daya output	V . I . Eff . pf	1,73 . V . I . Eff . pf

I = arus/ampere; V = tegangan; Eff = efisiensi; pf = faktor daya/cos ϕ; S = daya semu; P = daya aktif; Pout = daya keluaran

Figure 6 Specification of AC motor

3.3 V-Belt

The belt is used to transfer rotation between two shafts that are relatively spaced. The part of the belt that is wrapped around the pulley will cause a bend so that the inner width will increase [3].

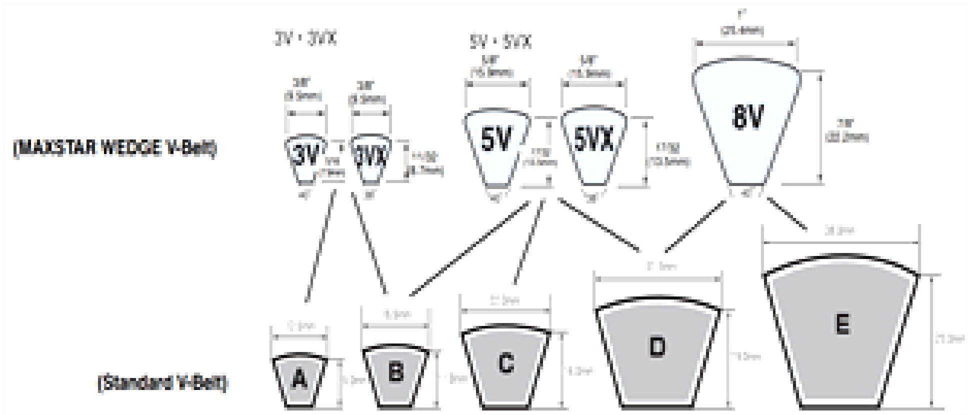


Figure 7 V-belt

Therefore, V-belt planning must be done to determine the type of belt used and the length of the belt to be used. The following are the calculations that will be used in designing V-belts, which is:

Belt Length Belt length (L) can be calculated using the formula:

$$L = 2C + \frac{\pi}{2}\,(D1 + D2) + \left(\frac{(D2 - D1)}{4c}\right)\,(mm)$$

Where:

C = The distance between the shaft (mm) [5]

3.4 Pulley and gearbox rotation

Pulley is power in the form of rotation from a drive shaft to a shaft driven by a belt transmission. The main function of the gearbox is to slow down the rotational speed of the motor dynamo, to amplify the torque generated by the electric dynamo [6].

1. Pulley speed rotation

   Calculating the pulley rotation using the equation

$$n2 = \frac{D1}{D2}\, n1$$

Where:
$n1$ = Electric motor rotation (Rpm)
$D1$ = Drive pulley diameter
$D2$ = Driven Pulley Diameter

2. Calculating the gear box rotation speed

   Because the shaft rotates through the 1:30 gearbox, the pooros rotation becomes:

$$n3 = n2\,\frac{1}{30}$$

3. Calculating the rotational speed of the dryer shaft [6]

$$n4 = \frac{D3}{D4}\, n3$$

3.5 Shaft

The shaft is one of the important parts of the machine because almost all machines transmit power along with rotation, so the shaft plays a major role in the transmission in a machine. The following are the calculations that will be used in designing a shaft that is subjected to bending or twisting loads, namely: [4]

1. Shaft weight

   Calculating the weight of the shaft, the following equation is used:

$$F\ poros\ \frac{\pi}{4}\,(D^2).L,\gamma$$

2. Calculating the design power

$$P = f.Pd\ (kw)$$

Where:

Pd = design power (kw)

fc = correction factor

P = nominal power (kw)

3. Calculating the moment that occurs on the shaft

$$T = 9.74\,.\,10^{5\frac{pd}{n1}}$$

Where:

T = design moment (kg.mm)

n1 = electric motor rotation (rpm)

4. Calculating the allowable shear stress

$$\tau_a = \frac{\sigma b}{sf1.sf2} = (kg/mm^2)$$

Where:

σb = Tensile strength (kg/mm²)

$sf1.\,sf2$ = safety factor [8].

5. Calculating the shaft diameter

$$Ds = \frac{5{,}1}{\tau a}\sqrt{(Km.M)^2} + kT.T)^2$$

Where:

Km = Bending moment correction factor (1.5-2.0) M

M = Bending moment (kg.mm)

Kt = Torsion correction factor (1.0-3.0)

T = Torque (kg.mm).

6. Bending stress that occurs in the shaft

$$\sigma_L = \frac{M_L}{Z}$$

Where:

M_L = The bending moment that occurs in the shaft (kg.cm)

Z = The moment of bending resistance that occurs in the shaft $= \frac{1}{e}\ (cm^3)$

While:

I = moment of inertia of the section on the shaft for a solid shaft section = $\frac{\pi}{64}\ d^4\ (cm^4)$

e = the average distance of the cross-section of the shaft to the center of the shaft (cm) = $\frac{d}{2}\ (cm)$

7. Allowable bending stress

   The requirements for the safety of the shaft against the bending stress that occurs is that the bending stress that occurs must be less than the allowable bending stress. The equation used to find the allowable bending stress is: [7]

$$\sigma = \frac{0{,}5\,.\,TENSIL\ STRENGHT\ (\sigma_{Ts})}{Sf} = (kg/cm^2)$$

4. Conclusion

According to the results of this design, we made a tool that has sufficient rice capacity for a capacity of 300 kg for one drying without requiring large areas of land to place the machine. The results of the design of the rotary dryer 300 drying machine have a total length dimension of 4915 mm. can be seen in the working drawings. The main materials used are mild steel plate, steel, reducer/gear box, ac motor, stainless steel pipe, v belt, etc. For the design of this machine frame using UNP5 iron material and mild steel plate. Raw materials for combustion can use rice husks, coconut shells, and firewood, this is very cost efficient when compared to using LPG gas. The design design for the drying chamber has a total length of 3000mm. and an outer diameter of 1180 mm. To rotate the drying container the propulsion system uses an ac electric motor, the advantage is that it is easy to control (the torque on the motor is controlled by adjusting the field current on the stator or using a gear box).

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