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Design and Build of Molen Machine Capacity 0.056 m^3

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***Abstract*: Molen machine is a tool that helps in the process of mixing cement, water, sand, gravel, and other added materials into cast concrete dough. The small capacity molen machine is designed and made to be able to assist the needs of the community or individuals in the process of mixing cement mixture materials on a small scale, which is usually done manually. making drawings, component manufacturing processes, assembling processes, and the process of testing molen machines by stirring a mixture of cement with other added ingredients. The last process is the improvement process based on the results of the trial process. The product of this final project is the design and prototype of a small capacity molen machine. The specifications of the molen machine that are made are mixing capacity of 0.056 m^3, the capacity of the contents of the mixing barrel is 148 liters, the main driving force is a 5.5 HP combustion engine. The transmissions used are pulleys, v-belts, chains, chain gears, and gears to produce a rotation of the stirring barrel of 25-30 rpm. The test results show that the small capacity mixer machine that was made can be used to mix cement with other added ingredients.**

***Keywords*: Small capacity molen engine, combustion engine, transmission, mixing barrel.**

1. Introduction

Technological progress shows that the development is very rapid in all fields, one of which is the infrastructure sector. Indonesia is one of the countries that include rapid development in the field of infrastructure. This can be seen from the many ongoing developments such as the construction of high-rise buildings, offices, housing, school buildings, hospitals, bridges, and others. Rapid development must be supported by machines and building construction tools that can help simplify and speed up the process of completion of the construction, for example, a cement mixer machine commonly called a molen machine which functions to mix cement with a large capacity so that it is more efficient and accelerates the development process.

In Indonesia, we can also find various kinds of building construction tools and machines, but these tools and machines are usually used to build large projects because these machines are large and have a large capacity of up to 500 liters. However, for smaller construction projects, such as simple housing development, shopping malls, or residential construction, tools and machines are still rarely used, because in general they still use human power, for example, to mix cement with sand so that a cement mixer process is a machine. which is used to mix cement along with other added materials such as sand, gravel, water, etc., so that the results of the mixture are evenly mixed and the workmanship is better. Usually, the capacity of the mixer barrel of the molen machine on the market ranges from 125 liters to 500 liters.

A. Research Stages

1) Design

At this design stage, it is carried out as a team, where each member has a task according to his field. Therefore, this design requires specialization in Drafting, Maintenance, Machining, and Fabrication. The results of the teamwork resulted in a design concept that was outlined in the form of drawings consisting of part drawings and arrangement drawings made under applicable standards.

2) Manufacturing stage

The designs and drawings that have been made will be a guide for operators in the manufacturing process. The selection of machines and tools to work on parts of a small capacity molen machine is adjusted to the profile and precision to be achieved. The machining process includes the manufacture of the shafts and gears themselves and other machine elements. The fabrication process includes making machine frames, cutting plates, and others. The use of measuring instruments with a high level of accuracy and the right measurement method also determines the quality of the part or machine that is made.

3) Assembly stage

This assembly stage is a process of compiling and unifying several parts into a tool or machine that has a specific function. The assembly job starts when the objects are ready to be installed and ends when the objects are perfectly joined. Therefore, the parts that have gone through the manufacturing process are then assembled according to the order of the drawings (assembly process). In this assembly process, the most important thing is alignment between parts and other parts.

4) Testing stage

At this stage, the machine that has gone through the assembly process is then tested whether the machine can function properly as expected.

B. Data Collection Techniques

Before carrying out the design and design process, the data

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collection process is carried out first. In the Design of Molen Machine with a capacity of 0.056 m3, the data collection methods used are:

1. Literature study, by collecting data and information from books and the internet as well as conducting discussions with supervisors and group partners about the molen machine.
2. Observation method (review or direct observation), namely by collecting data through direct observation in the field regarding the molen machine.

C. Functional Accuracy

The function of the small capacity mixer is to help mix the cement mixture with other added ingredients on a smaller scale than the general mixer. To find out in detail the components and functions of the small capacity molen machine design, a list is needed, as shown in the table 1.

2. Research Results and Discussion

A. Calculation of Engine Speed

To calculate the engine speed on the molen engine sourced from the combustion engine to the barrel shaft, the following data are used,

a) MB shows the combustion engine with shaft rotation ($n1$) = 1800 rpm
b) A indicates the diameter of the drive pulley (dp) = 3" = 76.2 mm
c) B indicates the diameter of the driven pulley (Dp) = 5" = 127 mm
d) TR indicates gearbox transmission with a ratio of 1:1
e) RD shows a reducer gearbox with a ratio of 40:1
f) E indicates the output of the reducer gearbox

1) Engine speed ratio

$$\frac{n2}{n1} = \frac{dp}{Dp} \quad (1)$$

$$n2 = \frac{76.2 \times 1800}{127}$$

$$n2 = 1080\ Rpm$$

The transmission gearbox has a ratio of 1:1 so that the rotation received by the transmission gearbox input) is the same as the transmission gearbox output rotation, which is 1080 rpm. The sprocket used has a 1:1 ratio, so that the rotation of the transmission gearbox output is the same as the reducer gearbox input rotation, which is 1080 rpm. The output speed of the reducer gearbox can be calculated in the same way as the rotation of pulley B as follows:

$$\text{n5} = \frac{n4}{i} \quad (2)$$

$$= \frac{1080}{40:1}$$

$$= 27\ rpm$$

B. Belt Size Calculation

To calculate the belt size, the following data are used:

a) Diameter of driven pulley (D_p) = 5" = 127 mm
b) Diameter of drive pulley (d_p) = 3" = 76,2 mm
c) Rotation on motor shaft (n_1) = 1800 rpm
d) Distance between shaft axes (C) = 300 mm

1) Belt speed

$$v = \frac{\pi.dp.n_1}{60 \times 1000} \quad (3)$$

$$= \frac{\pi \times 76.2\ mm \times 1800\ rpm}{60 \times 1000}$$

$$= 7.18\ m/s$$

2) Belt length

$$L = 2\,C + \frac{\pi}{2}(Dp + dp) + \frac{1}{4c}(Dp - dp)^2 \quad (4)$$

$$= 2 \times 300 + \frac{\pi}{2}(127 + 76.2) + \frac{1}{4x300}(127 - 76.2)^2$$

$$= 921.3\ mm$$

$$= 0.921\ m$$

C. Calculation of Shaft

1) Motor Load

The torsional moment transmitted from the combustion engine can be calculated using equation 5, using the following data:

a) Motor power (P) = 5.5 HP = 4101.35 watt
b) Motor shaft rotation (n) = $1800\ rpm$
c) Usage factor (CB) = 1.2

Table 1
Component mechanism function

No.	Component	Component Function
1	Burning motor	As the main driving system of the cement mixer machine.
2	Stirring Tong	As a cement mix material so that the mixture is evenly distributed.
3	Pulley & Belt, chain & sprocket	Round successor element
4	frame	As a mount for engine components
5	Gearbox reducer	Lowering rotation and increasing torque
6	Transmission gearbox	Changing the direction of rotation of the molen
7	Pillow block	Reduces friction between rotating components and as shaft mount
8	Axis	As a loop successor component

$$Mp1 = 9550\frac{P \times CB}{n} \quad (5)$$

$$= 9550\frac{4104.35 \times 1.2}{1800}$$

$$= 26111{,}92\ Nmm$$

D. Calculation of the Volume of the Mixing Barrel

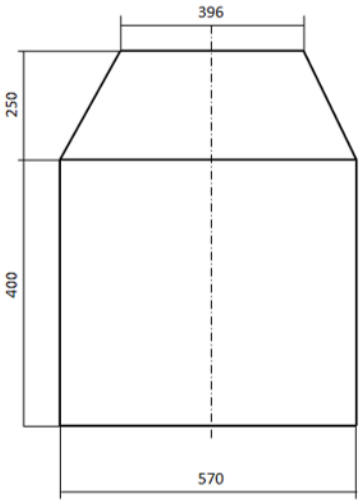

Fig. 1. Stirring tong

Volume:

a) Cylinder

b) Cone

$$V = \pi . r^2 . h \quad (6)$$

$$= \pi . 285^2 . 400 = 102070345.5\ mm^3$$

c) Cut off Cone

$$V = \frac{1}{3} . \pi . t . (R^2 + R . r + r^2) \quad (7)$$

$$= \frac{1}{3} . \pi . 250 . (285^2 + 285.198 + 198^2)$$

$$= 46301577.93\ mm^3$$

$$\text{Barrel volume} = 102070345.5 + 46301577.93$$

$$= 148371923.2\ mm^3$$

$$= 148.3\ dm^3$$

$$= 148.3\ liter$$

The following data will be used to calculate the mass of the mixture:

Cement density : 3.15 g/cm^3

The density of sand: 1400 kg/m^3

The density of water: 1000 kg/m^3

1 sack of cement 50 Kg = $V = \frac{M}{P}$ (8)

$$= \frac{50000}{3.15}$$

$$= 15873.015\ cm^3$$

$$= 15.872 \text{ Liter}$$

1 lorry of sand *Artco* = 65 liter

= 1400 kg/m^3 x 0.065 m^3

= 91 kg

1 small bucket of water = 4 liter

= 1000 kg/m^3 x 0.004 m^3

= 4 kg

Experiments were carried out with: $\frac{1}{2}$ bag of cement

= 7.93 liter / 25 kg

$\frac{1}{2}$ lorry *artco* sand = 32.5 liter / 45.5 kg

4 small bucket of water = 16 liter / 16 kg

Total = 7.93 + 32.5 + 16

= 56.43 liter

Total = 25 + 45.5 + 16

= 86.5 kg

Barrel volume = 148 liter

So, the volume of the vat filled (%) = $\frac{56.43}{148} \times 100$ (9)

= 38%

E. Design Results

Fig. 2. Molen machine design capacity 0.065 m^3

Fig. 2 is the result of a 0.056 m^3 capacity molen engine which has several main components, namely the engine frame, combustion engine, pulleys & belts, chains & chain gears,

mixing barrel, transmission gearbox, and pillow block. Each of these components has a very important function of a small capacity molen engine, such as the engine frame serves as a place for the components of the modern engine, then the combustion engine functions as an energy source to make the transmission system and mixing barrel rotate. The transmission system used is pulleys & belts, gears, and chains & chain gears which function to transmit power from the combustion engine to the mixing barrel so that the stirring barrel can rotate.

3. Conclusion

Based on the results of the analysis that has been done the author can conclude several things, namely as follows:

- From the design and manufacture of this milling machine, a modern machine with a capacity of 0.056 m^3 was produced, so it has a smaller capacity than the commonly used molen machine.
- The results of the experiments carried out, the molen machine can stir the cement mixture with other added ingredients and can pour the cement mixture when it is mixed.

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