Manure Feeder Machine for Grape Farm


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Abstract

In today’s world of rapid mechanization and automation are becoming an integral part of farm in order to decrease the human effort. Introduction of rotary feeder is a basic step towards mechanization that help in easy sorting of manure and availability of manure at right place and at right time. They are now becoming an essential part of modern manufacturing systems. A physical prototype of a rotary feeder was constructed. A study on the obtained experimental data was performed and conclusions were drawn about effect of various parameters on the feed rate. The machine has hopper, manure at the required position, ease of feeding, and better accessibility for cleaning. The proposed machine is also affordable in price, particularly for the manure feeding for grape farm. The engineer is constantly conforming to the challenges of bringing ideas on design into reality. New machines and techniques are being developed continuously to the manufacture various products at cheaper rates and high quality. Using different mechanisms and by reducing efforts during manure feeding process in grape farming, Manure Feeder Machine is evolved.

Keywords: Hopper, Rotary feeder, Thrust bearing, Manure, Belt conveyor, Shaft, Spur gear, Chain drive.

1. Introduction

One of the most critical issues that farmers have to face today is unavailability and high cost of labour. Thus mechanization in the field of agricultural is need of the day. Although a lot technologies have already been developed to perform various agricultural operations, many of the operations still persist to be absolutely labour depended. Some of these activities are feeding manure in the grape farm. This manure feeding process is required to be carried out on regular basis.

There are several ways to spread manure. For small amount, use like bucket or apply it from the tail end of a pickup trolley. These important activities done manually add to the expenses of the farmer making his business less profitable. Therefore a low cost, effective solution over this problem is crucial. The objective of the project is to decrease feeding cost, manpower, time and wastage of manure during feeding process especially for the grape farm by design and developing mechanical manure feeder machine.

Hoppers are a traditional meal consisting of rice flour pressed into noodle form and then steamed. We are making hopper for to hold agricultural manure. Hopper is main part of our Manure feeder machine. In which we are feeds the manure of require quantity. Hopper holds the basically two types of manure which is manure of chemically made and bio-waste. Chain drive is used for the transmission of power from the main shaft to the traverse shaft.

Chain is superior to friction drives. The drawback in friction drive (Belt or rope) is that the velocity ratio varies because of slip, due to momentary overloads or due to the pulley and belt contacts surfaces becoming slightly greasy. A conveyor belt (or belt conveyor) consists of two or more pulleys, with a continuous loop of material - the conveyor belt - that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The belt consists of one or more layers of material. They can be made out of rubber. Many belts in general material handling have two layers. An under layer of material to provide linear strength and shape called a carcass and an over layer called the cover. The carcass is often a woven fabric having a warp & weft. The most common carcass materials are polyester, nylon and cotton.

A power take-off (PTO) is any of several methods for taking power from a power source, such as a running engine, and transmitting it to an application such as an attached implement or separate machines. Most commonly, it is a system comprising a splined output shaft on a tractor or truck, designed so that a PTO shaft, a kind of drive shaft, can be easily connected.
and disconnected, and a corresponding input shaft on the application end. The power take-off allows implements to draw energy from the engine.

2. Design

The subject of machine design deals with the art of designing machine of structure. A machine is a combination of resistance bodies with successfully constrained relative motions which is used for transforming other forms of energy into mechanical energy or transmitting and modifying available design is to create new and better machines or structures and improving the existing ones such that it will convert and control motions either with or without transmitting power. It is practical application of machinery to the design and construction of machine and structure. In order to design simple component satisfactorily, a sound knowledge of applied science is essential. In addition, strength and properties of materials including some metrological are of prime importance. Knowledge of theory of machine and other branch of applied mechanics is also required in order to know the velocity. Acceleration and inertia force of the various links in motion, mechanics of machinery involves the design.

Following are the design of machine

1. Design of Shaft
2. Design of Gear

2.1 Design of Shaft

Bright Free Cutting Bar

Typical UTS Yield: UTS = 430 Yield= 400

\[ S_y = 400 \text{ N/mm}^2 \]

Factor of safety = 3

Assume chain drive, maximum tension = 7 KN

Coefficient of friction = \( \mu = 0.25 \)

Angle of wrap for both the sprocket \( \Theta = 180^\circ \)

Step No. 1

Permissible shear stress = \( S_{sy}/fs = 0.5 \times S_y/fs = 0.5 \times 400/3 = 100 \text{ N/mm}^2 \)

Step No. 2

Torsional moment

\[ P_1 = 7 \text{ KN} = 7000 \text{ N} \]

\[ P_2 = \phi \times \epsilon = 0.253 \times 2.193 \]

\[ P_2/P_1 = 2.193 = 7000/2.193 = 3191.97 \text{ N} \]

The torque supplied to the shaft is given by,

\[ \tau = (P_1 - P_2) \times R = (7000 - 3191.97) \times 80 = 544642.4 \text{ N-mm} \]

Step No. 3

The resultant bending moment diagram and torsional moment diagram are shown in fig. respectively. The stresses are maximum at point C and D.

Step No.4

Shaft diameter,

\[ \tau_{max} = 16/\pi d^3 ((M_b)^2 + (M_i)^2)^{1/2} \]

\[ 100 = 16/\pi d^3 ((45000)^2 + (544642.4)^2)^{1/2} \]

\[ d = 30.30 \text{ mm.} \]

2.2 Design of Gear

Then we selected following gear.

1. Gear 1(Driver) = 37 teeth
2. Gear 2(Idler) = 30 teeth
3. Gear 3(follower) = 24 teeth

Consider,

Tractor PTO drives 540 rpm.

For 1st gear,

\[ T_1 = 37, \quad N_1 = 540 \text{ rpm} \]

For 2nd gear,

\[ N_1/N_2 = T_2/T_1 \]

\[ 540/N_2 = 30/37 \]

\[ N_2 = 666 \text{ rpm} \]

For 3rd gear,

\[ N_1/N_3 = T_3/T_1 \]

\[ 540/N_3 = 24/37 \]

\[ N_3 = 832 \text{ rpm} \]

Then Belt conveyor rotates with 832 rpm. In 1 second Belt conveyor rotates with 14 revolutions. 14 revolutions is sufficient for feeding required quantity of manure.

2.2.1 Module Calculation

1. Driver gear

PCD = 67 mm
Number of tooth’s = 37 tooth’s  
Module = D/N 
= 67/37  
= 1.81 mm 
Module of the gear is 1.81 mm

2. Idler gear 

PCD = 53 mm  
Number of tooth’s = 30 tooth’s  
Module = D/N 
= 53/30  
= 1.76 mm  
Module of the gear is 1.76 mm

3. Driven gear 

PCD = 42 mm  
Number of tooth’s = 24 tooth’s  
Module = D/N 
= 42/24  
= 1.75 mm  
Module of the gear is 1.75 mm

Load calculation of MS angle plate

Fig.2.2 Load Calculation of MS Angle Plate

Specification

\[ A = \text{Area of section} \]
\[ F_e = \text{Permissible stress in direct compression} \]
\[ r = \text{Radius of gyration} \]
\[ l = \text{Effective length (KL)} \]
\[ K = \text{Coefficient of effective length} \]
\[ L = \text{Actual length} \]

**ISA 40×40×4 mm**

\[ A = 2.40 \text{ cm}^2 \]
\[ r = 0.77 \text{ cm} \]
\[ l = KL/r = 180/0.77=233.76 \]
\[ \text{Allowable } F_e = 64 \text{ kg/cm}^2 \]
\[ \text{Allowable load } = 64 \times 2.40=153.6 \text{ kg} \]

3. Working of Machine

The principle working of this machine is feeding manure to plants by rotary feeder and belt conveyor mechanism which drives by tractors PTO drive and wheel motion respectively.

**Steps**

1. Firstly, feed manure inside a hopper manually by using buckets and shovels.
2. Manure is crushed by crusher who placed inside a hopper. This crusher is mounted on shaft which is drives by using rotary motion of tractors P.T.O.
3. Then, crushed manure is flows down to rotary feeder which placed below a hopper. Rotary feeder drives by tire by using chain drive. And we get required quantity of material.
4. After achieving required quantity of manure by rotary feeder it passes to belt conveyor. Belt conveyor works by motion of crusher shaft through gear mechanism.
5. When clutch engages with plant then belt conveyor is in on condition with the help of clutch mechanism. Through belt conveyor rotation manure is feed to plants.

Fig 3.1 Flow diagram of experimental set-up

4. Experimental Setup

Fig 4.1 Photography of experimental set-up
5. Results

5.1 Comparison between Manually Feeding & Machine Feeding

Table 5.1 Comparison

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Parameter</th>
<th>Area (acres)</th>
<th>Worker required</th>
<th>Time (hr)</th>
<th>Cost (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Manual</td>
<td>1</td>
<td>4</td>
<td>8</td>
<td>1200</td>
</tr>
<tr>
<td>2</td>
<td>Machine</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>900</td>
</tr>
</tbody>
</table>

![Comparison between Manually Feeding & Machine Feeding](image)

6. Advantages

1. It increases productivity of grape farm.
2. The implementation of this machine is affordable to farmers and capable of performing the required operations of manure feeding in grape farm.
3. Less cost of labour involved.
4. Less time is required for manure feeding.
5. No Variation in quantity of manure feeding.
6. Machine size and shape are suitable to all type grape farms.
7. No need of skilled worker for operating this machine.

7. Future Modification

Our project is simply a ‘Manure feeding machine for grape farm’ which is manually operated without consumption of power. Following different modifications can be done to improve the output and efficiency.

A) The digging tool arrangement can be extended so that appropriate distribution of manure takes place in soil.
B) Refilling of soil tool attachment can be extended so that direct decompose of manure will take place.
C) Dual belt conveyor attachment can be made.
D) Automatic filling of manure in hopper.

Hence by having above modification above machine can be made a ‘Multipurpose manure feeder machine’ which can be making power driver operated.

Conclusion

The main conclusion will be drawn find out whether it is possible to automate a skilled manual process which would avoid worker fatigue. Also the future scope for developing the generalized mechanism for any profile can be identified. It is experimentally observed that the feed rate of manure increases as the speed of rotation of the rotary feeder increases. It helps farmer to save time and cost of production.

References

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