

Design and Fabrication of Poultry Litter Pulverizer

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Abstract:- This paper titled “Poultry Litter Pulverizer” focused on cleaning poultry farm using machine. These farms are sheds with bedded floor, chickens floak in this bedding (mixture of saw dust, coconut husk fibre and fine sand). The chicken manure collected in the bedding, if not properly ploughed in regular intervals can cause Marek’s disease, mycoplasma, respiratory viruses, E.coli, mites, and other poultry health problems. Which ultimately results in death of chickens as they are very sensible to diseases. Resulting in a huge economic burden for the farmers. To tackle this, poultry farmers have to employ workers daily to plough the bedding using Shovel, which causes an increased production cost. So design we are proposing is a machine that works on electricity in order to reduce noise to do the operation of ploughing the soil. The machine can be operated easily and the work can be done in a short time. This helps in reducing the fatigue as well as bringing down the poultry production cost.

Keywords:- poultry litter pulverizer, bedding.

I. INTRODUCTION

Broilers have on average a 47-day grow out period, during which the typical broiler chicken will generate about two pounds of litter. This means that a single broiler house, which can contain well over 20,000 birds, can generate over 40,000 lbs of litter per flock. Ploughing of poultry bedding is a tedious process that requires a lot of manual force. In various scenarios it has been seen that people found themselves physically incapable of doing such kind of job when it comes to one. Medical researches has shown that whenever a person is exposed in any scenario where he/she has to show extensive muscle movements to meet external force/stress, then there is a lot of chance that the muscles might get damaged or may be a serious injury can be prevailed because of the process.

The main parts of Poultry Litter Pulverizer are blade shaft, electric motors, spring height adjustment, rocker arm front wheels, control switch etc. Power is generated by electric motor. The blade shaft is mounted at the bottom of the frame. Blade shaft is propelled by power transmitted from electric motor to blade shaft using a v belt pulley arrangement. As an Engineer it is our duty to provide new technology to the society for the betterment of them, but also it is our concerns too to seek the need of reduction of human efforts in the places where health of a human is exposed to certain risks.

II. OBJECTIVE

The machine is aimed for using in small poultry farms in rural areas where such machines are not available. The main objective is to fabricate an economically efficient poultry litter pulverizer that clean the poultry house. If we can achieve our goal successfully in completing this project, it will be a better practically dependable solution for poultry industrial needs. In pursuit of the practical works of the project we’ll be able to practice and develop our expertise in several machining process and different machineries. Needless to say, we hope to put our theoretical knowledge into practical systems.

III. LITERATURE REVIEW

In search for various materials, method and properties of poultry litter, we were able to collect some data on the physical properties, pulverization principles, operational parameters of pulverizing poultry litter. Duhovnik *et al.* (2004) [1] studied the material transport of cattle manure along the spinner disc to improve the working principles of spreading it. They reported that manure with moisture contents of 70% and 79% had a coefficient of friction equal to 0.77 and 0.67, respectively. Landry *et al.* (2004) [2] used a modified soil sieve shaker with set of sieve sizes of 25.4, 16.4, 8.7, 5.2 and 1.2 mm to evaluate the particle size distribution of different manures. They observed that particle sizes on the top screen (25.4-mm openings) were in the range of 30 to 50 mm. They reported that large manure clods affect the conveying behaviour of manure products. Shiva Bhambota *et al.* (2014) [3] conducted a study to evaluate the pulverization and mixing performance of commercially available three different shape blades at three different rotavator rotor speeds (180, 215 and 250 rpm) in clay loam soil. They found that pulverization index decreased for all blade shapes with increase in the rotor speed of rotavator. They observed that lowest pulverization index was observed at 250 rpm (9.53 mm) followed by 215 rpm (9.99 mm) and 180 rpm (13.81 mm) for all types of blade shape. Glover (1973) [29] evaluated the three blade shapes (L, C and J) at three different rotavator rotor speeds for pulverization and mixing performance in clay loam soil. They observed that the average lower pulverization index was in case of J shape blade (10.15 mm) followed by C (11.21 mm) and L shape (11.99 mm). They concluded that J shape blade cut smaller bite length of soil followed by C and L shape blades resulting in smaller mass mean diameter (MMD) of soil clod.

IV. WORK PLAN

Stage 1 - Literature Survey:

A comprehensive study of relevant scientific data available is carried out to gain knowledge in the available firewood processing machines. The study was also helpful in giving insights on how to efficiently and economically fabricate a poultry litter pulverizer.

Stage 2 – Design the Machinery Design various mechanisms and the elements used in the poultry litter pulverizer.

Stage 3 - Cost estimation

Cost estimation is done by calculating the market price of each elements, processes required, transportation costs etc.

Stage 4 – Purchase of Inventory

Materials required are procured based on availability, price and quality.

Stage 5 – Fabrication of Machinery

The poultry litter pulverizer is fabricated by using the raw materials and several machining processes carried out under the guidance of project guide.

Stage 6 – Carrying out real time tests on the machinery machine was tested in a small poultry house with bedding of thickness 2 cm to check the capability of the machine.

Stage 7 - Establishing necessary changes based on test result If necessary, make changes in the components based on the feedback from previous tests.

V. DESIGN OF MACHINE

Poultry litter pulverizer developed at Ernad Knowledge city Technical Campus, Manjeri consisted of a five-wheel trailer, hydraulically operated push blade, spreader assembly, belt and pulley system, protective casing.

The main components of the Poultry Litter Pulverizer are as follows:

- Main Frame
- Shaft
- Electric motor
- Scoop (L – Shape)
- Horizontal plate
- Bearing
- Rocker Arm Front Wheels
- Belt Pulley
- Shock absorber
- Switch

Given below is a view of poultry litter pulverizer



Fig 1

➤ Components

A. Main frame

The frame is made of GI (Galvanized Iron) Rectangular pipes. This material is readily available, cheap yet possess high strength. All the essential components are mounted on the main frame.

| S. No | Name of the component | Material | Dimension | quantity |
|-------|-----------------------|----------|-------------|----------|
| 1 | Rectangular pipe | GI | 1×1 (inch) | 9m |

Table 1:- Decription of frame

B. Shaft

The blade shaft used in this project is custom made. It mainly consists of the shaft, L shaped blades, nuts, bolts and thrust bearings. Shaft is made of hollow circular GI tube.

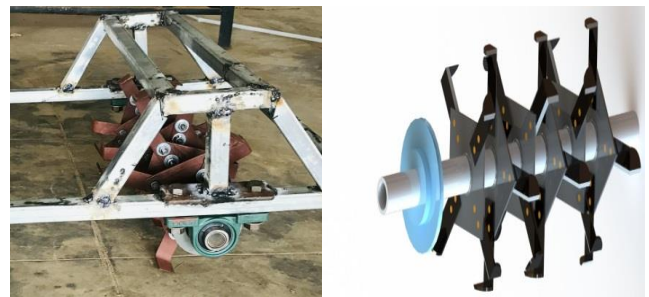


Fig 2:- blade shaft Assembly

| S. No | Name of the component | Material | Dimension | quantity |
|-------|-----------------------|----------|-----------|----------|
| 1 | Hollow circular tube | GI | 25 mm | .5 m |

Table 2:- Description of shaft

C. Electric Motor

25 HP AC motor is used to drive the blade shaft via a belt pulley setup. Motor is placed at the provision on the base of the frame.



Fig 3:-Single phase AC motor

| S.N. | Property | Rating |
|------|--------------------------|-------------------|
| 1. | Power Source Requirement | 0.25 HP , 230V AC |
| 2. | Rated Torque | 1.24 N m |
| 3. | Speed | 1440 RPM |

Table 3:- Description of Motor

D. Scoop

Scoop is part which is used to push litter. It performs the cutting action. It is an L – shaped blade design. A total of 24 scoops are bolted to the horizontal plate, which is welded to the shaft.



Fig 4:- Scoop

E. Horizontal plate

Horizontal plate is a part which is welded to the main part, which is used to carry load

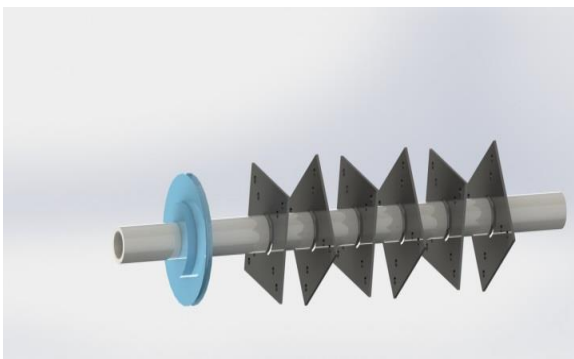


Fig 5:- Horizontal plate welded to shaft assembly

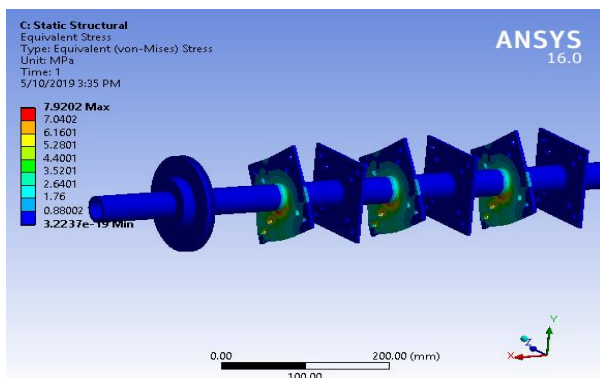


Fig 6:- Stress Analysis of horizontal plate

F. Bearing

Bearing constrains relative motion to only the desired motion, and reduces the friction between the moving parts. Pillow block type bearings are used here.



Fig 7

G. Rocker Arm Front Wheels

The rocker-arm system is the suspension arrangement. The "rocker" part of the term comes from the rocking aspect of the larger, forward leg on each side of the suspension system. Relative to the chassis, when one rocker goes up, the other goes down.



Fig 8:- Rocker arm system with wheels

H. Belt Pulley

The drive has two pulleys and a nylon V belt connecting them. The driving pulley drives the wheel of 15cm diameter. The two wheels in this arrangement has a center to center distance of 55cm.

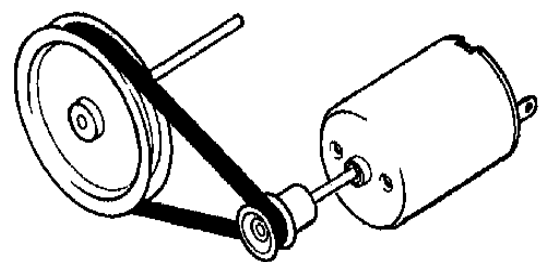


Fig 9:- V- type belt pulley system

I. Shock Absorber

A shock absorber or damper is a mechanical or hydraulic device designed to absorb and damp shock impulses. It does this by converting the kinetic energy of the shock into another form of energy (typically heat) which is then dissipated. Most shock absorbers are a form of dashpot(a damper which resists motion via viscous friction).



Fig 10:- hydraulic shock absorber coupled to the frame

J. Switch

Function of the motor starter switch is to turn the machine on or off by controlling the electricity flow to the .25HP electric motor.



Fig 11:- Change over Switch

VI. SCOPE AND DISCUSSION

The project “Design and Fabrication of poultry litter pulverizer” is an automation of manual labour done to clean poultry farms, make the work efficient and cost effective. Also, it is found that the project can work proficiently with the working capacities of covering large area in less time. The project is not producing any extra amount of thrust on the user and is cost effective as it is a one time investment. The project has been fabricated on the design of an efficient blade shaft mechanism working under the real world scenario with sufficient supply of driving torque provided by the motor to wheel.

VII. OPERATING PROCEDURE

- First connect the machine to the alternating current supply.
- Lift the poultry litter pulverizer to a suitable height.
- Start the motor with the on/off switch.
- Slowly push the handle downward to adjust the depth of cut.
- Slowly push the machine as work progress.
- Move back and forth for better pulverization of poultry litter.
- When the work is complete push the control lever to OFF position.
- Disconnect the machine from power supply.
- Release the handle then the machine comes back to its idle height.
- Clean the blade shaft after operation.

VIII. ADVANTAGES

- Ease of operation.
- Clean and disinfect the poultry house.
- Help to dry out the bedding and the moisture is released to air.
- Reduce bacterial growth.
- Provide a firm, spongy and heat insulating base by pulverizing.

IX. CONCLUSION

In this project we conclude that there are many parameters on which the total project is dependent, i.e. total knowledge about the system, design of cutting wheel and its arrangement of the main shaft, reduction in rotation. The motion study was successfully carried out when the whole assembly was completed. The frame needed some basic analysis to check whether it could take over the load or not. The following analysis was done and the results were positive. There was a problem in belt pulley alignment and bearing fitting. Also we need to change motor position at the end due to pulley arrangement. These difficulties were overcome by some expert advices. Finally the poultry litter pulverizer is fabricated successfully. The project is completed within the expected financial and time constraints. Hopefully this machine will be a good and dependable solution for poultry farmers. In the process of making this concept a reality, we as a team were able to gather more practical knowledge in machining discipline.

REFERENCES

- [1]. Duhonik, J., Benedièè, J and Bernik, R. 2004. Analysis and Design Parameters for Inclined Rotors used for Manure Dispersal on Broadcast Spreaders for Solid Manure. Transactions of ASAE. 47(5): 1389-1404.
- [2]. Landry, H., Laguè, C and Roberge, M. 2003. Engineering properties of solid and semisolid livestock manure as related to the modelling of machine-product interactions in handling and land application equipment. ASABE Paper No. 1111505. St. Joseph, MI: ASABE.
- [3]. Shiva Bhambota., Gurusahib Singh Manes., Apoor Prakash and Anoop Dixit. 2014. Effect of blade shape and rotor speed of rotavator on pulverization and mixing quality of soil. Agricultural Engineering Today. 38(4): 25-30.