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Design and Development Flexible Chaff Cutting Machine

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Abstract: ***As know about goat and cattle farming requires Chaff and other ingredients for the feeding of goats and cattle. But the Chaff like food is very long and it is very costly also. While eating, goats waste much amount of Chaff. There is up to 40-50% of Chaff is wasted by them. It is very big loss. To stop this wastage of Chaff some farmers also use the conventional method of cutting the Chaff. Some of them use machine like chaff cutter. But the main disadvantage of this machine is, it only cuts the hard or dry Chaff but it is not able to cut the wet or flexible Chaff. This type of Chaff is very much essential for faster growth of goats and ships. It can also be used for animal like horse also. So it is very much essential to manufacture a machine to cut the wet Chaff also. It should be cut in size of up to 3-4 inches in length. Machine should not make slurry and wastage of that Chaff. For that we are going to manufacture a machine of Chaff cutting with efficient price and easy in handling to user.***
Keywords: Chaff cutter, fabrication, Chaff cutter, conveyor selection, shaft design

I. INTRODUCTION

A chaff cutter is a mechanical device used to cut the straw or hay into small pieces so as to mix it together with other forage Chaff and fed to horses and cattle. This improves the animal's digestion and prevents animals from rejecting any part of their food. Chaff and operations until they were replaced by tractors in the 1940s. Chaff cutters have developed gradually from the simple machines to commercial standard machines that can be driven at various speeds so as to achieve various sizes of chaff with respect to animal preference type. New chaff cutter machines include portable tractor driven chaff cutters in which cutting of chaff is done in the field and loaded in trolleys. The present green fodder cutting machine features a single, only rod-shaped cut green fodder, green fodder cannot cut block. Whether peasant family, tribunal or farms and sales markets are in urgent need of a new, practical, functional and greener fodder cutter. The population of cattle in India in 1987 was 274 million. For such kind of population traditional human powered fodder cutting machines were used, but due to this the efforts for running the machine was physically demanding. And as per today's scenario the population of cattle is drastically increased. So to increase the productivity and reduce the physical effort required for running the machine the motorized machineries came into existence. To modify the design of conventional chaff cutting machine which can allow the farmer to not only cut the sugarcane in a form which can be utilized as a fodder for animal but can also cut various feeding materials such as soft and flexible Chaff like stylo, dry corn straw, Chaff, soya bean, wheat stalk, etc. with ease and thus reducing the manual work of the farmer and increase the fodder production.

A. Objectives

1) To ensure safety and make the machine compact to get good aesthetic look and to make it portable.
2) Provide 3-4 inch cut to the Chaff, which can be good fodder for animal and avoid wastage of Chaff.
3) Make it motor operated to save work effort and time.

II. LITERATURE REVIEW

M. V. Gudadhe, J. P. Modak[1] stated that Chaff Cutter Machine is hay or straw cutting machine which is used for uniform chopping of fodder for livestock to agro industries. In this paper, design and development of Chaff Cutter Machine is presented. The machine is developed gradually from basic machines into commercial standard machine that can be electrical driven to achieve various length of cut of chaff as per the preference. The new chaff cutter machine is modified for its compactness and to avoid blockage ofChaff.An easy way to comply with IJRASET paper formatting requirements is to use this document as a template and simply type your text into it.

P. B. Khope, J. P. Modak[2] addresses the development and performance of a Human Powered Flywheel Motor (HPFM) operated forge cutter. This set-up is used to cut crop residues like maize stovers, sorghum stovers in dry condition. This cut stovers can be fed to cattle directly

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K. S. Zakiuddin, J. P. Modak[3] stated that a chaff cutter is a mechanical device used to cut the straw or hay into small pieces so as to mix it together with other forage Chaff and fed to horses and cattle. This improves the animal's digestion and prevents animals from rejecting any part of their food.

III. DESIGN, MECHANISM AND FABRICATION

While designing the chaff cutting machine blades, shafts, bearings, belts, conveyor, motor are used to perform the mechanism of chaff cutting.

A. Design and Calculation

1) Blade Design

Length of blade = 250mm

Width of blade larger side = 44 mm Width of blade smaller side = 27 mm Thickness of blade = 8 mm

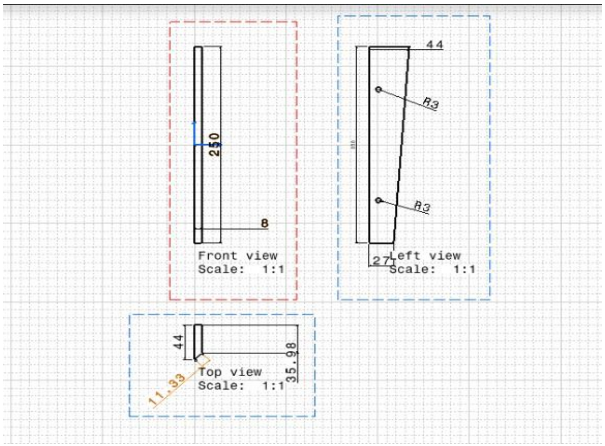


Figure 1: Blade design

2) *Blade Plate:* Width =300 mm Length of bladeplate

Force required to cut = 465.6 N By considering FOS = 1398.8 N Torque available at blade shaft:

T1 N1 = T2 N2

Where,

T1 = Torque available at motor shaft N1 = Speed of motor

T2 = Torque available at blade shaft N2 = Speed of blade shaft = 30 rpm

4947 X 1440 = T2 X 30

T2 = 237456 N.mm

Now,

length of blade plate

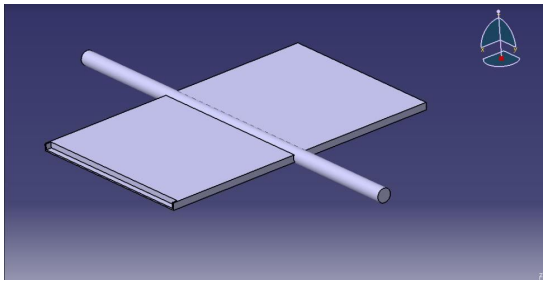
$L = \frac{T2}{1396.8}$

L = 170 mm

Length of blade plate from centre of blade shaft is 170 mm. But,

diameter of blade shaft (d) = 40 mm; r = 20 mm

L= 170 – 20 = 150 mm



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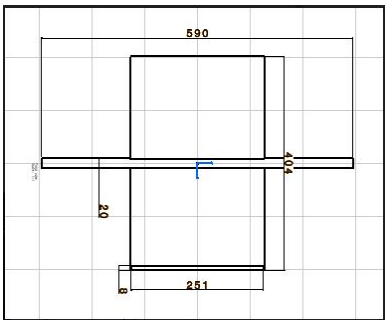


Figure 2: Blade Plate drafting and Blade Plate

3) Motor

Power = 1 HP = 746 Watt Speed = 1440 rpm

Torque available at motor shaft,

$$\text{Torque} = \frac{\text{Power(kW)} \times 60 \times 1000}{2 \times \pi \times N}$$

$$\text{Torque} = \frac{0.746 \times 60 \times 1000}{2 \times \pi \times 1440}$$

TL = 4.947 N.m = 4947 N.mm


Figure 3: Motor

4) Conveyor shaft

Length of shaft = 590 mm

Diameter of shaft –

Load on the shaft = Kr X m X g Where ,

Kr = Rolling resistance

m = mass of Chaff on the conveyor.

Ft = 0.30 X 9.81 X 10

Ft = 29.43 N

Torque at the shaft = Ft X 25

= 29.43 X 25

Torque at the shaft = 735.75 N.mm

Now , In case of pulley C ,

$$\frac{P1}{P2} = e^{\mu\theta}$$

P1 =2.125 P2 ….(1)

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But,

R_C (P1 – P2) = Torque at the shaft

$$(P1 - P2) = \frac{735.75}{25}$$

$$(P1 - P2) = 29.43N \quad \ldots\ldots(2)$$

From (1) And (2), P1 =55.59 N P2 = 26.16 NP1 + P2 = 81.75N
Bending force acting on the shaft at C is 81.75 N . To find R_A and R_B,
$R_A = R_B = 40.875N$
Bending moment at C
Mb =40.875 X 229 Mb = 9360.735 N.mm
Maximum Bending moment Mb = 7489.625 N.mm Maximum Bending moment Mt = 735.75 N.mm Maximum Torsional Moment –
M_t = 237456 N.mm

Now ,

$$Allowablestress = \frac{0.5\ Syt}{FOS}$$

τ_{max} = 66.67 N.mm

We have formula ,

$$\tau_{max} = \frac{0.5\ Syt}{FOS}$$

$$\tau_{max} = \frac{16}{\pi d^3}$$

$$66.67 = \frac{16}{\pi d^3}$$

$$d^3 = 574.89$$

$$d = 8.3mm \frac{}{\sqrt{(Mb)^2 + (Mt)^2}}$$

$$\sqrt{(9360.375)^2 + (735.75)^2}$$

B. Experimental Setup

This is the final working setup manufactured for flexible Chaff cutting purpose. This can be used as to cut the fodder Chaff for goat farming by the farmer to reduce the efforts and increase productivity.



Figure 4: Experimental Setup

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Figure 5: Housing

1) *Housing:* Housing covers the cutting blade. Whatever chopping or grinding action is done it takes place within the housing. Housing protects the worker from not touching the blades accidentally.

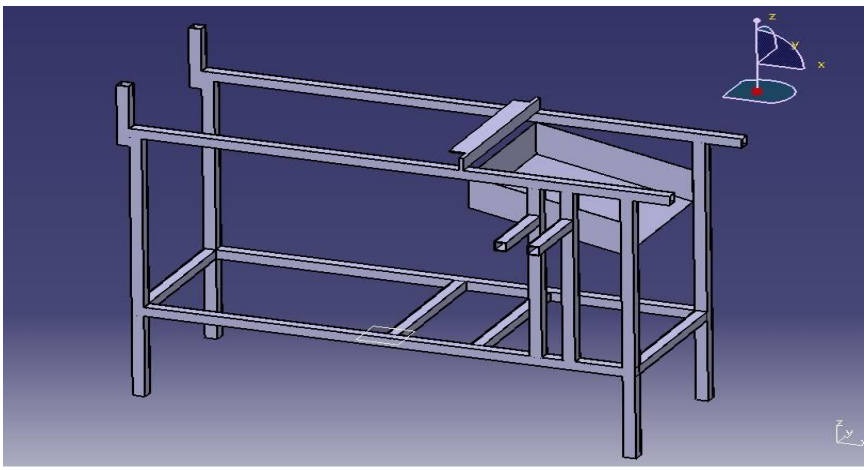


Figure 5: Housing

2) *Supporting Frame:* The whole assembly is mounted on this frame. The complete frame is made up of mildsteel.

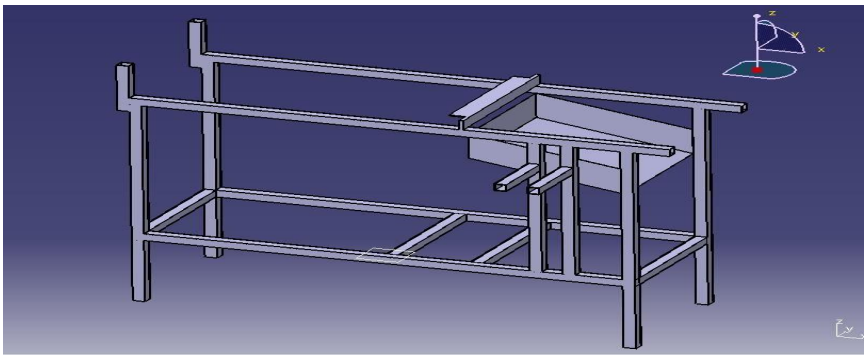


Figure 6: Frame

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IV. ASSEMBLY, WORKING AND TESTING

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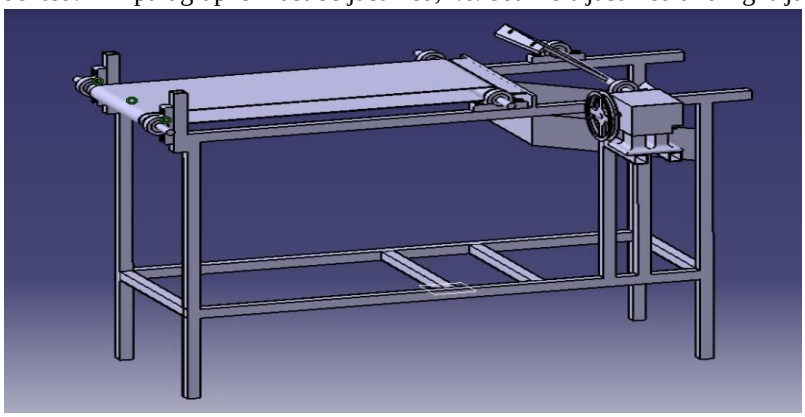


Figure 7: Main Assembly

A. Working Procedure

1) *Supply Power Source to Electric Motor:* Here we are using single phase 2 H.P motor so we require single phase power supply. Input speed of our electric motor is 1425 rpm. In order to rotate chaff cutting blade we have to rotate them by using power drives.
2) *Power Transmission through Belt-Pulley Drive Which Are Mounted on Shaft:* For transmitting power we choose belt & pulley as power drive .This belt pulley arrangement is coupled to cutting blades by using coupling shaft. Hence rotation of cutting blades occur.
3) *Feeding Of Food Material:* We feed fodder through conveyor. As feed trough has large opening & high length this provides guide way to Chaff & other fodder material like dry corn straw, Chaff, soya bean, wheat stalk, with ease and thus reducing the manual work of farmer and increases the fodder production.
4) *Collect Fodder From Output Tube:* After rotation of cutting blades, it causes cutting of supplied feed material like Chaff dry corn straw. This lightweight particles thrown away by centrifugal force of cutting blade towards outlet tube. Place container for collecting fodder.

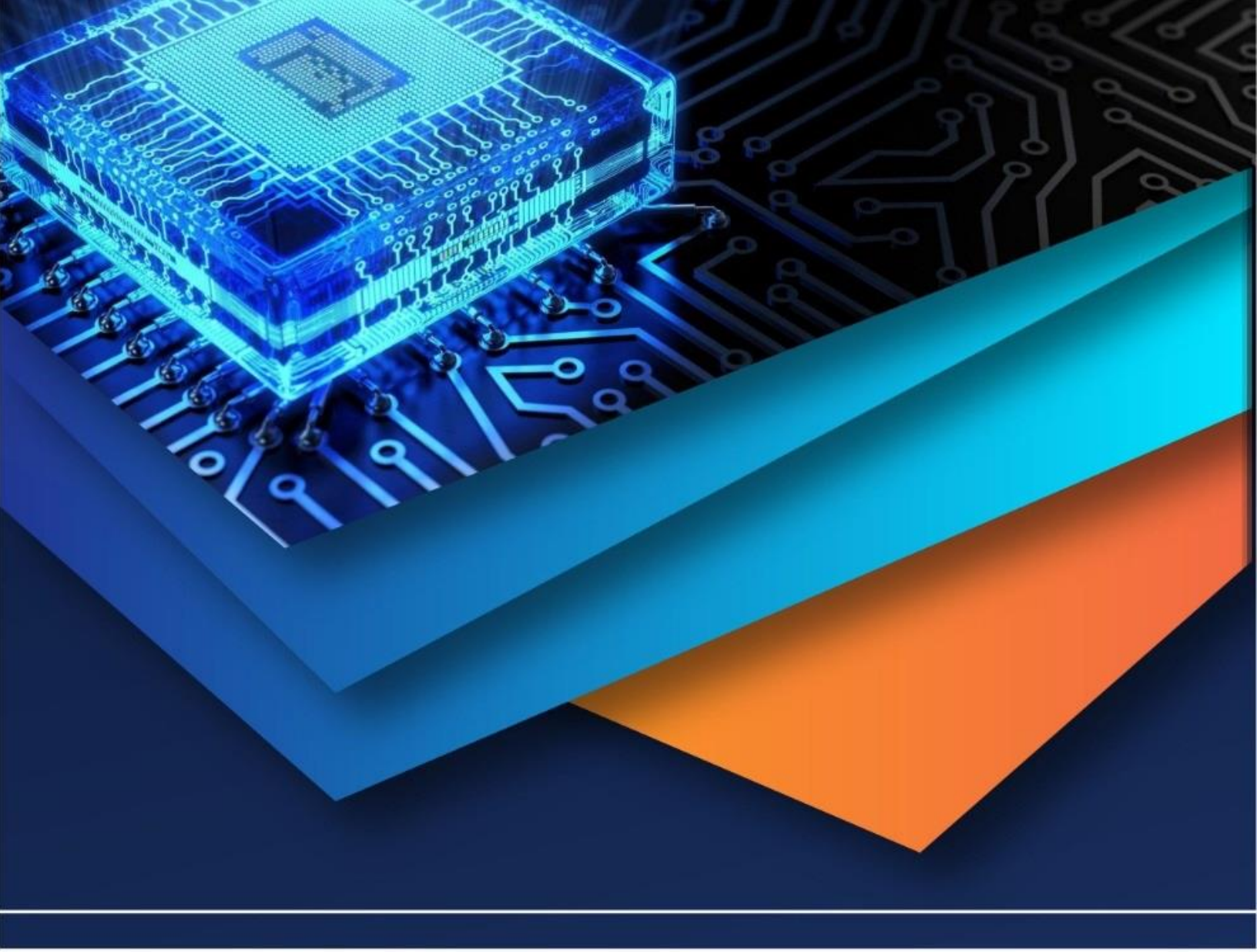
V. CONCLUSIONS

This Work replace different sources of chaff cutter by 2 H.P single phase which require low electricity & easily available anywhere so it's beneficial to farmer. By using different types of blades we can obtain different types of chaff for animal. By using this machine we can cut the sugarcane waste so that it can be utilized as a fodder for animal as well as grind various feeding materials such as dry corn straw, Chaff, soya bean, wheat stalk, with ease and thus reducing the manual work of farmer and increases the fodder production. The machine is simple in construction as there is not so much complication in design. It is also important that velocity ratio can easily be determine measuring number of teeth on gears PCD of pulleys. The machine is designed in such a way that it will require minimum space to install. As the motor is placed inside the machine stand not outside the machine, the space is considerably saved.

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