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Design and modification of fodder cutter machine blades for improving blade life

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ABSTRACT

The fodder cutting machine is used for agriculture purpose. Due to this machine there are uniform chopping of the fodder take place. This machine is used to cut various types of stalks, grass, wheat stalk, sorghum stalk etc. After cutting these stalks, the final material is produced in the form of little fine pieces. And the final product is fed to farm animals like cattle, deer, goat so that there will be better digestion of these animals. In this paper a chaff cutter blade is designed made of high carbon steel. By making some improvements in blade angles and edge thickness, the blade is designed. Some force, stress calculations are mentioned in this paper. These parameters are important for improving the blade life.

Key words: blade, material, thickness, load, power

INTRODUCTION

A fodder cutter is a mechanical device used to cut the straw or feed into little pieces to combine it as one with other rummage grass and took care of dairy cattle. This works on the cattle's assimilation and keeps cattle's from dismissing any piece of their food [1]. Fodder cutters have grown progressively from the straight forward machines to business standard machines that can be driven at different rates to accomplish different sizes of waste regarding creature inclination type [3]. New refuse shaper machines remember compact work vehicle driven fodder cutters for what cutting of waste is done in the field and stacked in trolleys. The populace of cattles and buffalows in India in 1987 was 274 million. For such sort of population customary human controlled grain cutting machines were utilized. Now there is increase in the population of cattle and buffalows, so some power operated machines are come in existence [2].

OBJECTIVE

In the previous fodder cutter machines, blades are damaged as early because of load acing on the blade while cutting fodder. Here we design a blade for cutting dry grass into fine pieces. We are modifying the blade by changing blade angles and blade edge thickness so that the less force is required to cut the grass. Our aim is to improve the life of blade

COMPONENTS OF FODDER CUTTER MACHINE

1. Electric motor

Electric machine is an electrical machine that is utilized to change over electrical energy into mechanical energy. For more modest burdens as in family application in fans. Albeit customarily utilized in fixed-speed administration, induction

motors are progressively being utilized with variable-frequency drives in various speed operation. VFD offer particularly significant energy saving for induction motor.

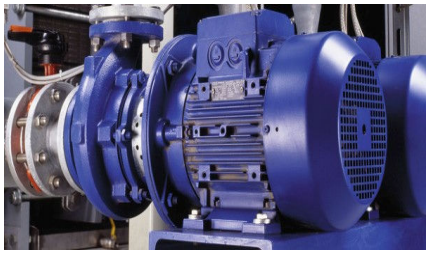

Fig. 1 Electric motor

2. Shaft

A shaft is a rotating element which transmits power from one part to another. Transmission shafts are used to transmit power between the source and the machine absorbing power. Machine shafts are the integral part of the machine itself. The material used for ordinary shafts is mild steel. When high strength is required, an alloy steel such as nickel, nickel-chromium or chromium-vanadium steel is used. Shafts are generally formed by hot rolling and finished to size by cold drawing or turning and grinding.

Fig. 2 Shaft

3. V-Belt

The V-belt has been in presence since the mid 1920's. As the years progressed, numerous alteration are done in the utilization of material of V-belt development and in cross sectional shape too. Initially, V-belts appeared to supplant the level and round belts on auto drives to guarantee more noteworthy unwavering quality. V belt drive course of action is utilized to transmit power from engine to screw which is associated with shaper mechanism. The utilization of V-belts in different, permitted drives with a much factor scope of torque limit than any time in recent memory reachable utilizing single belt

Fig. 3 V-Belt

4. Hopper

Box is utilized to take care of food material like sugarcane, cutting grass. Feeder chooses limit of feed choppers. Its capacity is give guidance to grass, corn straws and carry contact with debris cutting sharp edge.

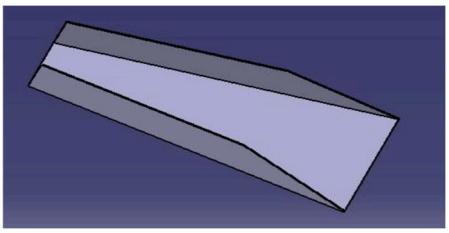

Fig. 4 Hopper

5. Housing

Housing covers the cutting edge. Whatever slashing or crushing move is done it makes place inside the housing. Housing shields the labour from not contacting the cutting edges inadvertently.

6. Fodder cutter blade

They have sharp edge, they used to cut grass into number of little pieces. Cutting blades are rotate in housing and get squashed in powder form.

Fig. 5 Blade

7. V-Pulley

To send power from electric motor to shaft this v pulley is used. A belt and pulley framework is described by different pulleys in like manner to a belt. This takes into account mechanical power, force, and speed to be communicated across axles. In the event that the pulleys are of contrasting distances across, a mechanical benefit is realized.

Fig. 6 V pulley

PROCEDURE FOR CUTTING CHAFF, STEMS, FODDER

1. Supply power source to Electric engine

Here we are utilizing single stage 1 H.P motor so we require single stage power supply. Input speed of our electric engine is 1440 rpm. In request to pivot refuse slicing edge we need to turn them by utilizing power drives.

2. Power transmission through belt-pulley drive which are mounted on shaft

For sending power we pick belt and pulley as power drive. This belt pulley game plan is coupled to cutting sharp edges by utilizing coupling shaft. Consequently, turn of cutting sharp edges happen.

3. Taking care of food material

We feed through container. As feed box has enormous opening and high length this gives guide method for grassing and other feed material like dry corn straw, grass, soyabean, wheat tail, effortlessly and along these lines decreasing the manual work of rancher and builds the grub creation.

4. Gather feed from yield tube

After pivot of cutting edges cause cutting of provided feed material like grass dry corn straw into powder structure. This light weight particle discarded by outward power of cutting edge towards outlet tube. So, place holder for gathering grub

IMPROVEMENT IN FODDER CUTTER BLADES

Blades of fodder cutting machine made of high carbon steel. We are using 2.5mm and 3.5mm thick blade here. We are using different blade angles like 10 degree, 20 degree, 30 degree, 40 degrees. The force obtained after theoretical analysis are as follows.

$$F = c.s + \frac{E1d.d}{2h}[\tan\alpha + \mu' \sin^2\alpha + v(\mu' + \cos^2\alpha)]$$

α is blade bevel angle, c is blade edge thickness, E1 is mean modulus of deformation, s is yield strength, μ'is coeff of friction between grass and blade, d is diameter of grass, h is deapth of compression, v is poisons ratio for plant.

Following table shows force required to cut dry grass by using 2.5mm blade and 3.5mm blade. The forces are calculated as per theoretical analysis for 10 degree, 20 degree and 30 degree blade angle.

Table-1

Blade thickness (mm)	Blade angle (degree)	Force (N)
2.5	10	71.11
2.5	20	69.04
2.5	30	59.8
3.5	10	112.65
3.5	20	97.4
3.5	30	96.7

By using 2.5mm blade and by using blade angle as 10 degree, 20 degree, 30 degree then the force required to cut the dry grass is 71.11N, 69.04N, 59.8N respectively. Similarly, for 3.5mm blade and by using blade angle as 10 degree, 20 degree, 30 degree then the force required to cut the dry grass is 112.65N, 97.4N, 96.7N respectively. So by using both type of blades, by using blade angle 20 degree and 30 degree minimum forces are required to cut the dry grass.

VON-MISES STRESSES ON BLADE BY FEA

TABLE-2

Blade thickness (mm)	Blade angle (degree)	Force (N)	Von-Mises Stresses (MPa)
2.5	10	71.11	53.7
2.5	20	69.04	47.3
2.5	30	59.8	46.5
3.5	10	112.65	46.7
3.5	20	97.4	41.4
3.5	30	96.7	35.4

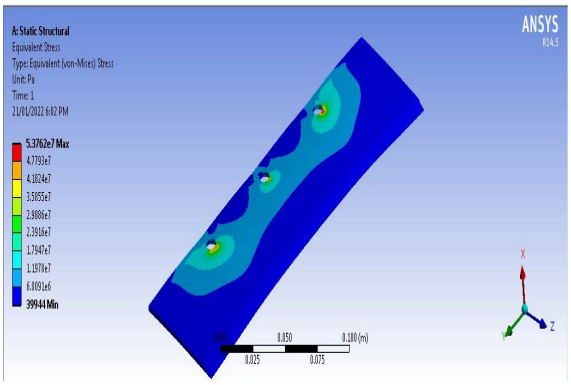

Fig. 7 Stress for 2.5mm blade and 10 degree angle

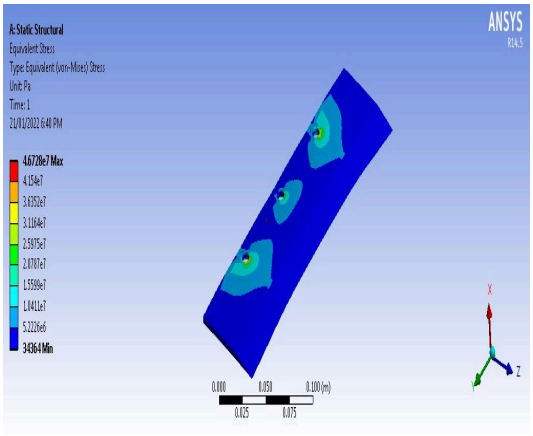

Fig. 8 Stress for 3.5mm blade and 10 degree angle

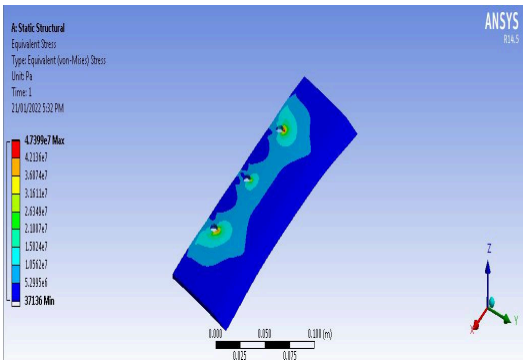

Fig. 9 Stress for 2.5mm blade and 20 degree angle

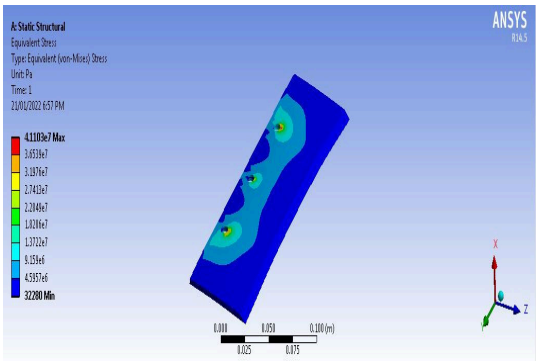

Fig. 10 Stress for 3.5mm blade and 20 degree angle

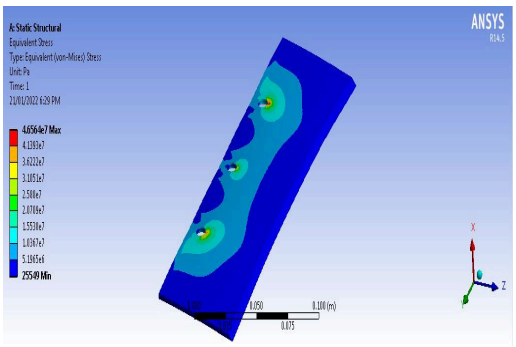

Fig. 11 Stress for 2.5mm blade and 30 degree angle

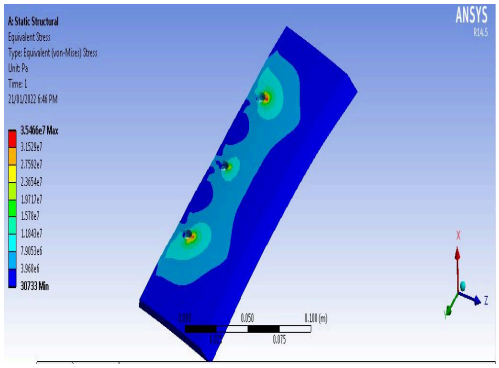

Fig. 12 Stress for 3.5mm blade and 30 degree angle

RESULT

According to FEA analysis of blades, the force vs stress graph for each blade and for each angle are as follows.

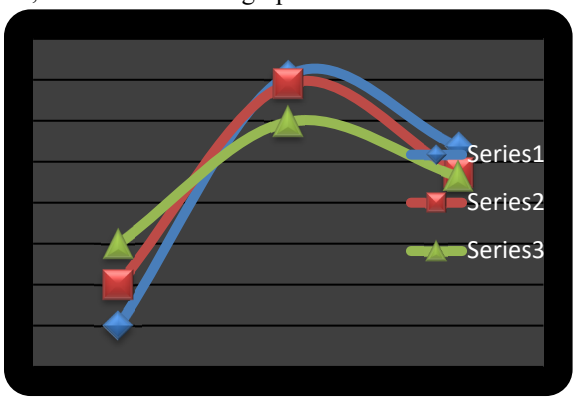

Fig. 13 Graph of force vs stress for 2.5mm blade

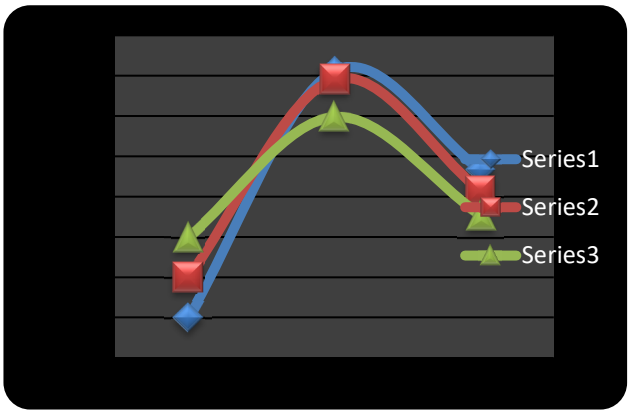

Fig. 14 Graph of force vs stress for 3.5mm blade

CONCLUSION

As per FEA analysis, the stresses required for 20 and 30 degree blade angle are less as compared to 10 degree blade angle. But this is only for cutting dry grass in fodder cutter. The stress distribution and forces will be different for different chaff, different stem sample. As the value of Von-mises stresses are minimum, this indicate that there should not be more wear on blade edge. So the life of blade is more in such case.

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