DESIGN AND FABRICATION OF CHAFF CUTTER WITH BLADE(AISI-1019)

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ABSTRACT

A chaff cutter is an essential agricultural machine used to cut straw or hay into small pieces before feeding livestock, enhancing digestibility and reducing wastage. This work focuses on the design and fabrication of a low-cost, efficient, and durable chaff cutter suitable for small- and medium-scale farmers. The machine is designed to operate manually or with a motorized system, improving flexibility and ease of use. The design incorporates a high-speed rotating blade mechanism housed in a robust frame, ensuring stability and safety during operation. Material selection is optimized for strength, durability, and corrosion resistance, while the cutting mechanism is designed for maximum efficiency with minimal power consumption. The fabrication process includes cutting, welding, machining, and assembly of various components to achieve a functional prototype. Performance evaluation is conducted based on cutting efficiency, uniformity, power requirements, and maintenance needs. The results indicate that the designed chaff cutter effectively processes different types of fodder, improving feed preparation and reducing manual labor. This project provides an affordable and efficient solution for farmers, enhancing livestock management and productivity. Future enhancements may include automation and alternative power sources for improved sustainability.

KEYWORDS: chaff, uniform chopping, cutter blade , Mild steel(AISI 1018)

1. INTRODUCTION

A chaff cutter is a mechanical device for cutting straw or hay into small pieces before being mixed with other forage and fed to horses and cattle. This aids the animals' digestion and prevents animals from rejecting any part of their food. Chaff and hay play a vital role in most agricultural production as it was used for feeding horses.Chaff cutters have evolved from the basic machines into commercial standard machines that can be driven at various speeds and can achieved various lengths of cuts of chaff with respect to animal preference type. The existing chaff cutting machines are observed and studied properly to detect the problems faced by the user are Bulky or less compact design,High voltage required such as 3 phase,Less safety while using by women,Noisy,Blockage of grass creates feed interference By observing above limitations we manufactured and modified present chaff cutter.

The objective of this present work is to modify the design of chaff cutting machine which can allow the farmer to cut various feeding materials such as sugarcane, top, grass, wheat stalk, with ease and thus reducing the manual effort of farmer and save electricity. consumption.

1. LITERATURE SURVEY

India has a vast resource of livestock and poultry, with about 65.1 million sheep, 135.1 million goats, and 10.3 million pigs as per the 19th livestock census [1]. Animal feeding is a very important factor in animal husbandry, and it will be more suitable when fodder is cut into small pieces. Chaff is hay cut into small pieces for feeding to livestock [2]. On dairy farms, chaff cutters are used to cut the chaff, dry grass, and green grass on a very large scale. Some farmers are using the chaff cutter to cut the chaff and feed types that are fed to domestic animals. Cutting chaff can be done manually or with a power-operated machine. Most of the farmers chop the fodder into small pieces with the use of sharp knives or sickles for feeding the animals, which may intensify the utilization and digestion ratio [3]. Manual chaff cutters demand physical energy and postural requirements and are commonly regarded as a source of drudgery; many farmers associated with this task reported back, shoulder, and wrist discomfort. So, to increase productivity and reduce the physical effort required for running the machine, motorized machines came into existence, which is best for dairy farmers.The implementation of this technology in the field of agriculture has brought about a wide range of changes in manual procedures, which are now replaced by advanced technical procedures [4]. To meet the growing demand from livestock farms, high-efficiency, safe forage processing chaff cutters are the need of the hour. An increase in cutting speed results in maximum efficiency and chopper capacity when using serrated edge blades [5].

3. METHODOLOGY

The methodology for developing a chaff cutter involves a structured process that includes problem identification, design, fabrication, and testing. The first step is to understand the challenges faced by farmers in traditional fodder cutting methods, which are often labor-intensive, inefficient, and prone to wastage. By conducting a detailed analysis of these problems, the specific requirements for the chaff cutter are identified, such as the type of fodder to be processed, desired cut size, and power options (manual, motorized, or solar-powered). This helps ensure that the machine addresses the core needs of the farmers effectively.

Once the requirements are clear, the conceptual design phase begins, where different design alternatives are explored. This includes selecting the right blade configuration for efficient cutting, determining the optimal feeding mechanism, and incorporating safety features. The choice of materials is crucial in this phase, with high-carbon steel being a popular choice for blades due to its durability and sharpness. The machine frame is typically made of steel or other robust materials to ensure structural integrity, while power transmission components like motors, belts, or gears are selected based on the desired machine capacity.

After finalizing the design, the fabrication and assembly stage follows. This involves cutting and shaping the machine frame, manufacturing or sourcing the cutting blades, and assembling the feeding and discharge mechanisms. The motorized or manual drive system is installed, ensuring all components are aligned and securely fastened. Once assembled, the chaff cutter undergoes rigorous testing to evaluate its performance. Parameters such as cutting speed, fodder size uniformity, power consumption, and throughput capacity are carefully analyzed.

The testing phase may also identify areas for improvement, prompting design adjustments to enhance efficiency and durability.

Finally, after optimization, the chaff cutter is ready for deployment on farms, with feedback from users being continuously collected to ensure the machine meets the practical needs of livestock farming..

2. DESIGN AND CALCULATIONS

Main Components used in developing Model of Chaff cutter

1. Main Frame : The frame is made of GI (Galvanized Iron) Rectangular pipes.
2. 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.
3. Electric motor: 0.5 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.
4. Cutting blade: Cutting blade is main part in chaff cutter machine which is used to cut forage into small pieces which is made AISI 1018 hot rolled steel also includes improved machining characteristics and Brinell hardness.and also it is corrosion resistant.
5. Sprocket : A sprocket or sprocket-wheel is a profiled wheel with teeth, cogs, or even sprockets that mesh with a chain, track or other perforated or indented material.

2.1 Selection of sprocket

Selection of the sprocket Large sprocket= 4x
Small sprocket = x Ratio of the sprocket = 1:4
Speed of the sprocket
N4 = 1.01 X 4 N4 = 4.04 rps

4.2 Ratio of Spur Gear

Consider ratio of the gear 1 and 2 is 1:2 N2 = 4 X2
= 8 rps
We get the final RPM at the D.C generator gear
= 8 X 60
= 480 rpm

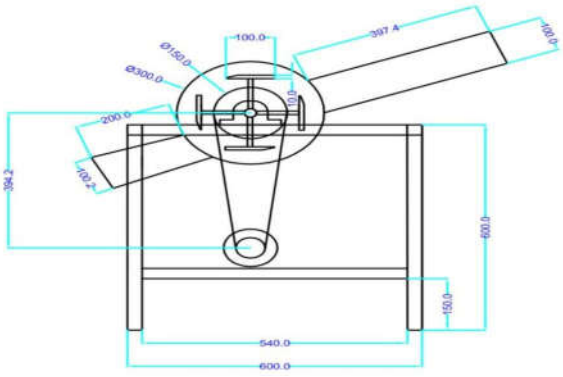

Figure 4.1 CAD Model of Chaff Cutter

Figure 4.2 Built Model of Chaff Cutter

3. Conclusions & Results

The chaff cutter has revolutionized livestock farming by streamlining the process of fodder preparation, making it more efficient and sustainable. By ensuring that straw, hay, and grass are cut into small, digestible pieces, it enhances the feeding process, leading to improved nutrient absorption and better overall health for animals.

1.This optimized feeding method directly contributes to increased productivity, whether in terms of higher milk yield for dairy cattle or improved weight gain in meat-producing livestock.

2. Farmers benefit from these improvements as they result in better returns on investment and more efficient use of available resources.

3.One of the most significant advantages of the chaff cutter is its ability to minimize fodder wastage. When animals are provided with long, unprocessed fodder, they tend to consume only the parts they prefer, leaving the rest unused.

4.The chaff cutter addresses this issue by producing uniformly chopped fodder, ensuring that livestock consume the entire portion provided to them. This not only reduces wastage but also promotes a balanced diet, leading to healthier and more productive animals.

5. Beyond improving feeding efficiency, the chaff cutter plays a crucial role in reducing manual labor and saving time.

4. References

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