ISSN 2229-5518

FABRICATION AND PERFORMANCE MEASUREMENT OF MANUALLY POWERED FODDER CUTTER

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Abstract

In India, Animal husbandry is a vital part of the rural economy. Almost every rural family keeps at least a cow or buffalo for meeting milk requirement and to earn some money for daily expenses. The milk production is predominantly affected by cattle feeding . However most of cattles are fed with whole crop. It may leads to wastage of feeding. It was noted that there is always scarcity of fodder feeding in summer. In such situation the whole crop is to be cut into small pieces so that fodder can be used effectively. Presently fodder cutting machines are electrically operated. But today there is huge shortage of electricity almost every parts of India. To overcome uncertainty of electricity, we can replace electrically driven motor by manually powered cattle feed cutter. The fodder cutter energized by human powered flywheel motor is suitable for marginal farmer who have 2-3 cattle. The experimentation carried out for establishing empirical model for identified variables affecting cutting of crop resides.

Keywords: Manually operated fodder cutter , pedal operated fodder cutter.

1.Introduction

Livestock production and agriculture are relatively linked together, and both crucial for overall food security. Livestock sector is an important livelihood activity foremost of the farmers. , small and semi-medium farmers with average operational holdings of area less than 4 ha own about 87.7% of the livestock of this country. India has vast resource of livestock and poultry about 65.1 million sheep, 135.1 million goats and about 10.3 million pigs as per 19th Livestock census.This plays a vital role in improving the socio-economic conditions of rural masses. India continues to be the largest producer of milk in world. As a result of several measures to increase the productivity of livestock, milk production has significantly increased by about 25 % from the level of 102.6 million tones at the end of the tenth plan to 127.9 million tones at the end of the eleventh plan in 2011-12. Poultry sector is now in current state where commercial production is the norm of the day with a number of technologies intervention. By the end of 2011-12, the total production increased by 37 % to about 70 million. Wool production in 2012-13 was 46 million kg with a growth rate about 3 %.The average yield of wool per season at national level from different category of sheep during 2012-13 is 1.09 kg/season from rams, 0.73 kg/season from ewes, 0.42 kg/season from lambs. Meat production in 2012-13 was 5.95 million tones. The annual growth rate for production of meat is7.87 % in 2012-13.

The main objectives of the Fodder-cutting machines are used for chopping fodder for draft animals and domestic cattle. These can be operated manually. The mechanization of agricultural practices has resulted in increased agricultural productivity in India but at the same time the Incidence of traumatic injuries among agricultural workers seem to have increased.. It is estimated that every year in Haryana, Punjab and Uttar Pradesh (three States of northern India) alone there may be 5000–10,000 deaths, in older age groups, various reasons have been reported for injuries. These include economic necessity, slow reflexes, and carelessness with increased experience, physiological impairments and other age related reasons. Agricultural workers in low-income countries (LICs) are neither covered by Insurance nor do they have adequate infrastructure for medical facilities. In LICs safety standards and their enforcement are also not adequate enough to protect farmers from injuries. However, its important is not the same in every state of the country as agriculture is a state subject regulated locally. This paper reports the results of an epidemiological study, which resulted in safer design fodder-cutter machine.

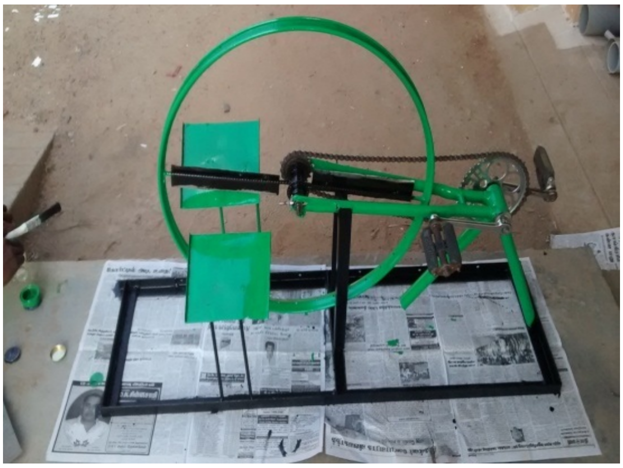

Figure 1.Fabricated project

Figure 2. fodder field

The main objectives are

1.To construct a cost effective equipment and to aid a farmer .

2.To develop a safe design for fodder-cutter machine

3.To construct an equipment which runs with 0% fossil fuels

3. Materials and methods

Yield strength is the most common property that the designer will need as it is the basis used for most of the rules given in design codes. In European Standards for structural carbon steels (including weathering steel), the primary designation relates to the yield strength, e.g. S355 steel is a structural steel with a specified minimum yield strength of 355 N/mm². It is in the nature of all materials to contain some imperfections. In steel these imperfections take the form of very small cracks. If the steel is insufficiently tough, the 'crack' can propagate rapidly, without plastic deformation and result in a 'brittle fracture'.

The risk of brittle fracture increases with thickness, tensile stress, stress raisers and at colder temperatures. The toughness of steel and its ability to resist brittle fracture are dependent on a number of factors that should be considered at the specification stage. A convenient measure of toughness is the Charpy V-notch impact test - see image on the right. This test measures the impact energy required to break a small notched specimen, at a specified temperature, by a single impact blow from a pendulum..

Low-carbon steel contains approximately 0.05–0.25% carbon making it malleable and ductile. Mild steel has a relatively low tensile strength, but it is cheap and easy to form; surface hardness can be increased through carburizing.

Ductility is a measure of the degree to which a material can strain or elongate between the onset of yield and eventual fracture under tensile loading as demonstrated in the figure below. The designer relies on ductility for a number of aspects of design, including redistribution of stress at the ultimate limit state, bolt group design, reduced risk of fatigue crack propagation and in the fabrication processes of welding, bending and straightening.

The various standards for the grades of steel in the above table insist on a minimum value for ductility so the design assumptions are valid and if these are specified correctly the designer can be assured of their adequate performance. The properties of aluminium include: low density and therefore low weight, high strength, superior malleability, easy machining, excellent corrosion resistance and good thermal and electrical conductivity are amongst aluminum's most important properties. Aluminium is also very easy to recycle.One of the best known properties of aluminium is that it is light, with a density one third that of steel, 2,700 kg/m3. The low density of aluminium accounts for it being lightweight but this does not affect its strength.

Aluminium alloys commonly have tensile strengths of between 70 and 700 MPa. The range for alloys used in extrusion is 150 – 300 MPa. Unlike most steel grades, aluminium does not become brittle at low temperatures. Instead, its strength increases. At high temperatures, aluminum's strength decreases. At temperatures continuously above 100°C, strength is affected to the extent that the weakening must be taken into account.

Compared with other metals, aluminium has a relatively large coefficient of linear expansion. This has to be taken into account in some designs. Aluminium is easily worked using most machining methods – milling, drilling, cutting, punching, bending, etc. Furthermore, the energy input during machining is low.Aluminum's superior malleability is essential for extrusion. With the metal either hot or cold, this property is also exploited in the rolling of strips and foils, as well as in bending and other forming operations. Aluminium is an excellent conductor of heat and electricity. An aluminium conductor weighs approximately half as much as a copper conductor having the same conductivity.

Features facilitating easy jointing are often incorporated into profile design. Fusion welding, Friction Stir Welding, bonding and taping are also used for joining.

Another of the properties of aluminium is that it is a good reflector of both visible light and radiated heat.

Aluminium reacts with the oxygen in the air to form an extremely thin layer of oxide. Though it is only some hundredths of a (my)m thick (1 (my)m is one thousandth of a millimeter), this layer is dense and provides excellent corrosion protection. The layer is self-repairing if damaged. Anodizing increases the thickness of the oxide layer and thus improves the strength of the natural corrosion protection. Where aluminium is used outdoors, thicknesses of between 15 and 25 ¥in (depending on wear and risk of corrosion) are common. Aluminium is extremely durable in neutral and slightly acid environments. In environments characterized by high acidity or high basicity, corrosion is rapid. Aluminium is a non-magnetic (actually paramagnetic) material. To avoid interference of magnetic fields aluminium is often used in magnet X-ray devices.After oxygen and silicon, aluminium is the most common element in the Earth's crust. Aluminium compounds also occur naturally in our food.

Other mechanical properties of structural steel which are important in designers aspect

- Modulus of elasticity, E = 210,000 N/mm²
- Shear modulus, $G = E/[2(1 + \nu)]$ N/mm², often taken as 81,000 N/mm²
- Poisson's ratio, $\nu = 0.3$

Coefficient of thermal expansion, $\alpha = 12 \times 10^{-6}/°C$ (in the ambient temperature range).The properties of aluminium include: low density and therefore low weight, high strength, superior malleability, easy machining, excellent corrosion resistance and good thermal and electrical conductivity are amongst aluminum's most important properties. Aluminium is also very easy to recycle.One of the best known properties of aluminium is that it is light, with a density one third that of steel, 2,700 kg/m3. The low density of aluminium accounts for it being lightweight but this does not affect its strength..Aluminium alloys commonly have tensile strengths of between 70 and 700 MPa. The range for alloys used in extrusion is 150 – 300 MPa. Unlike most steel grades, aluminium does not become brittle at low temperatures. Instead, its strength increases. At high temperatures, aluminum's strength decreases. At temperatures continuously above 100°C, strength is affected to the extent that the weakening must be taken into account.Compared with other metals, aluminium has a relatively large coefficient of linear expansion. This has to be taken into account in some designs. Aluminium is easily worked using most machining methods – milling, drilling, cutting, punching, bending, etc. Furthermore, the energy input during machining is low.Aluminum's superior malleability is essential for extrusion. With the metal either hot or cold, this property is also exploited in the rolling of strips and foils, as well as in bending and other forming operations. Aluminium is an excellent conductor of heat and electricity. An aluminium conductor weighs approximately half as much as a copper conductor having the same conductivity.

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The average work rate of a man working continuously is equivalent to 75W (Alexa drove, 1981). Therefore, only continuous manufacturing process requiring less than 75W can be man powered. Any manufacturing process requiring more than 75W and which can be operated intermittently without affecting end product can also be man powered. Before starting this process, collecting fodder (forage) is mandatory, it can be collected from the farms land where it is cultivated.once it is collected and there is a process to place fodder in guiding plates as shown in figure 3.

ISSN 2229-5518

Figure 3 loaded fodder

After loading fodder on guiding plates, pedal is operated manually to provide motions to the blades as shown in figure 4. The blades are sharp enough to cut a huge volume of fodder and they are placed with 180^o angle shift , so that the blades can store enough energy to make the cutting action a successful one.

Figure 4 pedaling action

Figure 5

Due to pedaling, cutting blades tend to rotate and due to rotation of blades fodder can be cut into particular size. As shown in figure 5. The system design is flexible to facilitate a farmer to slice the fodder to various sizes for feeding various group of animal husbandry.

Figure 6 Sliced fodder

4.Description

This pedal operated fodder cutter consists of following elements such as, flywheel, cutting blade, pedal , chain, and base. The bicycle rim is used as a flywheel which is light compact, regular and circular. The blades are mounted on the wheel through a link by joining the link with the wheel by welding. The blades are placed in such a way that the blades have the angle shift of 180^o. A guiding plates are used for facilitating cutting action for the convenient flow of fodder into the blades. The blades tend to rotate inside the wheel in regular motion, stainless steel is chosen as a material for blades which can resist the wear and corrosions very effectively. The pedal is used to power the system which can be operated manually. Chain sprocket is used for transmitting power from the pedal to cutting wheel. The mild steel columns are used to make balancing base , it also acts as a stand.

Specification

COMPONENTS	DIMENSIONS(mm)	
Flywheel	Length	600
	Breath	50
	Depth	2
Base	Length	1200
	Breath	350
	Depth	2
Blade	Length	250
Chain	Length	1320
Pedal rod	Length	180

ISSN 2229-5518

Frame	Length	430
Gear teeth	Large =44 teeth	Small=17 teeth


Figure(5.1)

The materials selected for various components of the fodder cutter are tabulated as follows

COMPONENTS	MATERIAL
Base	Mild steel
Fly wheel	Aluminium alloy
Blade	Mild steel

5.Results and Discussions

The fabricated model can be tested for its performance. The cutting performance is directly affected by physical nature of the fodder plants. Farmers harvest these fodder plants at various age groups of such plants. The fodders are harvested from two months to five months. So the variation in the physical nature of the fodder has been identified as the eight months plants are harder than three months plants. so the samples of fodder selected are three, four and five months aged. The observations of the cutter performance were made with various age group plants are tabulated as follows,

Measure of Cutting Performance

S.NO	Age group	Rate of slicing
1	3 months	2.3 kg/min
2	4 months	1.7 kg/min
3	5 months	1.2 kg/min

Cost Expenditure

The cost expenditure to complete the fabrication are tabulated as follows

S.NO	NAME OF THE MATERIAL	COST (in Rupees)
1.	Mild steel(base)	750
2.	Plates	100
3.	Flywheel& blades	300
4.	Pedals & chain	250
5.	Welding	500
6.	Painting	100
	TOTAL	2000

Conclusion

A rough measure done on the grass cutter shows that it has ability of cutting 2.3 kg per min. The fabrication and performance analysis of manually operated cattle feed cutter are done. With some future thinking it will be further modified and implemented to buildup maximum facilities that can be incorporated in this equipment. The main objective of this work is to run a system with zero percentage fossil fuel. It works by manual effort. By keeping entire project as a base, an integrated mechanism with maximum possible features will be made**.** It cuts the fodder uniformly, which is ideal for the livestock. It is durable, long lasting and low maintenance requiring machine.

Reference

1. ASAE S318.6. Safety for Agricultural Equipment. BIS 7898, 1981. Manually Operated Chaff Cutter-specification. Bureau of Indian Standards, New Delhi.

2. DeMuri, G.P., Purschwitz, M.A., 2000. Farm injuries in children: a review. Wisconsin Medical Journal 99, 51–55.

3. Franklin, R.C., Mitchell, R.J., Driscoll, T.R., Fragar, L.J., 2001. Agricultural work-related fatalities in Australia, 1989–1992. J. Agric. Safety Health 7, 213–227.

4. Modak J.P. et all, “Manufacturing of Lime- fly ash-sand bricks Using Manually Driven Bricks Making Machine” a project sponsored by Maharashtra Housing & Area Delvelopment Authority, (MAHDA), Mumbai, India.

5. Reed, D.B., Claunch, D.T., 2000. Nonfatal farm injury incidence and disability to children: a systematic review. Am. J. Prev. Med. 18, 70–79.

6. Singh, G., 1997. Data Book on Mechanization and Agro-processing Since Independence. Central Institute of Agricultural Engineering, Nabibagh, Bhopal, India.

7. Singleton, W.Tm., Hicks, C., Hirsch, A., 1981. Safety in Agriculture and Related Industries (AP Report 106). University of Aston in Birmingham, Birmingham.

8. Steuland, D., Zoch, T., Stamas, P., Krieg, G., Boulet, W., 1990. The spectrum of emergency care of agricultural trauma in central Wisconsin. Am J. Emergency Med. 8, 528–530.

ISSN 2229-5518

9. The Abbreviated Injury Scale, 1990. American Association for Automotive Medicine, Arlington Heights,

10. Tiwari, P.S., Gite, L.P., Dubai, A.K., Kot, L.S., 2002. Agricultural injuries in Central India: nature, magnitude, and economic impact. J. Agric. Safety Health 8, 95–111.