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Experimental Setup and Study of Solar Operated Chaff Cutter

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***Abstract*— Solar energy is a renewable energy. Earth continuously intercepts solar power of about 1.78 x 10^{11} MW. By using solar energy converging devices solar energy may be converted into other form of energy. Use of solar energy in agricultural field is essential now-a-days. Solar photovoltaic system converts solar energy directly into electrical energy using solar photovoltaic cell [3]. Increasing wind velocity improved the power generated by solar panel [6]. The main aim of this paper is experimental study and testing of solar operated chaff cutter. A solar operated agricultural chaff cutter uses solar panel to absorb the spectrum of solar energy is quite wide and its intensity and that energy converted into electric energy via solar PV system. Experimental model of solar operated chaff cutter is taken into consideration in this investigation. In this paper we also considered losses in solar panel, angle of solar panel with horizontal, performance of cutter.**

***Keywords*—** Solar Energy, Agriculture, Chaff cutter, Photovoltaic, Spectrum

I. Introduction

Energy plays vital role in the field of agriculture, transportation, industrial, commercial, residential etc. With the exponential growth in population, emerging technology developments, whole world is facing an issue of energy shortage. With the increasing demand of energy, nowadays the world daily oil burning up is 85 million barrels of crude oil. In spite of the well-known consequences of fossil fuel combustion on the ecosystem, this is estimated to increase to 123million barrels per day by the year 2025[1]. All the solar panels are manufactured according to Standard Test Condition (STC) which is rated is solar radiation of 1000 W/m^2, panel temperature of 25 °C and light spectrum with an air mass (AM) is 1.5 [2-7].

In this experimental study we used solar energy in agriculture field. Agricultural field is also suffering from energy crisis. A solar operated chaff cutter uses solar panel to absorb solar radiation. we use solar charge controller to control output from solar panel. Then output from the solar charge controller supply to the battery. We use lead-acid battery to get input from solar charge controller and give output to DC motor. Cutter is attached to the motor shaft, so that cutter will get power from motor to cut the grass, maize etc.

II. Objectives

1. The objective of the proposed work is to design and construct the solar operated chaff cutter.

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2. To use solar energy in the agricultural field and overcome problem of energy crisis.

3. To make chaff cutter portable.

4. To reduce dependency on non-renewable energy sources.

III. Methodology and Calculations

A. Nomenclature

P Power

I Current

A ampere

Ahr ampere-hour

Whr watt-hour

hr hour

w watt

Kwhr Kilowatt hour

rpm revolution per minute

sec second

^{0}C degree Celsius

B. Methodology

In the proposed system solar panel convert solar energy into electrical energy. This energy can also store in lead acid battery. Solar charge controller is used for controlling voltage, current output from solar panel.

- Single phase DC operation: The power supplied to cutter is single phase so to make it easy to operate at any location.
- Problem Statement: Now a days, we are running chaff cutter machine on electricity generated by non-renewable energy sources. In agriculture field mostly farmers are using electrically based appliances. To reduce dependency on electricity generated by non-renewable energy sources, renewable energy sources must be needed in agriculture field so we have taken solar energy as renewable energy source. This way we use renewable energy sources in agriculture field.
- Solid Model: The model is designed by using CAD software PTC Creo.
- Motor Selection: motor selection is depending on power requirements of cutter.
- Selection of material: For frame we used mild steel bar, which provide maximum strength compared to other materials. [4]
- Fabrication: In fabrication welding, grinding, soldering, drilling etc. processes are used.

C. Calculations

1) Motor 12 V, 4 Ahr

$$P = VI.$$

$$P = 12 * 4$$

$$P = 48\ Whr.$$

For 25-minute run =1/2.4 hr

$$P = 48/2.4$$

$$P = 0.02Kwhr. \quad (1)$$

2) Solar charge controller 12 V, 6 A

$$P = VI$$

$$P = 72\ watt. \quad (2)$$

Input for controller with 20 % loss

$$P = (0.02 * 0.2) + 0.02.$$

$$P = 0.024\ unit. \quad (3)$$

3) Battery size calculation

$$Battery\ size = (Total\ load\ X\ backup\ time)/\ battery\ voltage$$

$$Battery\ size = (24\ X\ 4)/12.$$

$$Battery\ size = 8\ Ah. \quad (4)$$

So, we require battery of 12 V 8 Ah

Losses in battery is considered as 15 %

Loss in battery is 0.0276 unit

Losses in panel considered as 25 %

Panel generate = (0.0276×0.25) +0.0276

$$panel = 34.5\ watt. \quad (5)$$

As 1 Kw solar panel generate 4 Kw / day

10-watt solar panel generate 40 w / day

So, we require 10-watt solar panel.

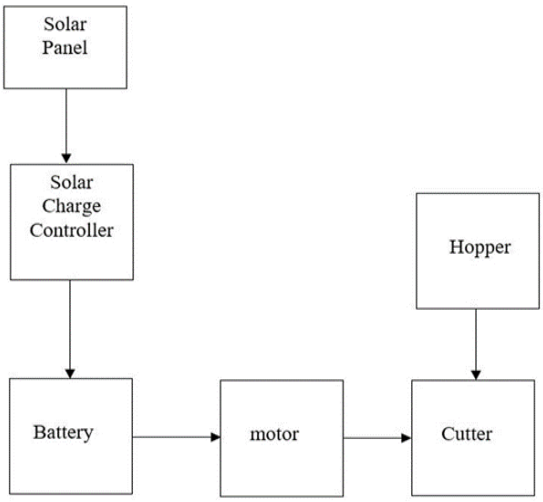

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Figure 1. Project details.

IV. Results and Discussion

By using stop-watch the time required for cutting of different fodder for animal is measured and analysed.

Figure 2. Experimental model

Solar operated chaff cutter performed on grass, sugarcane leaves at different rpms of cutter.

Taking 10gm weight of each type of fodder.

TABLE I.

OBSERVED CUTTING SPEED AND TIME TAKEN FOR CUTTING FODDER

Fodder	Cutter speed (rpm)	Time taken for cutting (sec)
Wet sugarcane leaves	1100	600
Dry sugarcane leaves	1000	500
Wet grass	1100	400
Dry grass	1000	320

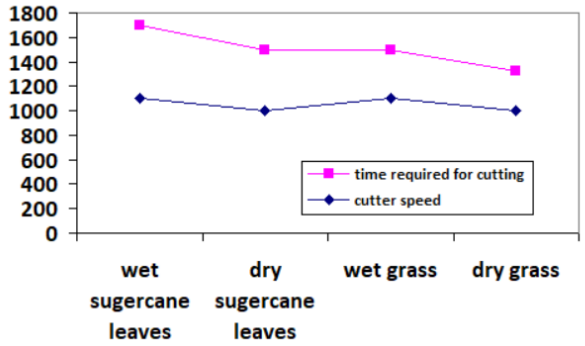

Figure 3. Cutting speed Vs time taken for cutting

TABLE II.

OBSERVED CUTTING SPEED AND TEMPERATURE

Fodder	Cutter speed(rpm)	Temperature(^{0}C)
Wet sugarcane leaves	1100	38
Dry sugarcane leaves	1000	35
Wet grass	1100	38
Dry grass	1000	35

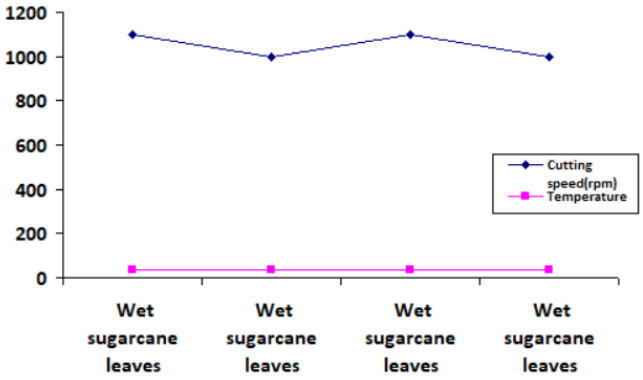

Figure 4. Cutting speed Vs Temperature

V. Conclusions

In this experimental study and testing of solar operated chaff cutter following conclusions are drawn

1. Higher the atmospheric temperature then greater the cutting speed of cutter.
2. As the quantity of fodder inserted in machine increases, cutter speed gets decreases.

References

[1] Misc., 2015. Oil consumption, www.worldwatch.org, January

[2] V Perraki, G Tsolkas. Temperature dependence on the photovoltaic properties of selected thin-film modules. International Journal of Renewable and Sustainable Energy. 2013; 2: 140- 146.

[3] Numerical Simulation for Solar Hybrid Photovoltaic Thermal Air Collector -Lippin paulya, L Rekhab, Christy V Vazhappillya, Melvinraj C R

[4] Design and fabrication of solar operated multipurpose agricultural chopper- Channabasaveshwara Institute of Technology, Gubbi, Prof. Natesh C P

[5] Kalogirou, S.A., Tripanagnostopoulos, Y., 2006. "Hybrid PV/T solar systems for domestic hot water and electricity production". Energy Conversion and Management, 47, pp. 3368–3382.

[6] S Armstrong, WG Hurley. A thermal model for photovoltaic panels under varying atmospheric conditions. Applied Thermal Engineering. 2010; 30: 1488-1495.

[7] Joshi, A.S., Tiwari, A., Tiwari, G.N., Dincer, I., Reddy, B.V., 2009. "Performance evaluation of a hybrid photovoltaic thermal (PV/T) (glass-to-glass) system". International Journal of Thermal Science, 48, pp 154-164.