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Fabrication and Analysis of Areca Nut Leaf Cup Machine using Solar and Steam Power

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Abstract - The present research work emphasizes on developing an Areca nut leaf cups making machine with a combined source of solar energy and steam power. The concept is to generate electrical power from solar panel when cloudy weather occur, steam power to be utilized. Experimental setup to be a set of die punch, die heating by solar power or steam power. The heat and pressure from the cup shaped dies will give the leaf form and make it robust. Total operations like folding, trimming, pressing into shape and drying are done in a single operation by pressing the pedal lever. The results of both the experiments were compared and concluded.

Keywords- Areca nut leaf, dies, solar panel, pressure vessel, trimming, folding, pressing etc…

I. INTRODUCTION

Areca nut leaf has to be used as best alternatives for plastic cups and plates making. Presently there are commercially available machines, which increases the production rate and safety to laborers. But most of the machines are working with the electrical power source and those machines were consumes electricity from commercial distribution. Electricity is scarce andunreliable and some of them were not easy to portable in size. Therefore there is enough scope to eradicate commercial power consumption and handy to use. This plates and cups are generally manufactured by the use of heating coils, which is to be heated by the commercial electrical power sources.

But we are modified the machine frame and structure, and we are using solar and steam power for heating a coil instead of normal electrical power. With about 300 clear, sunny days in a year, India receives about 5 Petawatt-hours per year (PWh/year) (i.e; 5 trillion Kwhr/day).

The daily average solar energy incident over India varies from 4 to 7 kWh/m^2 with about 1500–2000 sunshine hours per year), which is far more than current total energy consumption. It provides a compelling solution for society to meet their needs for clean and abundant sources of energy in the future. In the era of modern civilization, energy demands are likely to increase for power generation for industrial and domestic usage. These power was utilized to make a areca nut leaf cups so we can save our electricity as well as mitigate our electricity bill.

II. EXPERIMENTAL TEST SETUP

2.1.1 Layout Diagram

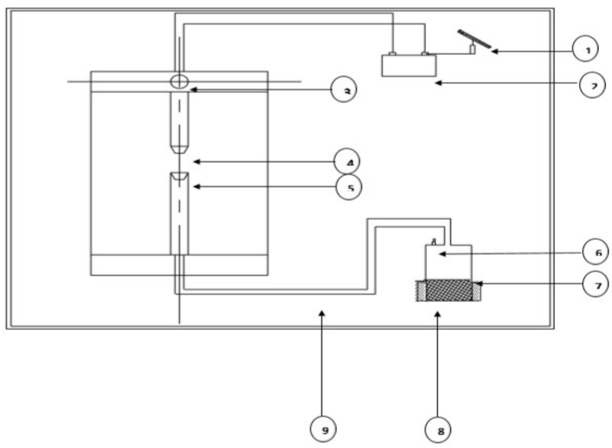


Fig 1 layout diagram

2.1.2 Parts

1. SOLAR PANEL
2. BATTERY
3. THERMOSTAT WITH HEATING COIL
4. UPPER DIE
5. LOWER DIE
6. PRESSURE GAUGE
7. PRESSURE VESSEL
8. BURNER
9. PRESSURE TUBE

III. WORKING PRINCIPAL

It consist of solar panel, battery, steam boiler, steam turbine, regulator, upper die and down die etc….solar panel power is supplied to the battery. Regulator is used to regulate the temperature, and which is connected to the heating coil. Nearly 75-90^{o}c of heat is generally utilized from this solar power source. When rainy season occur solar power is not applicable to produce power, so that we attached to pressure vessel to producing steam. Waste areca leaves are utilized to burning process. It will burns and make a steam from it, which is supplied to the lower die. And lower and upper dies are pressed, to fold a leaf and required shape to be obtained after trimming a leafs.

4.1 Solar Panel Selection

Power Consumptionof Heater = Number of coil x Watts x Hours

= 2x250x1

Total electrical load = 500 watts

Daily Sun Shine Hour in summer = 6 hour/day

Daily Sun Shine Hour in winter = 4.5 hour/day

Daily Sun Shine Hour in Monsoon = 4 hour/day

4.1.1 Solar Panel Size

Average Sunshine hour = (Daily Sun Shine Hour in summer +winter Monsoon)/3

Average Sunshine hours = (6+4.5+4)/3

Total = 8 hrs

Total Electrical Load =1000

4.1.2 Formulae

Size of solar panel =(Electrical load/ average sunshine) x correction factor

= (1000/4.8)x1.2

=250 watts

Mono-Crystalline Solar Panel Is Selected. And which has 60 no of cells and series connection.Which has been produced maximum in 29.37 voltage.

4.1.3 Monocrystalline Solar Panels:

Both monocrystalline and polycrystalline solar panels have cells made of silicon wafers. To build a monocrystalline or polycrystalline panel, wafers are assembled into rows and columns to form a rectangle, covered with a glass sheet, and framed together.

While both of these types of solar panels have cells made from silicon, monocrystalline and polycrystalline panels vary in the composition of the silicon itself. Monocrystalline solar cells are cut from a single, pure crystal of silicon. Alternatively, polycrystalline solar cells are composed of fragments of silicon crystals that are melted together in a mold before being cut into wafers.

IV. RESULTS AND DISCUSSION

5.1.1 Specification Of The Frame

Length ofthe Hollow Frame : 903 mm

Height of the frame : 590 mm

Center distance betweenbases to lower die :480 mm

Center height of the upper die :72 mm

Top clearance between upper and lower die :21 mm

Thickness of the Hollow Frame :26 mm

Capacity of the pressure vessel :2 liters

Length of the steam hose :1700 mm

Outer diameter of the Hose :190 mm

Inner diameter of the Hose :140 mm

5.2 Trial Run -1(Solar Power Utilization)

Experiment conducted on:15thMarch 2020

Ambient air temperature : 26.6°C

Time of experiment : [10.30 am-12.30 pm]

5.3 Table 1:

Table: 1 Voltage, Temperature, Time Power Relation Table

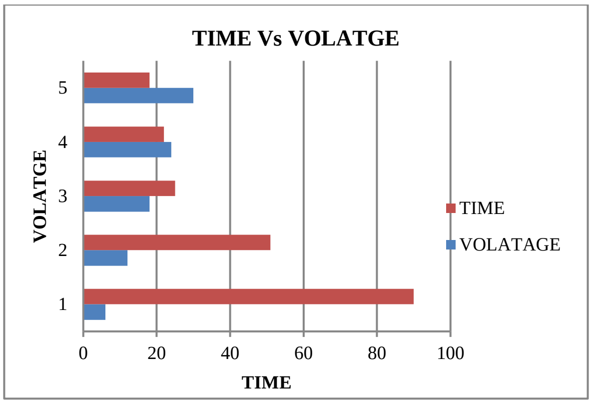
Sr.N.	Varience Voltage	Temp	Time (Min)	Current (Amps)	Power (Watts)
1.	6V	50^{0}C	90	0.08	0.48
2.	12V	60^{0}C	51	0.16	1.92
3.	18V	65^{0}C	25	0.24	4.32
4.	24 V	70^{0}C	22	0.33	7.92
5.	30 V	80^{0}C	18	0.43	12.9

This table clearly shows that to increasing the voltage by connecting the step-up transformer with the solar panel, the voltage is increased from 6 Volt to 30 Volt power supply.

Above table values are indicates maximum temperature obtained by the upper die according to the voltage given. From this maximum voltage is given 30 Volt and to obtained temperature is 80^{0}Cat the 18 minutes of time. And we also calculate the current and power supply of given voltage.

5.3.1 Graph:

This graph clearly shows the variation between time and voltage basically solar power utilization efficiency based on time and given voltage supply according to this graph spike tells us upper die heating time is drastically reduced when voltage increases



Graph:1 Time Vs Voltage Variation

5.4 Efficiency:

Table: 2 Solar Power Utilization Efficiency Table

SL.NO	INPUT POWER (watts)	OUTPUT POWER (watts)	EFFICIENCY (ὴ) (%)
1.	167	0.48	0.29
2.	167	1.92	1.20
3.	167	4.32	2.58
4.	167	7.92	4.74
5.	167	12.9	7.72

This table shows that efficiency of utilizing solar power from the solar panel. Input power is calculated by solar intensity range and day time period. Output power is obtained by the voltage. Based on this values efficiency will be calculated. According to the output power and input power we obtained maximum 7.72 percent of solar efficiency

V. MODEL CALCULATION

POWER INPUT = Isun x AREA

SOLAR PANEL AREA = 1.67 m^2

SUN ILLUMINATION INTENSITY

(Isun) = 100 W/ m^2

(Time period between 10.30 to 12.30 PM)

Power input =Isun x AREA

=100 x 1.67

=167 Watts

6.1.1 Maximum Efficiency:-

EFFICIENCY = POWER OUTPUT/POWER INPUT

POWER INPUT = 167 Watts

POWER OUTPUT = 12.9 Watts

ὴ = (12.9/167) x 100

= 7.72

VI. TRIAL RUN -2 (STEAM POWER UTILIZATION)

Experiment conducted on : 17thMarch 2020

Ambient air temperature: 25.2°C

Time of experiment : [10.30 am-11.30am]

Volume of water : 1 liter

Steam Temperature : 80^{0}C

7.2 Table:3

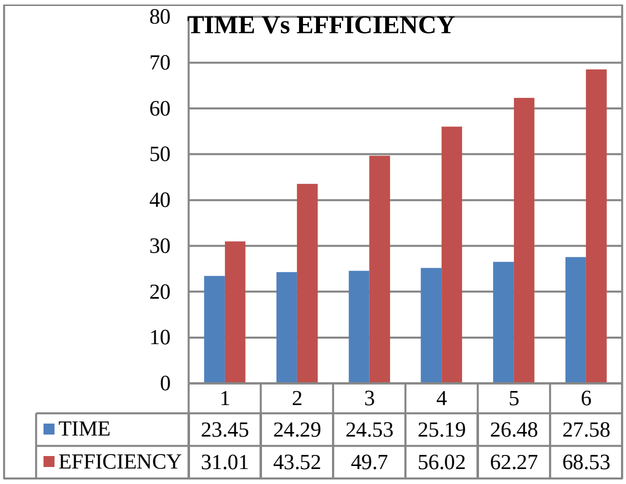
Table: 3 Steam Power Utilization Efficiency Table

SL.NO	TEMP(T) (^{0}C)	TIME (t) (MIN)	ENERGY OUTPUT (Q) (JOULES)	EFFICIENCY (ὴ) (%)
1.	50	23.45	103812.8	31.01
2.	60	24.29	145672.8	43.52
3.	65	24.53	166602.8	49.70
4	70	25.19	187532.8	56.02
5.	75	26.48	208462.8	62.27
6.	80	27.58	229392.8	68.53

This table indicates that the steam temperature obtained by Pressure vessel. From the pressure vessel steam is directlysupplied to the lower die. Here we take the time of heating a lower die. Table values clearly tells us when temperature increases during heating, time also increases.1 liter of water is converted into steam, which is supplied to the lower die,when temperature reaches 80^0 C which is taken 27.58 minutes of time. From this we calculated our steam power utilizationefficiency. Maximum we can get 68.53 percent efficiency.

7.2.1 Graph :

Graph: 2 Time Vs Efficiency Variation Figure



This graph clearly shows that time and efficiency spikes. When time increases to heating a lower die, production efficiency was drastically increases.

VII. MODEL CALCULATION

(STEAM POWER UTILIZATION)

Mass **(m)** = 1 liter of water

Specific heat of capacity (**C_P**) =4186 J/Kg

ENERGY INPUT (**Qinput**) = 334720 Joule

ENERGY OUT PUT (**Qoutput**) = m Cp ΔT

= 1 x 4186 x (80 – 25.2)

= 229392.8 Joules

8.1.1 Maximum Efficiency:

Efficiency (ὴ = (Energy output / Energy input) x 100

= (229392.8 /334720) x 100

ὴ = 68.53 %

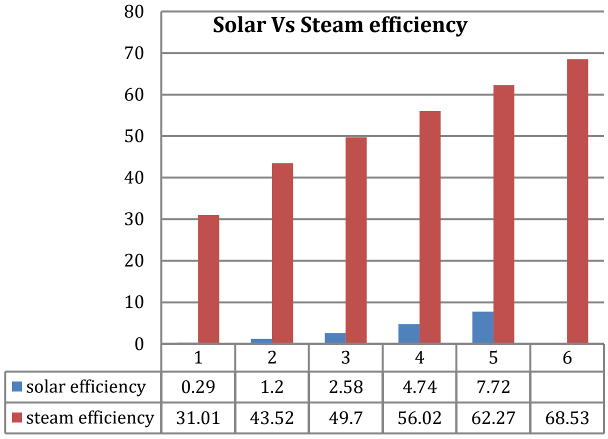
8.2 Comparison Table:4

Table: 4 Solar Power And Steam Efficiency Comparison

Solar Power Utlisation				*Steam Power Utlisation*			
S.No	*Power Input (Watts)*	*Power Output (Watts)*	*ὴ*	*S.No*	*Energy Input (J)*	*Energy Output(J)*	*ὴ*
1	167	0.48	0.29	1	334720	103812.8	31.01
2	167	1.92	1.20	2	334720	145672.8	43.52
3	167	4.32	2.58	3	334720	166602.8	49.70
4	167	7.92	4.74	4	334720	187532.8	56.02
5	167	12.9	7.72	5	334720	208462.8	62.27
				6	334720	229392.8	68.53

This table shows the comparison between solar as well as steampower utilizationefficiency. Comparatively steam power efficiency is good to use for ourproduction.

8.2.1 Comparison Graph:



Graph: 4 Solar Vs Steam Efficiency Variation Figure

VIII. DISCUSSIONS

9.1.1 Trail Run: 1 (Solar Power Utilization)

In trail run-1 study is fully based on the solar power production and calculations. Mono crystalline 250 Watts solar panel is used this machine.Solar energy is calculated by three different time period in a single day, which is to be directly stored by battery, but nearly it will produce 30 Volts power supply at the time of 12.30 PM that day and heater will heated by the battery source, but it will take nearly 18 minutes to reach 80^{0}C temperature. **Graph 1** refers when the voltage increases at that moment heating, time will be drastically mitigate, then pressing a upper and lower die at 80^{0}C temperature in 5 minutes. Finally we done trimming of leafs a 4” areca nut cup was obtained and one cup production takes nearly 23 or 25 minutes for this solar power utilization machine. But our voltage will be dynamically changed Finally, I conclude it will take more time to make a areca nut leaf cup So trail run-1 study was clearly shown solar power source is quite complicated to produce areca nut leaf cups.

9.1.2 Trail Run: 2 (Steam Power Utilization)

In trail run-2 study was done by using steam power. In this study steam was obtained by 2 liter of pressure vessel, and it is directly connected to the lower die. In this study was obtained 17 th MARCH in the time period between (10.30 AM to 11.30 AM). We take 1 liter of water to make a steam, and at the time of experiment atmospheric temperature is 26.5^{0}C. I take different temperature reading as well as time taken to obtained that required temperature (80-95^{0}C)..Which has been obtained at the time of 27 minutes 58 seconds. And lower die was pressed areca nut leaf in 5 minutes 4 seconds to maintain at the (80-90)^0 c temperature. Then folding operation was done by this dies .I got 4” areca nut cups after trimming of a leafs. And this machine was portable machine, we can easily move anywhere at any time, and we can produce nearly (6-10) cups at 1 hour in this steam utilization technique. It will provided 68 % efficiency comparatively our solar power utilization. Our Trail run-2 study was clearly describe Steam power utilization of making areca nut leaf cups are efficient as well as very economical. In this method we totally eradicate our electrical consumption.

10.1 Output Sample : 01(Solar Power Utilisation)

10.2 Output Sample : 02 (Steam Power Utilisation)

10.3 Experimental Test Model:

IX. ADVANTAGES

- ✓ To reduce electrical power consumption.
- ✓ To reduce pollutions.
- ✓ Easily disposable.
- ✓ Eco-friendly and bio- degradable.
- ✓ Portable machine

X. CONCLUSION

Our conclusion, 4” Areca nut leaf cups are obtained two way of power resources either Solar or Steam. In Solar power utilization. It is quite critical to make more number of areca nut leaf cups in one hour which has been taken more time to heat the upper die .By that our panel maximumproduction efficiency will be 7%. Rather we use Steam power to produce a heat on the lower die. It will be more effective than solar power utilization. It hikes nearly 68% inour production efficiency. This shows that dependency on commercial electrical power consumption has been completely eliminated.

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