Production Of Jaggery By Using Solar Energy

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Abstract— Jaggery (palm sugar) is a traditional Myanmar dessert and often eaten after meal to aid digestion. Jaggery is produced from toddy palm and it is considered a sweet and is eaten by children and adult favourite dessert, usually in the afternoon with a pot of green tea. Traditionally sold in small blocks for use in desserts, candy or as a sweetener, jaggery is considered by nutritionists to be more complex sugar than refiened white suger. It is a healthier alternative to refined white sugar and favourite dessert in Myanmar. So, people in Myanmar need to produce jaggery more and more. However, there is an acute scarcity of wood, which is the main source of cooking and heating fuel. In this project research paper, the method of making jaggery by using solar energy is expressed. This method decreases at least 80% of fire wood less than regular one. It is also better for jaggery. In addition, its costs lower and a family who cook jaggery can use it easily. This explanation intends to improve from project to manufacture.

Keywords : **jaggery, solar energy, firewood, method, manufacture**

I. INTRODUCTION

The term "energy crisis" is commonly hard these days. This generally refers to the depletion of natural fuel resources needed to meet energy demands. People are becoming increasingly dependent on imported oil and natural gas and the world output of these resources is expected to decline in the future.

There is one natural resource without pollution solar energy. The abundant energy from the sun is becoming increasingly important.

The solar energy research is intended to look for energy sources instead of usual fuel (firewood). In this project work, a parabolic solar cooker and the two days sun-bathing system are used.

It is believed that cooking jaggery by using solar energy is getting useful and successful among other researchers.

II. REGULAR COOKING SYSTEM

The main process of making jaggery is to dry up the sweet toddy. Thus, a lot of fire-woods are needed to produce much jaggery. In the middle of Myanmar where much jaggeries are produced, the toddy palm workers has a great problem to get a lot of fire-woods since there is a few forest in this region.

On the other hand, the outwearing of forests is due to cutting down the trees to get fire-woods because of the weather bad.

According to the study of the process of making jaggery which is in a village near by Monywa, it is known that the woods of 6.4 viss (10.24 kg) are needed to get one viss (1.6 kg) jaggery from the sweet toddy of 14 litters. Hence, about 10 tons of woods are wasted to obtain 1000 viss jaggery. Therefore, it is proposed to replace the use of fire-woods by solar energy to reduce the wasted of woods.

III. COOKINGJAGGERY BY USING SOLAR ENERGY

The parabolic solar cooker is needed to cook jaggery by using solar energy.

The Parabolic Solar Cooker

The frame of parabolic solar cooker was constructed with M.S rods. The reflective materials were used the number pieces of acrylic mirror, which have 1840 numbers. The area of parabolic solar cooker was 0.7853 m^2. Two M.S rods with ball bearing are joined to its frame as a shaft. It can be rotated horizontally (X-Y) plane on a circular base. It can be turned vertically around the shaft line. Therefore, the steering consists of 3-axis. The photograph of the parabolic solar cooker is shown in figure (1) and laying out of parabola is also shown in figure (1). The total estimated cost, the materials involved in the construction and their costs are shown in table (3.1).

In order to use parabolic solar cooker needs investment. It will not be far to be able to use as profitable product.
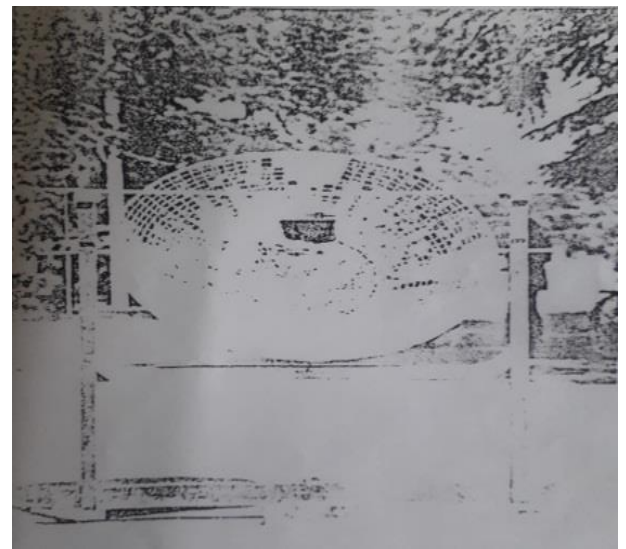

Figure 1.Parabolic Solar Cooker and Laying Out of Parabola

Table1.Materials and Their Costs for Parabolic Solar Cooker

No.	Material	Dimension (cm)	Quantity	Price (kyat)	Cost (kyat)
1	Mirror	135 x135	1	600	11000
2	Wood 4″x2″	105	2	175	1400
3	Wood 2″x2″	210	3	175	1225
4	Wood 2″x1″	30	1	175	175
5	Wood 3″x2″	120	2	175	700
6	Bonfix	-	5	200	1000
7	Nail	-	10	60	600
8	Binding wire	-	½	-	450
9	M.S. rods (5/16) ″	120	4	150	600
10	M.S. rods (1/2) ″	13	2	350	700
11	Bolt nut	15	1	150	150
12	Ply wood	126x126	1	0.52	6550
13	Labour charges	-	-	-	5000
	Total estimated cost				29550

The Solar Data for Monywa Region

The geographical location of Monywa is favourable for solar energy use. Monywa is situated in the dryzone and the largest city in Sagaing Division. It is on the bank of Chindwin river. It is situated between latitude 21° 55′ N and 22° 18′ N and longitude 95° 4′ E and 95° 23′ E. The total land area of Monywa township is 266.0 sq-mile, stretching 20 miles from north to south and 13 miles from east to west.
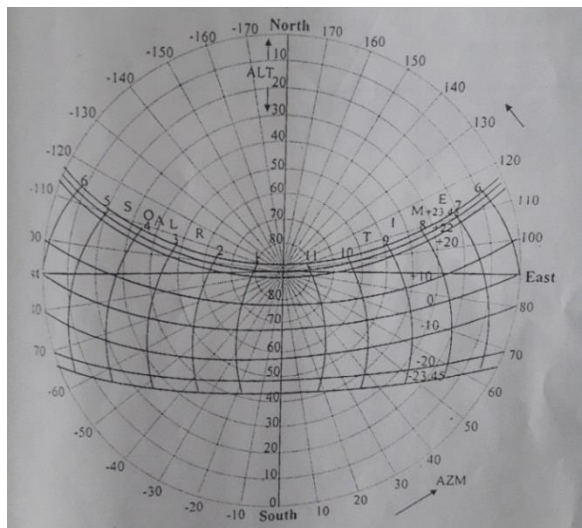

Figure 2.Sunpath Diagram for Monywa Region, 22°N Showing Azimuth and Altitude Angles and Their Relation to Declination and Time of Day

Table 2. The Measurement of Temperatures for Parabolic Solar Cooker's Oven and Surrounding

Date	Time hour: min	Surrounding Temperature T_s°C	Collected Temperature T_C°C
6.8.2019	11:35	34.5	34.5
	11:50	34	56
	12:05	35	57
	12:20	35.5	59
	12:35	35	59
	12:50	36	63
	13:05	37	70
	13:20	37	72
	13:35	38	76
	13:50	36.5	75
	14:05	37	80
	14:20	37.5	90
	14:35	37	95
	14:55	37.5	99
	15:05	38	103
	15:20	37	105
	15:35	37	109
7.8.2019	10:40	35	35
	10:55	34	55
	11:10	34.5	60
	11:25	34	56.5
	11:40	35.5	58
	11:55	35	60
	12:10	35.5	65
	12:25	36	71
	12:40	36.5	76
	12:55	38	78
	13:10	36.5	77
	13:25	36.5	79
	13:40	37	84
	13:55	37.5	90
	14:10	38	104
	14:25	37	109
	14:40	37.5	113

Table 3. The Measurement of Temperatures for Parabolic Solar Cooker's Oven and Surrounding

Date	Time hour: min	Surrounding Temperature T_s°C	Collected Temperature T_C°C
11.8.2019	11:10	35	35
	11:25	38	62
	11:40	36	58
	11:55	38	60
	12:10	39	61
	12:25	39	63

Date	Time hour: min	Surrounding Temperature T_s°C	Collected Temperature T_C°C
	12:40	40	65.5
	12:55	39	58
	13:10	39.5	64
	13:25	39.5	64.5
	13:40	40	65.5
	13:55	40	97.5
	14:10	41	103
	14:25	43	104
	14:40	43	107
	14:55	43	110
	15:10	42.5	112
12.8.2019	10:10	33	33
	10:25	33.5	34.5
	10:40	34	39
	10:55	34	49
	11:10	35	45
	11:25	36	59
	11:40	35	56
	11:55	35	58
	12:10	36	62
	12:25	37	70
	12:40	38	71
	12:55	38	77
	13:10	38	80
	13:25	37	81
	13:40	38	84
	13:55	39	90
	14:10	38	102
	14:25	39	105
	14:40	40	115
	14:55	39.5	115
	15:10	39	116

Table 4. The Measurement of Temperatures for Parabolic Solar Cooker's Oven and Surrounding

Date	Time hour: min	Surrounding Temperature T_s°C	Collected Temperature T_C°C
13.8.2019	10:10	30	30
	10:25	30	33
	10:40	31.5	39
	10:55	33	44
	11:10	35	49
	11:25	36	52
	11:40	36	58
	11:55	37	63
	12:10	37	69
	12:25	36	70
	12:40	38	74

	12:55	38	79
	13:10	37	81
	13:25	38	88
	13:40	38	92
	13:55	39	94
	14:10	38	100
	14:25	39	105
	14:40	40	110
	14:55	39	110

IV. COOKING JAGGERY BY USING SOLAR ENERGY TOGETHER WITH FIREWOODS

Since this process is to dry up the sap of toddy palm, it must be heated. It can also be possible to dry up the sap of toddy by planning it in the sunshine and open air. But there is a need to prevent the loss of the sap from being fermented. Not to be fermented, the easy way is to boil it up with a great care.

It is found that the sap which has been boiled up cannot be possible to have every fermentation for two or three days long. Therefore, the sap which has been boiled up is placed in the sunshine and open air to evaporate and dry up.

The rate of evaporation depends on the surface area of the lank in which the toddy is placed. The wider is the surface area of the tank, the greater is the rate of evaporation. Thus, it is needed to put the toddy in the wide tank to get a good rate of evaporation.

Equipments

(1) A tank of volume 107 cm x 76 cm x 5 cm
(2) A regular cooking pan

Steps of Cooking Jaggery
(i) Step(1)
The sap is collected in the morning and weighted on a balance. And then the collected saps are placed in a pan and heated on the stove to the boiling point. About two minutes after boiling up, the pan is placed out of the stove.

(ii) Step(2)
The saps which have been boiled are put in the tank to have sunbathing. 7 to 9 liters of sap can be put in the tank to have sunbathing.

(iii) Step(3)
Collect those toddy in the evening sieve it to sun-bathe for next day.
One day sunbathing have to cook 50% toddy and two days sunbathing have to cook 20% toddy.
Notice – It must be cleaned; buckets, tanks and pats. The tanks should be placed far from the path and dirt. Including the dirt can spail jaggery colour. Therefore, the tank should be placed higher from the ground.

Comparison of Fuel

Regular cooking system.

Firewoods for one vissjaggery　　- 6.4 viss

One day sunbathing system

Firewoods for one vissjaggery – 3 viss

Lesser use for woods -45.3%

Two days sunbathing system

Firewoods for one vissjaggery – 1.9 viss

It is lesser use for firewood by

using two days sunbathing　　- 19 %

D. Investment

107 cm x 76 cm x 5 cm tank = 6000 kyats

Charge for tank　　　　　　　= 2500 kyats

Total　　　　　　　　　　　= 8500 kyats

The tank can be used so long as to keep carefully.

V. DISCUSSION AND CONCLUSION

This process does not involve complicated appliances. It is a very simple method. So the toddy-plam worker should have no problem using this method either in terms of technology or investment. It is believed that the toddy-plam workers (cooks) can use these cooking system. It's suitable for Middle – Myanmar where jaggeries are being cooked.

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