

Effect of temperature in cooking of animal feed by solar cooker (Solar Energy Research and Utilization)

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Abstract: The Solar cookers available are made of locally available materials, such as clay, pearl millet husk, and horse excreta/cow dung etc. And the structure are made by this material are temporary structure and life are less and maintenance cost are also more. Considering this, a solar cooker is made of concrete and brick masonry work construction. The life of the structure is more and less maintenance cost. The solar cooker saves time of farmer and 1059 kg of wood per year equivalent to 3611 MJ of energy. The temperature of the structure at the time of cooking is 80c to 110c. ER Publications on a wide range of subject areas given in "Topics Covered". The document contains information regarding desktop publishing format, type sizes, and typefaces. Style rules are provided that explains how to handle equations, units, figures, tables, abbreviations, and acronyms. Sections are also devoted to the preparation of acknowledgments, references, and authors' biographies. The abstract is limited to 150 words and cannot contain equations, figures, tables, or references. It should concisely state what was done, how it was done, principal results, and their significance.

Keywords: Animal feed solar cooker, boiling of animal feed.

Introduction

During the Survey of Rural areas, it was found that huge amount of firewood, animal dung cake and agricultural waste are burnt for boiling of animal feed using traditional fuel wood stove. Poor villagers have to forage 8 to 10 hours a day in search of firewood as compared to one to two hours ten years ago. One third of India's fertilizer consumption can be met if cow dung is not burnt for cooking and instead is used as manure. The cutting of firewood causes deforestation, which leads to desertification. Cooking accounts for the major share of energy consumption in developing countries. Fifty percent of the total energy consumed in India is for cooking. Most of the cooking energy requirement is met by non-conventional fuels such as firewood, (75%) agricultural waste and cow dung (25%) cakes in rural areas.

Sun Radiations : N. M. Nahar, P. Sharma and G. R. Choudhary has been described in their paper that:- The arid parts of India receive maximum radiation i.e. 7600-8000 MJm⁻² per annum, followed by semi arid parts, 7200-7600 MJm⁻², per annum and least on hilly areas where solar radiation is still appreciable i.e. 6000 MJm⁻² per annum. The maximum Solar radiation are received in Jaipur is 1300 w/m² at summer season. And the environment temperature is about 40 c to 45 c. Therefore, the animal feed solar cooker seems to be a good substitute for boiling with firewood.

Review of Literature

The first solar furnace was fabricated by naturalist George Louis Leclere Buffon (1707-1788). But Nicholasde-Saussure (1740-1799) was first in the world to use the sun for cooking. Augustin Mouchot, a French physicist, described a solar cooker in his book "La Chaleur Solaire" published in Paris, in 1869. He has also reported in the same book earlier work on solar cooking by English astronomer, Sir John Herschel, in South Africa, between 1834 and 1838. Adams, an army officer, made India's first solar cooker in 1878 and he cooked food in it at Bombay, India. Since then different types of solar cookers have been developed.

Presently the solar cooker which are available are made by locally available materials, such as clay, pearl millet husk, and horse excreta/cow dung etc. Central Arid Zone, Research Institute Jodhpur (CAZRI) are made by this type of structure.

Design / Structure

A structure of Dimension 5'3" x 2'9" x 6" is construct on the ground with concrete and brick masonry. In concrete the Proportion of cement, sand and coarse aggregate are 1:2:4 (M-15) with water to make paste. And the Ratio of the plaster in brick masonry and concrete is 1:5 (cement : sand).



Figure 1: Animal Feed Cooker

1.5" deep layer of this paste is provided at the bottom of the structure. The sides of the solar cooker are also made by the same material. And the structure are divided in two chambers and both are separated by a concrete wall between them and the dimension of both the block are same 2' x 2'. And both chambers are covered by two wooden frames (one for each) with two glass on each frame and spacing are different in between the glass in both the frames. And 'sagwan' wood is used for making wooden frame. And black board color is used for insulation and increase the heat absorption capacity.



Figure 2: Demonstration of Animal Feed Cooker

Procedure

In boiling of animal feed, Fenugreek, guar korma, and cotton seed mixed with water before 6 hour of the Test. Two iron pans (tagari) of Rectangle size and the dimension is 1'10" x 1'10" with lid can be kept inside this two chambers (one for each). Handle are attached to easily remove and enter in the chamber and feed are easily placed in the chamber. And cover the tagari to decrease the time of cooking. And we are also use Rubber at the side of frame to make pressure in the chamber and provide insulation and heat is not released.

Temperature Readings

Time	Block I (10 mm Spacing)		Block II (20 mm Spacing)		viro nent mp.
	Outer	Inner	Outer	Inner	
12:30 PM	40	65	56	89	40
01:30 PM	46	71	65	101	42
02:30 PM	41	70	58	100	40
03:30 PM	50	66	60	89	38

Table 1: Temperature without Load Material

Time	Block I (10 mm spacing)		Block II (20 mm Spacing)		Environment Temp.
	Outer	Inner	Outer	Inner	
10:00 AM	39	30	30	42	31
11:00 AM	45	39	33	59	32
12:00 PM	52	48	39	72	35
01:00 PM	55	54	41	80	36
02:00 PM	45	57	50	90	38
03:00 PM	43	55	60	86	36

Table 2: Temperature with Load Material

Material: 1.5 kg in each block.

Guar, Fenugreek and cotton seed are mixed in equal proportion 500gm each. And Material: Water is 1:8 is used.

Note – All Reading are in Degree Celsius.

Methods

A) Effect of Variation of depth:

- Pans (tagari) are placed at different distances from the glass by placing material below the tagari .
- Material used below the tagari are Sand, Stone, Wooden and Coarse Aggregates.
- At different distances and using different material check the temperature variation in each and every stage.
- When depth reduce then temperature is increase and take less time to cook

B) Effect of Insulation:

- It means to maintain the temperature of the structure and wooden frame and rubber are used as insulator in the structure.
- Wooden Frame and Rubber doesn't absorbed heat and due to this property it maintain the temperature of the structure.

C) Effect of Temperature:

- Temperature effect is different in both the blocks because spacing between the glasses is different.
- In Arid Areas Sun Radiations are more. So take less time to cook in arid areas. And 300 Clear day in a year. And Temperature are more in arid areas.
- Alcoholic Thermo-meter is used to measure the temperature effect of the structure at inside, outside and environment.

D) Effect of Boost Temperature :

- Black Board Color is used in the pans to increase the heat absorption capacity of the structure And the temperature is boost by using black color.
- Plane Mirror is used to increase the reflection in the structure and boost the temperature at outside and inside of the structure.
- Due to boosting the temperature Animal feed take less time to cook at low environment temperature.

E) Effect of Glazing:

- Glazing means we used two glasses in a single frame and test at different distances between the glasses .
- Distance between the glasses are taken 10mm, 20mm, and 30mm. And single glass is also used in a frame.
- Temperature are more when spacing between the glasses are more.
- Cross-section area of the structure also affect the temperature of the structure,

F) Effect of quantity:

- In Animal feed Guar, Fenugreek, and cotton seed are mixed in equal proportion. And Material : Water is 1:8 is used.
- Material are used in different quantity and check the cooking time of animal feed at each stage.
- Material are cooked according to the Animal requirement and quantity of Animal.
- When less quantity are taken then it take less time to cook.

Conclusion / Results

Animal feed cooker is suitable for farmer and it saves the time of farmer. And cost of the structure is 6500rs. And the structure is free in 2 years when used wood for cooking of Animal feed. Conservation of firewood help in preserving the ecosystem and animal dung cake could be used as fertilizer, which enhances agricultural productivity.

- ✓ Capacity - 10-12 Kg in a Day
- ✓ Cost - 6500 per piece
- ✓ Cons. Material - Concrete And Brick Work
- ✓ Life of Structure - 8-10 Years

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