

Solar Food Warmers for Educational Centers in Costa Rica

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Abstract

During last thirty five years, author has studied many solar thermal devices for different processes like heating water, drying agricultural products, purification of water and specially warming and cooking meal.

The first hot box oven was made in Feb. 1979 for the personal use, mainly to warm lunch cooked previous night. Since that time we have designed, constructed and studied different solar cookers- hot box types, hybrid solar- 110 VAC electric, hybrid solar- 12 VDC electric, cooker cum dryer, solar electric microwave oven etc. In addition to use in our personal house for cooking meal and drying domestic fruits and vegetables, we got one patent, organized different activities to promote its uses in Costa Rica and in other 40 countries.

During past eight years, author has observed in Costa Rica the rising demand of our solar ovens, for use at educational institutes to warm the lunch for the students at schools and colleges etc. This is to reduce the use of microwave ovens and electricity bill.

Keywords Solar oven, Solar electric hybrid cookers, Solar Electric Microwave, Micro Wave Oven.

1. Introduction

In 1978 author like other 60-70 percent of the population, was cooking with electric range, as the high percentage of electricity in Costa Rica was (and still) is generated with hydro plants. In Feb. 1979 (dry or summer) the State Electric utility company (Instituto Costarricense de Electricidad, ICE) imposed electric rationing 7 am to 5pm due to low hydro potential. However the high solar radiation during that period, motivated me to design and make one solar Food warmer for personal use- a simple and cheap hot box [1].

2. Methodology

Photo 1 shows the first model of solar oven for heating meal. As the name implies it is a box made of a wood. Inside it has a galvanised iron sheet painted black on top to absorb solar radiation, glass wool as heat insulation and single window glass on top to allow solar radiation to impact the metallic plate and at the same time, impede the exit of heat radiation emitted by the hot plate. The air in the box is thus heated through the greenhouse effect. On sunny day the air temperature inside the box reached up to 70- 90 °C, sufficient to warm food. The meal cooked previous night and kept in the refrigerator was taken at about 11 am (an hour before the lunch time) and kept in two or three metallic dark containers, and were placed in the solar hot boxes. In 45-60 minutes the meals were sufficiently hot to enjoy.



Photo 1 Solar Oven for warming lunch (1979, left) and Cooking lunch (1980) at authors house.

2.1. Simple Hot Box Oven

Looking into success it was decided to convert this solar warmer into solar cooker (Fig. 1, right). As shown in the photo 1 the only two changes were made.

On the top of the box, one more transparent glass was added to reduce the top heat losses. Secondly one reflector was added to the box to increase the solar radiations [2]. In this case on sunny day the air temperature inside the box reached up to 130- 150 °C. This could be used for cooking, baking, roasting food, and also for purification of tap/ river water from microbiological point of view (pasteurization). On clear sunny day three- four meals can be cooked in 2-4 hours. The model was patented in Costa Rica in 1984 [3].

In order to promote the concept so that many people could use this simple technology, we organized various workshops / Conferences (1-4 days) for construction of solar cookers and demonstration of solar cooking. Also we made different models of solar cookers/ ovens for various uses and facilities. We can just name these and can be read in another publications [2, 4]:

- a. Hybrid Solar Oven with 110VAC Electricity and Sun. In Hybrid cookers, solar energy is integrated with some conventional energy sources, such as electricity in our case (as back up),
- b. Hybrid Solar Oven, with LPG,
- c. Solar/ Electric 12 VDC Cooker, using only solar panel and battery,
- d. Concentrating Cooker,
- e. Short term heat storage using bricks and Phase change chemical salts,
- f. Solar / Electric Powered Microwave, using solar panel, battery and inverter,
- g. Solar Oven cum Water Heater,
- h. Solar Oven cum Dryer,
- i. Multipurpose and hybrid solar oven,
- j. Two compartment solar oven for research purposes.

3.Results

Due to our promotional activities [5] , and providing information on making solar oven (Do It Yourself) in our web site [6] , many people visit and contact us, from Costa Rica and out of Costa Rica, to know about the solar cookers. Some persons have constructed solar cookers, for

- *personal uses, both in Rural and urban (Mainly) areas,
- * Scientific projects, for schools and colleges,
- *promoting solar cookers in another communities through NGOs.

In spite of different advantages (cash, energy reduction, reduced deforestation and pollution savings), solar cookers are not accepted on massive scale- neither in Costa Rica nor in the whole world. The number could be about 500-550 solar cookers in Costa Rica (one million families). In the whole world the numbers of cookers made will be about 2 millions, including refugee camps, as compared to 50-60 millions microwave ovens only in American Residences and about 350 millions firewood and 135 millions improved firewood stoves in developing countries.

The numbers of Solar Cookers made (and or in use) are low due to different reasons as mentioned in the literature, like cultural, social, economical and climatic conditions etc. [5,7].

3A Solar Ovens at Educational Institutes

At the Educational centers (colleges, Universities), some students buy the lunch at canteen, others take their lunches from home. These students normally use Micro Wave Ovens, provided by the institutions (4-10), for convenience and being fast (4-5 min heating time per lunch box). Institutions pay for electricity and students make long queue for heating.

During last 6-8 years, we have observed more schools are making ovens either themselves through our web page [6], or asking us to make solar ovens for warming lunch. Photos 2 to 5 show some of these cookers at different schools/ universities:





Photo 2. Warming launch in solar ovens at Universidad Nacional by different students



Photo 3. Colegio Claretiano, (left) 2008 and Tecnico Profesional de Flores, Heredia, 2008



Photo 4. Saint Paul College (left, 2007) and College Maria Auxiliadora, San Jose (2014)

Last two solar ovens installed at College Maria Auxiliadora, are made of Stainless Steel boxes and could heat 110-120 lunch boxes in 90-120 minutes. It has lot of advantages-saving fuels for college and queue time for the students who are given short time for lunch. In this way, students are taking their classes while their food is being warmed with free and clean solar energy.

The buyers are already informed that solar ovens, could be used for 9-10 months in a year and thus are for saving (and not eliminating) conventional fuels. During rainy season or very cloudy period the students use Electric Micro Wave Ovens.

3B Some Precautions

It's very important to take some considerations when used for collective purpose- like assigning some responsible for cleaning the glasses, absorbing plate and avoid mixing of lunch boxes etc.

Although the use of metallic and dark colored containers are good for the use in solar ovens, however for use in educational centers good plastic box which can resist higher temperature (100-120° C), as well can be used in Micro wave oven are recommended.

We have observed one day in our university canteen, when there was no electricity to run MW oven many students rushed to us to find more Solar Ovens. This is some misconception among the potential users. People say us that we should use solar energy as back up, whereas the logic says it should be other way around- conventional fuel should be used as back up.

4. Conclusions

Heating lunch boxes require low temperature. Thus even cloudy day is fine in contrast to cooking. Solar ovens are being used for heating the lunch boxes at different educational centers mainly due to convenience, saving fuels for college and saving queue time for students.

As the solar oven is being used collectively, some precautions have to be taken before hand as explained. Although electric energy saving per lunch box is low however if used by more number of students or employees for warming their lunches, the energy saving by the institutes will be very high. Based on our experience, the food can be heated for 9-11 months in a year as compared to 6-8 months in if used only for cooking.

Thus Solar Cooking is a simple solution to complex problems- fuel, health and planet.

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