HEATING MEAL AT LOWER COST USING FREE AND CLEAN SOLAR ENERGY.

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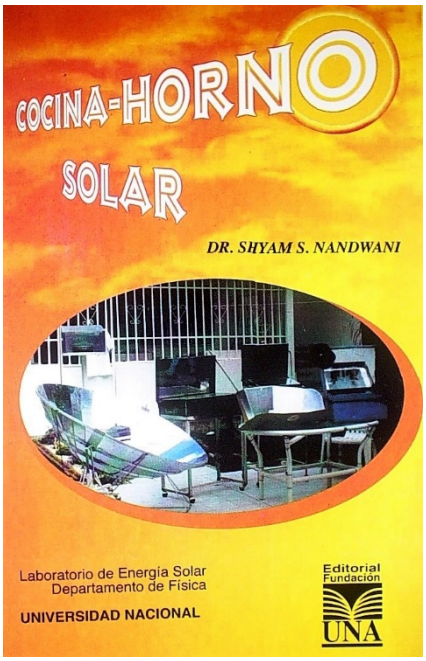

In the previous publications and the book (published in 1992 and again in 2003), author explained the construction of conventional solar oven and many others advanced models (Sol- AC Electric hybrid, Sol – DC Electric Hybrid, Heat storage, Tracking, Multipurpose Solar Oven etc.) for cooking/heating meal, mainly for domestic purposes, advantages and limitations etc. In this short communication, the stress will mainly for HEATING MEAL at educational institutes and at LOWER COST. Although study can be useful for heating also cooked meal for workers at homes, offices, construction places and street vendors etc.

Costa Rica, a small country with a population of 5.1 million and without military has 5000 primary and secondary schools and 1.2 million students studying for 200 days per year.

1. USE OF MICROWAVE OVENS FOR HEATING LUNCH

Every one has to take hot lunch (40-50 °C) during mid-day. Most of the students and staff take their cooked meal from home and heat in Micro Wave (MW) ovens. No doubt this is convenient and fast way to warm lunch box. However, there are some limitations like:

a. each meal/lunch box requires 2-3 minutes of electricity to heat, depending on the quantity of food, material of lunch box and the power of MW oven. Assuming 2.5 min for heating one lunch box, consumption of electrical energy for the college with 200 students studying for 200 days per year will be about 2250 kWh/year. Electric energy cost for the college per year, just for heating meal will be around US$ 375/ year.

b. In MW oven, one meal can be heated at a time. Although some colleges have 8-10 M W ovens, long queue and more time is needed to heat meal for these students. Their lunch break is only 30-45 min, thus not always all the students can heat lunch during this time so some have to take cold meal.

c. Although practically all the houses have MW ovens for heating, still some families do not prefer MW oven for heating lunch for their kids at school for possible health problem, like cancer.

Although about 99% of the population is electrified with 98% of the renewable fuels (Hydro, Geothermal, Wind, Biomass and Sol), still about 212 schools do not have electricity, thus cannot use MW Ovens.

2. USE OF SOLAR ENERGY FOR WARMING MEAL

Considering that warming meal does not require high temperature/solar radiation (as compared to cooking), one can think of simple solar oven- which uses free and clean solar energy. Author made first time solar oven for personal use at home in Costa Rica in march 1979 for warming family lunch and due to electric rationing during summer, imposed by National Electric company.

THE TICO TIMES

CENTRAL AMERICA'S LEADING ENGLISH-LANGUAGE NEWSPAPER

Sunny Visions -- Getting a Charge from Old Sol

SUNNY LUNCH: Dr. Nandwani and his daughter wait for their meal, being heated on the scientist's solar stove.

Photo 1. Authors first Solar Food warmer (Left) constructed for the house in Feb. 1979 and published in local English newspaper (The TICO TIMES, Right) and bottom photo.

Author himself was warming lunch at office and still warming at house, for last 42 years whenever climate permits (10-11 months in a year). During last 15-20 years, author is also promoting use of Solar Ovens for heating lunch at educational centers through free lectures, demonstration and organizing practical workshops etc. The size of the of absorbing plate is about 100 cmX60 cm or 0.6 m^2, which can accommodate about 40-50 lunch boxes. Photo 2 shows one Solar Oven heating about 40 lunch boxes, at Technical College, Heredia in 2020. This college got 4 solar ovens.

Photo 2. One of the solar oven at one college, Heredia, 2020.

3. ADVANTAGES/LIMITATIONS OF SOLAR OVENS

Solar Oven, using free energy from sun, can pasteurize water and warm many meals simultaneously. In spite of many advantages, only 30-40 educational institutes have installed about 80-90 solar ovens and they are satisfied. One of the possible reasons for not having more solar

ovens, is the initial cost of Solar Oven. One metallic Solar oven of this size, can cost around US$350 – 400, and can last at least 10 years. From amortization period (12-18 months), its justified, however most of the people go for initial cost.

The different ways to reduce the cost of heating lunch, would be

1. Portable individual small solar oven,
2. NO solar oven, just transparent conventional pots and SUN
3. NO solar oven, and free disposable transparent pots and SUN

We will be talking only points 2 and in brief also point 3.

The concept of heating meal WITHOUT USING SOLAR OVEN is the same as of mini greenhouse effect as shown in Photo 3. Just keep the lunch box in the sun. The pots should be transparent and suitable also for microwave oven, in case of very cloudy day.

Photo 3. Heating meal without Solar Oven.

Secondly some researchers are designing advanced solar cookers with advanced mathematical heat transfer analysis (for publication and for possible academic promotion) whereas other researchers/ promotors are looking for cheaper solar cooker with the hope of more acceptance. According to author with more than 40 years of research and observation thinks the COOKIT is the cheapest Solar Cooker, costing around US$5-10, designed by Solar Cookers International, around 25 years ago, as shown in Photo 4.

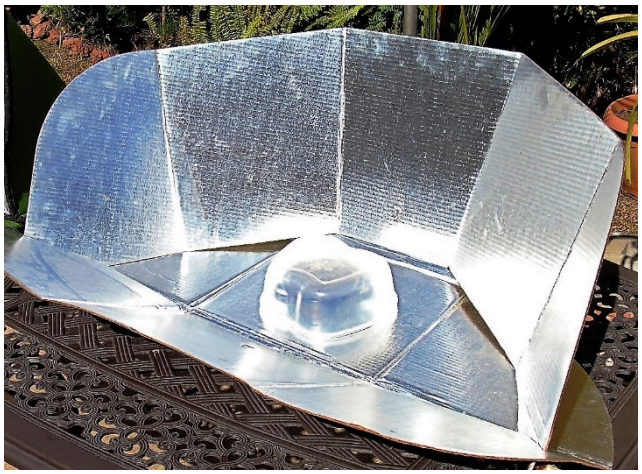

Photo 4. Simplest Solar Cooker, Cookit, designed by Solar Cookers International.

For heating meal we thought of removing the Cooker, and just Use the pot and transparent glass cover and Solar Energy.

Although based on logic, one can think of it should work, we did experiments during one pandemic year with different transparent plastic and glass (20 to 30) pots bought as well as free boxes coming with different and disposable eatable stuffs (Photos 5a and 5b).

Photos 5. Different pots studied for heating meal with Solar Energy, Conventional (Top) and Disposable (Bottom) pots.

Although detailed results of temperature with solar intensity for heating 250 g of meal will be sent to some journal, some data are mentioned here for two pots (Photo 6).

Photo 6. Transparent plastic (left) and glass (right) pots for heating meal with Solar energy

The meal temperature in 2- 2.5 hrs, reached to was 52.0 °C, sufficient hot to enjoy. The similar experiment was also done with disposable transparent plastic pots (Photo 5). In case of change in climate, all these pots studied can be used in MW Oven to finish heating with far less electrical energy.

Disposable plastic boxes can be washed, dried in Sun and can be reused for warming lunch may be 5-10 times depending on use etc. This option is not suggested for students but may be for fixed street vendors, selling some items at sunny place.

We expect that this study for heating meal with solar energy, even without expensive solar oven can be used by more educational and other institutions. Due to pandemic situation, since beginning of 2020, the classes are virtual we could not study at colleges etc. According to Ministry of Education, at the beginning of January 2022, the classes will be presential and students will be bringing their lunch boxes. Then we can see the acceptance by school/colleges students and public etc. Also many times, at the house you already got cooked meal left from previous day and U just need to heat. Just warm with Solar Energy without having Solar Oven.

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