SOLAR COOKERS

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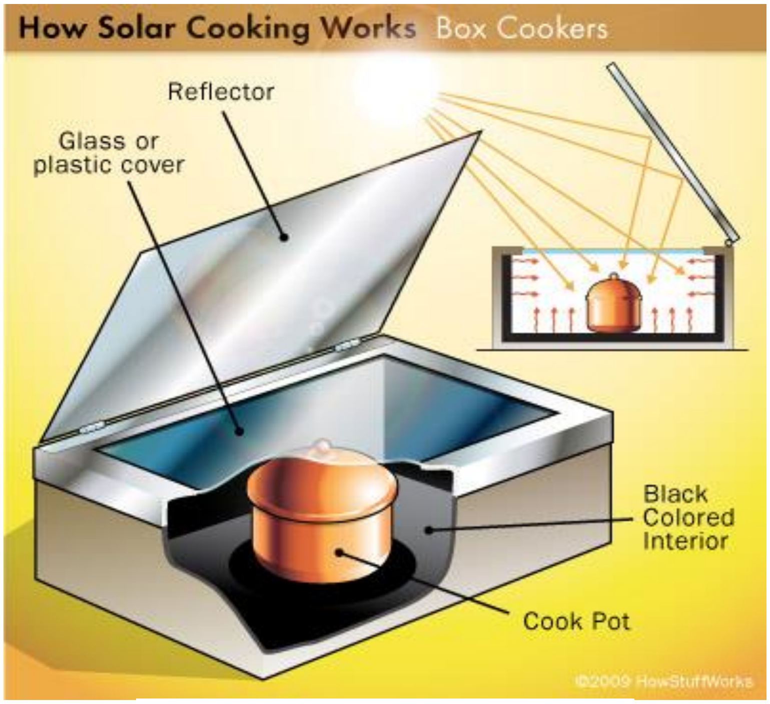
Introduction. A solar cooker is a device which uses the energy of direct sunlight to heat, cook or produce drink and other food materials. Many solar cookers currently in use are relatively inexpensive, less technological devices, although some are as powerful or as expensive as traditional ovens, and advanced, large-scale solar cookers can cook for hundreds of people. Because they use no fuel and cost nothing to operate, many eco-friendly organizations are promoting their use worldwide in order to help reduce fuel costs and air pollution.

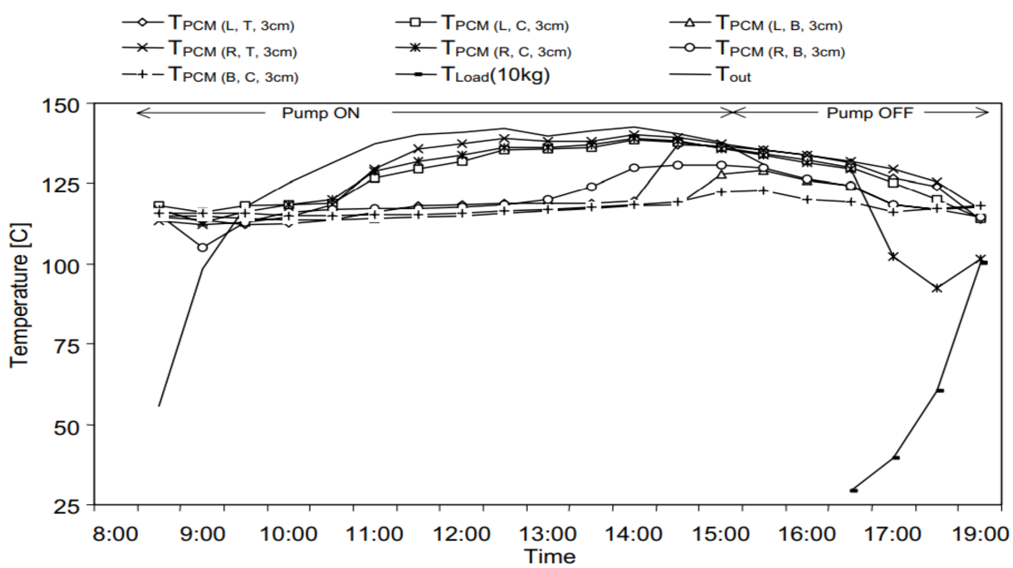
The aim of the work. Have a look on principles of its work and analyse different constructions and peculiarities of solar cookers.

The main body. The container of food is placed inside the solar cooker, which may be elevated on a brick, rock, steel, or other heat able materials, and the solar cooker is placed in direct sunlight [1]. Foods that cook quickly may be added to the solar cooker later. The cooking time depends primarily on the equipment being used, the amount of sunlight at the time, and the quantity of food that needs to be cooked. Air temperature, wind, and latitude also affect performance. Food cooks faster in the two hours before and after the local solar noon than it does in either the early morning or the late afternoon. Large quantities of food, and food in large pieces, take longer to cook. As a result, only general figures can be given for cooking time.



Picture 1 – The principle of work

In addition to this, it is essential to investigate the temperature changes inside the cooker and its substitution with environment. The graphic on picture 2 shows the variations of phase change materials (PCM) temperatures on 3 September 2002[2]. This experiment was undertaken to see whether the PCM was capable of evening cooking or not. At 5:00 PM. 10 kg of water was loaded inside the cooking vessel. The initial temperature of the loaded water was 31.6C. From this figure, it can be observed that TPCM (R, C, 3 cm) suddenly dropped from 134.1C to 102.1C due to the water (1.0 kg) filled in the 7mm gap between the cooking vessel and the PCM storage unit. At the moment when the water was filled into the gaps, some of the water was converted into steam. Water was put into the gap to increase the heat transfer rate from the PCM unit to the cooking vessel. Results show that the temperature for the load of 10 kg water sharply increased. From 6:35 PM, the temperature of the load stayed at 100C. It was found that the total time for evening cooking was 96min and that the PCM storage unit was able to cook food in the late evening. It was observed that heat transfer from the PCM to the cooking vessel was higher due to the water that is filled in the gap. However, this is impractical because of high heat loss through vaporization of water and risk to the user.



Picture 2 – Variations of temperatures, Tout and Tload (10 kg) temperatures for evening cooking on 3 September 2002

There are different types of boxes and panels design: parabolic reflectors, paraboloidal reflectors, spherical reflectors and vacuum tubes. Parabolic reflectors are used to collect energy from a distant source (for example sound waves or incoming starlight). Since the principles of reflection are reversible, parabolic reflectors can also be used to collimate radiation from an isotropic source into a parallel beam. Parabolic reflectors are used in one of two ways [3]: Firstly, light will be focussed onto a line that runs the entire length of the trough. Normally a tube will run the length of the trough at the focal point carrying a liquid that will be heated the sun's energy. To maintain the focus of sunlight on the tube, a tracking mechanism will be necessary to change the vertical angle of the trough as the sun rises and falls in the sky. In other way, reflectors will focus light onto one point and are typically used to provide the energy for Stirling Engines running generators. To maintain the focus of light on the Stirling Engine, a tracking system will need to follow the movement of the sun vertically and horizontally.

Picture 3 – Two types of parabolic reflectors

Paraboloids are compound curves, which are more difficult to make with simple equipment than single curves [4]. Although paraboloidal solar cookers can cook as well as or better than a conventional stove, they are difficult to construct by hand. Frequently, these reflectors are made using many small segments that are all single curves which together approximate compound curves. Paraboloidal reflectors that have their centres of mass coincident with their focal points are useful. They can be easily turned to follow the sun's motions in the sky, rotating about any axis that passes through the focus. Therefore, the cooking pot stays stationary at the focus.

Picture 4 – Paraboloid reflector

There are two types of spherical mirrors i.e. convex and concave [5]. A concave mirror is a spherical reflecting surface (or any reflecting surface fashioned into a portion of a sphere) in which its depressed side faces the source of light. A convex mirror is a spherical reflecting surface (or any reflecting surface fashioned into a portion of a sphere) in which its bulging side faces the source of light. They can be used to obtain a magnified or diminished image of an object (as required), which makes them different than plane mirror. Concave spherical mirrors are used to harness light energy from sun (they can concentrate suns light rays incident on the surface at a point and that heat is converted to electrical energy). On the other hand convex mirrors are used in automobiles as rear view mirror (as the image produced by them covers more area than concave or plane mirror, but the disadvantage is, the objects appear diminished in the image. This is why there is this line “objects in the mirror are closer than they appear on the mirror. Spherical reflectors are used in torch, telescopes, headlights of car and many more places. It is not necessary that a spherical reflector may look like a part of a sphere. They may be a part of a paraboloid.

Picture 5 – The instance of spherical reflectors

Evacuated tube solar cookers are essentially a vacuum sealed between two layers of glass [6]. The vacuum allows the tube to act both as a "super" greenhouse and an insulator. The central cooking tube is made from borosilicate glass, which is resistant to thermal shock, and has a vacuum beneath the surface to insulate the interior. The inside of the tube is lined with copper, stainless steel, and aluminium nitrile to better absorb and conduct heat from the sun's rays. However, this technology is not widely spread because of its cost and hard construction.

Picture 6 – Vacuum tube solar cooker

Conclusion. To conclude, the biggest advantage of solar cooker is it does not harm the environment. It can at least maintain the air quality of your home better. When you use it, you can reduce the emission of carbon monoxide. If you use an air conditioner, you could save fuel expenses. By using it, you would not remain depended on gas or electricity anymore. Sometimes, you have to face a shortage of electricity or gas. You just need sunlight to access it. In this case, it can be helpful. The food quality is approximately the same as you get on gas or electricity. There are some countries where days are shorter. Solar cookers do not work in rainy cloudy weather. They take more time than a usual cooker. So you have to start cooling earlier than usual. When you use it, you have to keep an eye on somethings like the weather. Solar cooker are not efficient at retaining heat. So, it has not proved beneficial for some countries. People need to learn cooking ways. Due to variable weather, sometimes it does not cook fully. It does not sustain its heat as the usual stove does. If you can handle the weather condition, then it is recommended equipment. Using a solar cooker may damage your eye. Like the reflection of the sun radiation into your eye.

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