

Design of Solar cooker

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Abstract:

The design we propose is based on the principle of a concentrator. A typical focusing type solar cooker in the form of a parabola is taken and certain modifications have been made to it in order to meet the standards set by the problem statement. The entire design can easily be realized with cheap raw materials. Thermal storage unit is provided along with the cooker

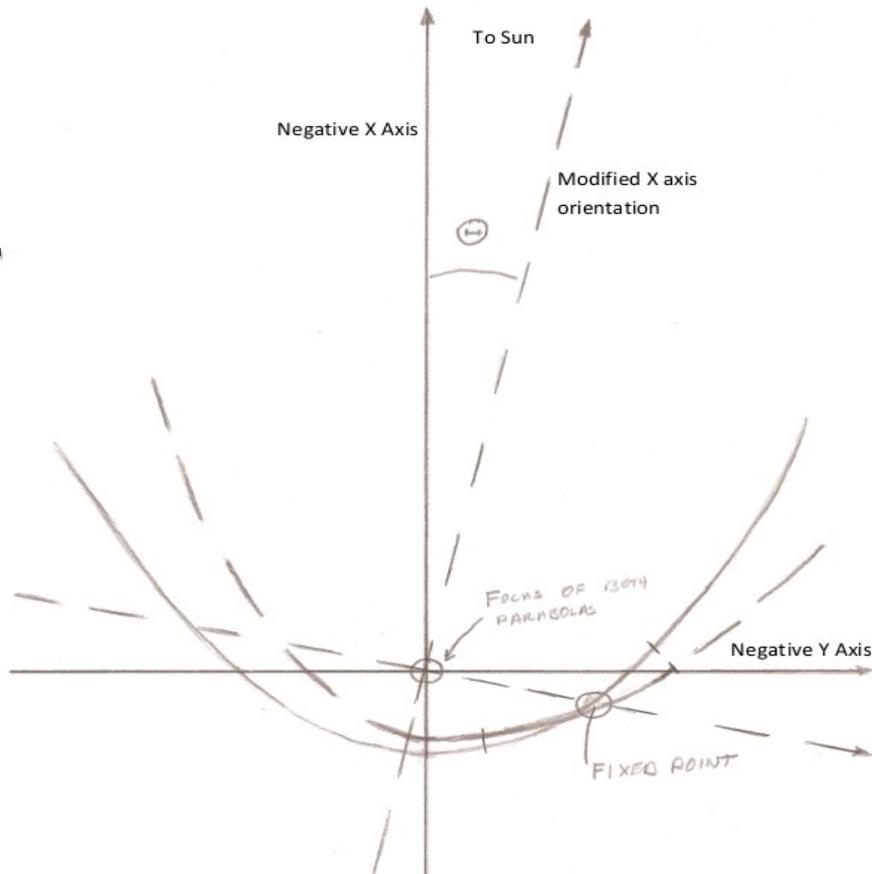
Design

A parabolic shaped solar cooker can easily be made using an umbrella. Reflectors made of Aluminium are fixed along the spokes of the umbrella. The handle is removed and the cooker is fixed in its place. The entire set up is covered with a plastic sheet which traps the heat thus keeping the vicinity of the cooker warm.

The sun's position changes during seasons. The parabola's focus in polar space always remains at the origin, leaving one fixed point where the mirror is attached to the support. In this case it is convenient to change the position of the original axes with the negative x axis point at the sun at all times.

To translate between the two coordinate systems, Θ which is the angle between the two frames, is added to get the angle variable of the second frame (dashed lines in the figure below). Between summer and winter the parabola must change shape, and orientation. Its altitude is thus shifted by Θ to match the displacement of the plane of the sun's motion and changing its shape to properly focus on to the cooking area.

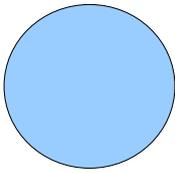
The cooker has to be moved constantly to make sure that the sun's rays directly focus onto the cooker.



The steel spokes of an umbrella are covered with aluminum sheets which offer high reflectivity. The cooking vessel is painted black to ensure good absorption of the reflected light. It mainly consists of two parts. The lower part comprises of a double walled storage cavity. The walls are filled with common salt as they offer good insulation property and retain heat for a very long time. The cavity is filled with oil.

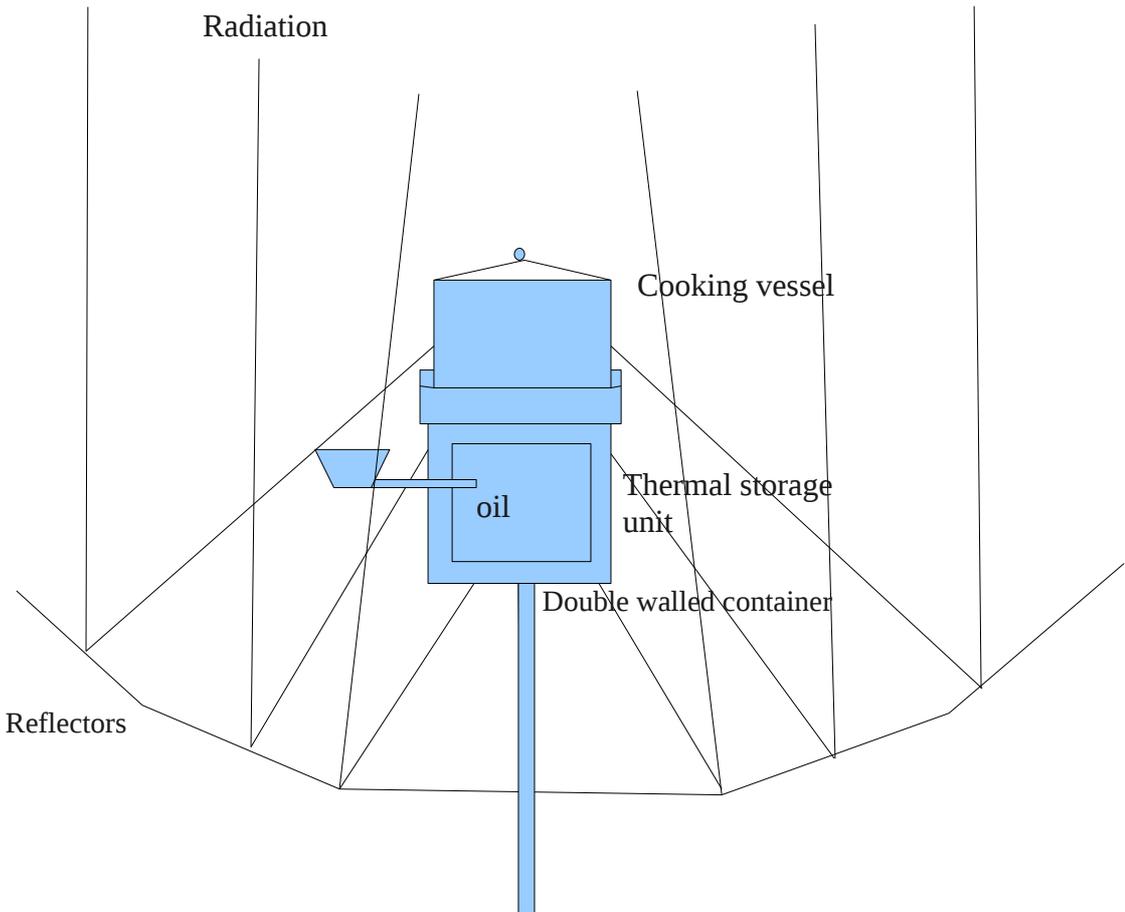
During the daytime, radiation from the sun is reflected onto the cooking vessel and the contents inside it get cooked. The oil inside the vessel gets heated through the salt(that is filled inside the walls of the container).

The entire parabolic has to be constantly focused towards to the sun to ensure maximum efficiency. The interior of the vessel is provided with a pipe whose significance comes into the picture only after daylight



SUN

Radiation



Cooking vessel

Thermal storage unit

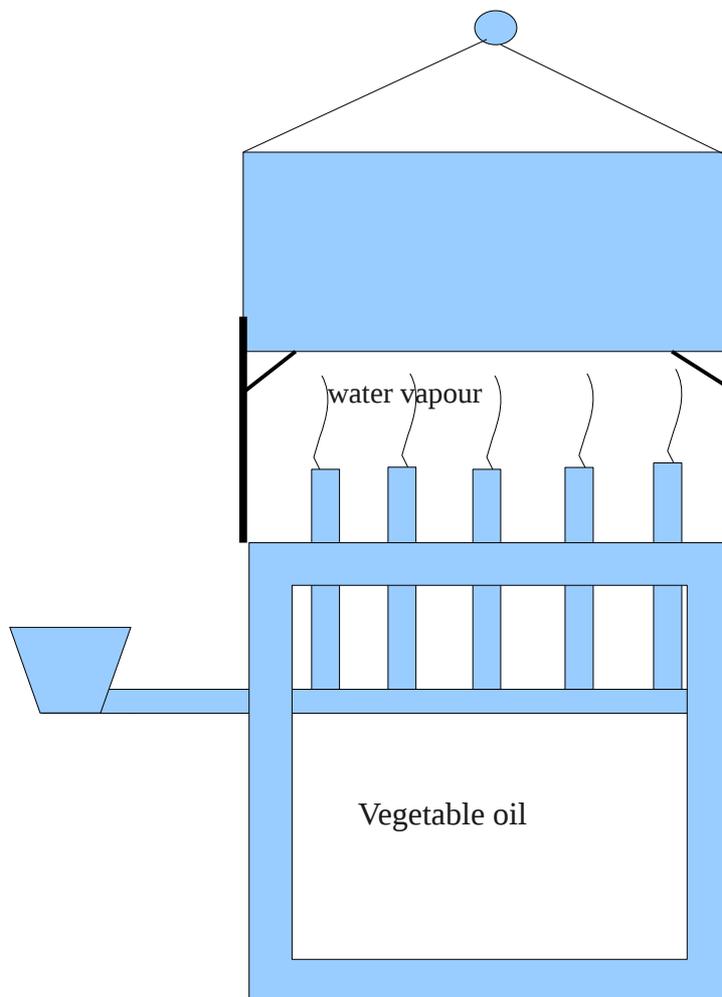
oil

Double walled container

Reflectors

In order to understand the functioning of the cooker at night, the interior of the double walled vessel has to be looked into in a more detailed manner.

Water is poured through a funnel that leads into the vessel. The water in the pipes gets heated because of the hot oil inside the double walled container. The water turns into vapour and comes out through the pores which is used to cook rice. If chapathi needs to be cooked then a pan can be placed over the pores. The vapours heat the pan thus roasting the chapathi.



Thermal Storage Unit:

The insulated thermal storage device was designed to hold a large amount of heat after the sun goes down allowing cooking in the evening. The original thermal storage design used a pipe system to deliver the heat to the thermal storage from the trough.

Simple vegetable oil can be used to fill the container.

The principle ways of cooking food are Boiling, Frying, Roasting, and Baking

Heat losses during cooking

Vaporization of water	: 35 per cent
Heating food to boiling temperature	: 20 per cent
Convection losses from vessel	: 45 per cent

Concluding Remarks

The working design that we proposed was constructed. We are continuing to explore methods to increase concentration, and reduce the cost and construction time associated with the device. A thermal storage device was also successfully constructed and tested indicating thermal retention times sufficient for cooking into the evening.