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Solar Kitchen

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Abstract: ***The present research focuses on solar kitchens.It is an optical system to provide concentrated solar radiation, the concentrated energy of sunlight can be used to calendar or cook food. Solar kitchens use the thermal conversion of solar radiation to generate heat and thus, heat or produce distilled water. The temperature reached inside the container depends on the amount of solar radiation that enters through the glass, as well as the level of thermal insulation that has.Nowadays, the overexploitation of fuels that at the time of transforming into energy releases emissions into the atmosphere have caused serious problems to the environment, the main one is produced by humans, it originates in the combustion of hydrocarbons as oil and its derivatives coal, firewood and natural gas. The main objective of this research will be to focus on the use of renewable energy obtained from the use of solar radiation, the benefits of using solar cookers are as follows: (renewable, inexhaustible, not contaminating, avoid global warming and reduces the use of fossil fuels).To support this research, a model of a solar cooker was built. In addition to having a common and easy to use design, a temperature sensor (thermocouple)connected to an Arduino card was added and together they will provide us with the amount of heat generated inside the container that we can see on an LCD screen.***

Keywords: Energy, renewable, kitchens, solar, heat

1. Introduction

Currently, more people are looking to reduce their costs by using solar kitchens as an option in the heating of food and the results have been of great satisfaction and benefit.In the present investigation we will focus on the construction of a solar kitchen, this is due to the fact that currently there is a great problem in the consumption of fossil fuels, and its use as a human need generates an economic destabilization in the daily life of the people. In addition, there is a problem in pollution due to the excessive use of fuels used to heat or cook food, causing serious damage to the environment, this is why the idea of using solar radiation to heat different types of food arises, and sometimes it also produces distilled water. The main feature of this solar kitchens is to allow the sun's rays to multiply, to generate heat inside the solar concentrator. For this to be possible, a series of mirrors were included inside the cabinet and a thermal insulator (Expanded polystyrene) was also added in the walls to take advantage of the heat as best as possible.To know exactly the maximum temperature reached inside the concentrator we include a temperature sensor connected to a logic card and this is connected to a rechargeable battery to visualize the temperature at all times.

2. Theory

Solar cookers are devices that allow cooking food using solar radiation as an energy source. They are another alternative for rural cooking and although they do not completely cover the need for cooking food, for example, making tortillas, or cooking on cloudy days, their use represents a saving in the consumption of firewood[1].

3. Types of Solar Kitchens

Solar kitchens and components, that is, artifacts that allow cooking food using the sun as an energy source, are classified as[2]:

3.1 Oven or box type solar cookers solars

They consist of a thermally insulated box that has been designed to capture solar energy and keep its interior warm. They are made with materials that are generally low heat conduction, which reduces the risk of burns to users, prevents the possibility of fire (both the kitchen and the place where it is used) and also prevents food is burned, preserving its flavor and nutritional value[2].

Figure 1: Oven or box type solar cookers solars

3.2 Parabolic or concentration parabolic solar cookers

They are based on the concentration of solar radiation at a point called focus, typically through a parabolic reflector. In this focus the pot that cooks the food is placed. These cookers generate high temperatures and allow frying food or boiling water[2].

Figure 2: Parabolic or concentration parabolic solar cookers

3.3 Mixed solar kitchens

Most solar kitchens use the two previous methods to achieve high temperatures.The furnaces achieve this by adding external reflectors, which reflect the energy density through the glass.In most cases the reflectors are flat. In the case of

concentration cookers, it is achieved by introducing the container with food in another glass container or transparent plastic bag that performs the greenhouse effect[2].

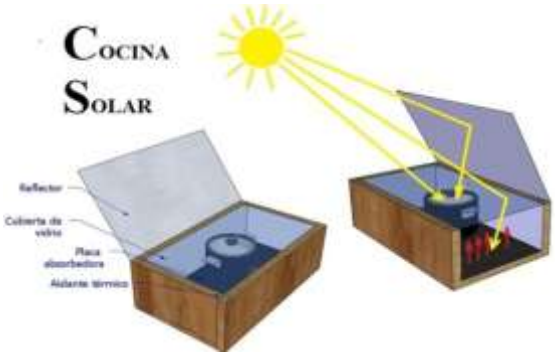

Figure 3: Mixed solar kitchens

3.4 Indirect solar kitchens

Indirect kitchens take advantage of the solar energy stored in a thermal fluid to heat the containers. The sun heats a thermal fluid (oils generally) through some solar collectors and is stored in an isolated tank. When you need to cook, the fluid is pumped into the kitchens.

Kitchens should be as close as possible to the tank to avoid mechanical losses.

These types of kitchens are more complicated to design and have a high cost. They are used for hospitals or common dining romos. Thanks to storage, you can cook at any time in a similar way as it is done in a conventional kitchen[2].

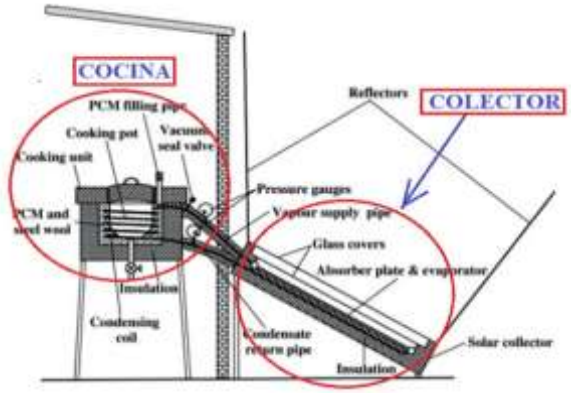

Figure 4: Indirect solar kitchens

Due to the above, our solar kitchen model that we built is of the box type, apart from being a comfortable model to use very practical to move to anywhere it is built with low cost materials and are easy to get in communities even if it does not matter how marginalized they are.

4. Development

To analyze the operation of solar kitchens, it is necessary to generate the design and manufacture of the prototype. One of the functions is the steam that is generated inside the solar concentrator as a usual way to accelerate the cooking of food, which gives us enough precision to heat some foods, for that reason the idea of carrying out this project arises[3].

4.1 Main characteristics for heat gain

4.2.1 Greenhouse Effect.

One of the basic principles of capturing solar radiation is what is known as the greenhouse effect. This is based on the property that some materials have, such as glass, to be traversed by solar radiation, but to reflect only a part. If inside a glass receptacle, in addition, the basic color of the materials is black, they concentrate with a large dose the energy received, so that the infrared rays do not have enough energy to escape through the glass. This conversion of solar radiation into heat energy through infrared rays, which allows the temperature of objects inside it to increase, is known as the greenhouse effect. The temperature reached by the materials affected by the greenhouse effect can be transmitted by conduction and this allows, for example, cooking food or simply generating heat to make sauna[4].

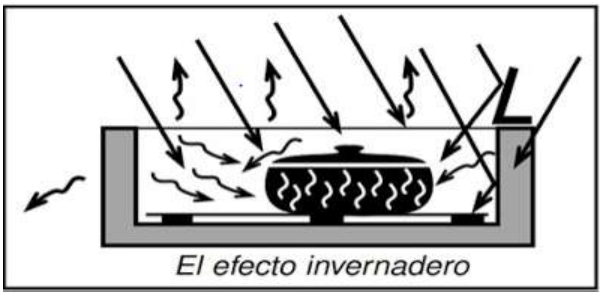

Figure 5: Green house effect

4.2.2 Orientationofthecrystal

The more directly the glass is facing the sun, the greater the gain of solar heat. That is why in some designs the coverage is inclined, so that the oven has a greater area exposed to the sun than an oven with horizontal glass cover. In our environment, because of its location, the inclination of the coverage allows a greater heat gain. However, it must be takenintoaccount that heat can also be lost through this greater area[2].

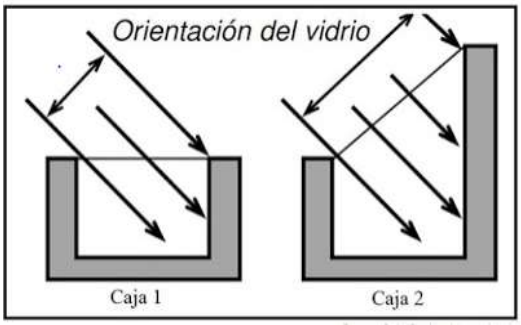

Figure 6: Orientation of the glass

4.2.3 Reflectors

The more solar radiation enters the box, the greater the amount of energy inside it. This is why generally polished aluminum external reflectors are used to increase the amount of solar radiation that affects the glass coverage[2].

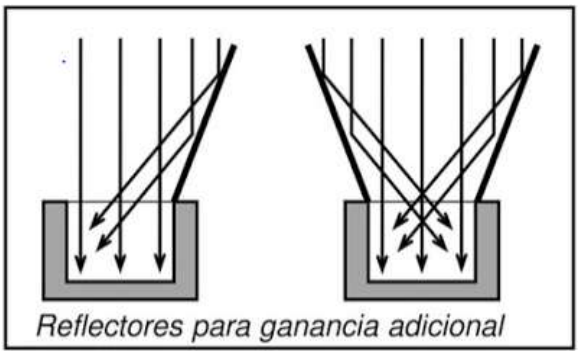

Figure 7: Reflectors

5. Construction of the Kitchen

5.1 Step 1, construction of the structure.

The structure of our solar cooker is box-type and is made with a frame of 18-gauge steel, to give greater rigidity, previously designed to get the sun's rays reach the largest mirror, and then get projected into the box such as shown in figure 8.

Figure 8: Etructure

5.2 Step 2- Thermal insulation

Once the main frame was finished, we focused on building the outside of the kitchen. It was lined with MDF wood of 9 mm thickness to reduce a bit of weight, but to give a good thermal insulation inside, different materials were considered. such as: (loose chip, dry sand, polyurethane foam and expanded polystyrene) for our case and according to the requirements of our project we use expanded polystyrene in sheet form with a thickness of 15mm, this material was chosen as thermal insulation by its different common uses for thermal processes combined with this is a low cost and easy to handle product, all the walls of the kitchen were lined with the exception of the lid where the mirror was placed.

5.3 Step 3- Placing glasses

We place the glass that will adsorb the solar radiation at an angle of 45 ° on the top of the box and fixed with hinges to make it easier to extract food, then we fix on the inside 2 mirrors that plow the function of reflectors for a greater concentration of heat, in the rest of the walls where there is no glass lining with aluminum foil for being a material with characteristics of easy heating will favor us a lot. The afore mentioned can be visualized in figure 9.

Figure 9: Placing glasses

5.4 Step 4, circuit assembly to display temperature.

For this step we include electronic devices such as an Arduino one, this is a programmable open source logic card easy to find in any electronic store, figure 10.

Figure 10: Arduino

Then we include a type K Max6675 temperature sensor or better known by the name of thermocouple, as a general characteristic this sensor is able to withstand temperatures from -10 ° to 150 °, figure 11.

Figure 11: Temperature sensor

The data revealed by the Max6675 sensor were displayed on a 16x2 LDC screen. After, a program was made on the Arduino platform where the Max6675 module was attached to the LDC, the complete diagram of our connection is as follows. Figure 12.

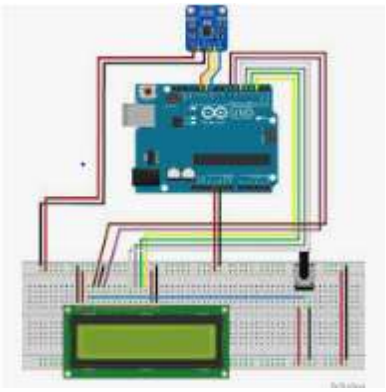

Figure 12: Diagram

5.5 Step 5, we include the circuit to the kitchen.

Finally, once the entire circuit was connected, a wooden box was built to protect it from the sun and a rechargeable battery was fitted with a solar panel so that the temperature sensor will work unknowingly while the kitchen is being used, all with the objective of taking advantage of solar energy as best as possible.

6. Results

The results that we obtained in the construction and use of the solar cooker are really satisfactory.It was possible to prove that food or any type of liquid can be heated starting 50 ° C, while the sun favors us in a constant manner during this heating process. It is also possible to include one or two containers simultaneously inside the box, it should be noted that if the kitchen is exposed to the sun previously before starting to use it, the results regarding the time in which the food is heated will be more satisfactory.Because this research project is innovating, we assume that it is subject of changes for its improvement. For example, the heating time of a food varies depending on the temperature it is in before entering it into the solar cooker box, but it is possible to accelerate the process if more crystals are added to achieve a magnifying glass effect and reach higher temperatures in a shorter time. In this case, this research is based on real evidence and everything mentioned above can be supported.

7. Conclusion

Solar cookers are a key element for the use of solar energy, just like solar water heaters, it is possible to heat food without spending all the gas consumed by a conventional stove. This principle is based on solar radiation through a glass, this is how heat reaches our food in a way that does not pollute the environment or food.

With this research we intend to get more people to know this new system and thus be able to include this type of solar cookers in most of the houses to save money and go a step further to help live on our planet reducing pollution.

References

[1] Unidad de ecotecnologías, UNAM, Campus Morelia, México. (Cocinas solares) 2014 Resumenpárrafo. Obtenido de:http://ecotec.unam.mx/Ecotec/ecoteca/cocinas-solares

[2] Realidad Energética Renovable con TECNOLOGÍAS LÍMPIAS (Para una Eficiencia Energética y Desarrollo Sostenible) noviembre de 2015. Obtenido de: http://alternativarenovable.blogspot.com/2015/11/aplicaciones-fototermicas-bajas.html

[3] Terra Tecnología práctica. (cocinar con el sol) Artículos. Obtenido de: http://www.terra.org/categorias/articulos/cocinar-con-el-sol

[4] Terra Ecología práctica, Hornos solares de acumulación, Comunidad de cocinas solares agosto de 2005. Obtenido de: http://www.terra.org/categorias/comunidad-cocina-solar/hornos-solares-de-acumulacion

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