Solar Thermal Systems for Cooking, Baking and Heating Domestic Water

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Summary

The objective of the project is to design a low cost solar thermal system for the purpose of cooking, baking and heating water for domestic use. This system needs to be suitable for rural areas of underdeveloped countries. During the design process, students will be limited to use the inexpensive materials available locally.

Introduction

In many underdeveloped countries (especially in rural areas), wood is being used as a source of energy for the preparation of daily meals. This leads very often to the depletion of forests and even to the elimination of all trees. As a result the ecological balance can be affected. This can lead to mudslides during the rainy season and can be catastrophic to the area. Most of the underdeveloped countries dealing with the described problems are located in tropical climates where solar energy can be harvested and used for cooking, baking and heating water for domestic use. There are commercially available solar thermal systems. However, they are not affordable because of the high cost factor. Build-it-yourself systems using available and affordable local materials could improve sustainability of many rural areas in underdeveloped countries.

Principles of Solar Thermal Systems

The solar thermal systems use direct light and heat from the sun concentrating it in some manner to produce heat at useful temperatures. The solar energy system utilizes devices that convert the sun's heat and light to another form of energy that we can be directly applied to meet our daily needs. There are two main categories of domestic energy needs, thermal needs and electrical needs. Thermals needs include space heating, domestic water heating and cooking appliances. This accounts for 61% of the household energy demand. Electrical needs include lights,

refrigeration and domestic appliances. This accounts for 39% of the total household energy demand.

As part of the project students are going to track energy from the sun to its useful purpose. They will be investigating the following

- Radiation produced by the sun

  Light is an electromagnetic wave made up of photons which have a certain energy level corresponding to different colors. Spectrum based on temperature will be discussed. The atmosphere absorbs, reflects or scatters the energy.

- Energy that encounters the earth and atmosphere

  In space solar energy is about 1.4 KW/m2. At noon on a clear day about 1 KW/m2 reaches the surface of the earth. The atmosphere reflects or scatters the rest.

- Energy captured by the collector that converts to heat

  Maximum solar input of 1 KW/m2 determines the total energy that can be collected. As a part of the project students will be calculating the size of the collector area to generate the needed amount of energy. Daily the sun rises from the east and sets in the west. The zenith angle determines the flat surface affective area of the collector. The student will study the sun chart for different geographical areas. Students will investigate what happens when the light hits the surface. The light can be absorbed, reflected or transmitted. Students will consider different materials for the solar collector to improve efficiency. Students will also investigate the thermal dynamics of producing heat, as well as solar collector design.