Simple Solar Water Heater for Developing Countries

Dr A.Jagadeesh
Nayudamma Centre for Development Alternatives, 2/210 First Floor
Nawabpet
NELLORE 524 002, Andhra Pradesh, INDIA
Ph: + 91 861 5518626
E-mail: a_jagadeesh11@rediffmail.com

The sun is an energy source available to everyone, an energy source that can be used simply, and inexpensively to reduce developing countries' dependence on imported fuels. Solar water heater is the simplest and most cost-effective solar applications.

Solar water heaters are based on a common natural phenomenon: cold water in a container exposed to the sun undergoes a rise in temperature. The solar water heater is basically a flat-plate collector and an insulated storage tank. The collector is commonly blackened metal plate with attached metal tubing and is usually provided with a glass cover and a layer of insulation beneath the plate. The collector tubing is connected by piping to a tank that stores hot water for use during non-sunny periods. When mounted on a roof or other suitable support, the collector absorbs radiation, by transfer of resulting heat to water circulating through the tubing, hot water is supplied to the storage tank. In the most common designs, the storage tank is located above the top of the collector. The elevated position of the tank results in natural convection: water circulates from the collector to the tank.

When solar water heater technology is so simple, how is it that developing countries are yet to catch up? The reasons are not far to seek. The main constraint is prohibitive cost. For instance, in India a 100 liter solar water heater costs around Rs. 12,000/- (about US $ 300). Another interesting point is that not many people living in towns and villages have access to overhead water storage tanks to get continuous supply of cold water.

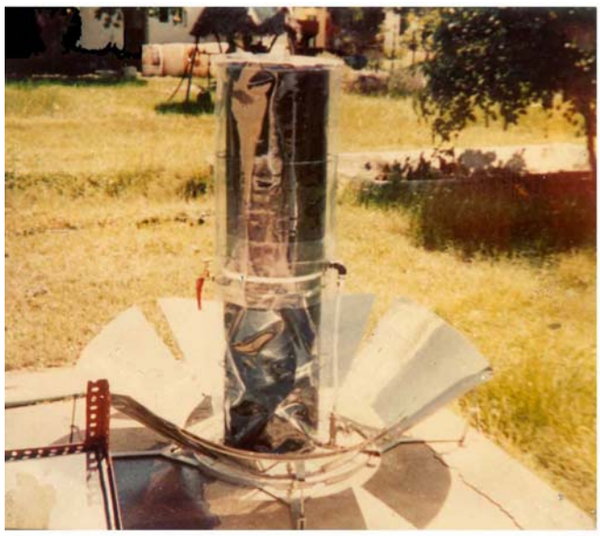
To overcome the above barriers, the author designed and tested a vertical and cylindrical Solar Water Heater.

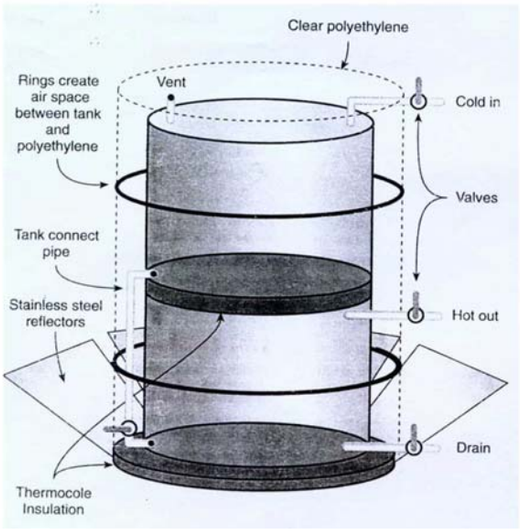
Design Details

Two vertical and cylindrical collectors made of stainless steel (normally used in the manufacture of drinking water drums) with a height of 0.6 m and a diameter of 0.32 m are made and placed one over the other with thermocole in between as well as at the bottom to prevent heat losses.

The top cylindrical auxiliary tank is provided with an inlet at the top and provided with a cap and the same is provided with an opening at the bottom, which is connected to the bottom cylinder with a hose pipe (strong enough to withstand high temperatures). There is a lever attached to the pipe to control water flow. The bottom cylinder is provided with an outlet at the top from which water is drawn. Both the cylinders are provided with concentric rings to provide gap and covered with high density transparent polyethylene sheet to simulate green house effect. A lotus flower shaped reflector (as shown in the picture below) made of stainless steel acts as a reflector. This takes into account the diurnal motion of the sun.

The insulator is made of bamboo basket with a height of 1.3 m and a diameter of 0.45 m (circular) and covered with 6mm of glass wool (rock wool) and over it with transparent polyethylene cover so that the whole setup is airtight.





Operation

The collector is filled with potable water in the morning at 8 a.m. and is covered with the insulator (bamboo basket) at 4 p.m. The hot water can be used either in the evening, night or next morning. Hot water up to 70° C is obtainable depending on the sunshine. In 15 hours of storage about 70° C drop in the hot water temperature is observed. This 100 liter unit costs around Rs. 6,000/- (about US$ 150) in South India and will be highly useful as a pre-heater for cooking, for bathing, for washing cloths and utensils, for rural schools, hospitals etc.

Advantages

• The unit is mobile, modular and easy to install and dismantle for transporting.
• No necessity of cold water supply through pipes.
• No need for over head storage water tank.
• There is no need to have separate collector as it is an integrated system.
• Since the collector is made of stainless steel, the hot water will be hygienic.
• Because of the omni-directional reflector, relatively higher water temperatures are obtained even in moderate sunshine.
• The unit occupies less space being vertical and circular, on the ground or roof.
• All the materials used in the fabrication of this simple and cost-effective solar water heater are available locally.
• The unit is durable except that the polyethylene cover has to be replaced once in 4 months, which costs just Rs. 30/- (about US$0.7).
• When using pre-heated water for cooking from this unit, considerable fuel such as firewood, kerosene, gas, electricity etc. can be conserved.

Simple Solar Dryer

Dr A.Jagadeesh
Nayudamma Centre for Development Alternatives, 2/210 First Floor
Nawabpet
NELLORE 524 002, Andhra Pradesh, INDIA
Ph: + 91 861 5518626
E-mail: a_jagadeesh11@rediffmail.com

Drying soaked rice, pickles, salted fish, and millet in winnowing basket is a common sight in India. Winnowing basket in sunlight is a common sight in our country. But this system suffers from many disadvantages like falling of dust in the contents, longer time to dry, no protection from insects, birds etc.

In order to overcome these defects a simple and inexpensive solar drier which can be fabricated locally has been designed and tested by Dr A. Jagadeesh.

The bigger unit consists of a tray-shaped structure made of bamboo of dimensions 1 m x 0.16 m x 0.15 m height with slant sides for wider incidence of sun light. It is covered with black polyethylene sheet inside, which acts as absorbing material. In areas where there is difficulty in procuring black high density polyethylene sheet the inside portion of the basket is coated with enamel black paint and covered with transparent HDP cover. Over the basket, a transparent polyethylene sheet is provided with opening at two sides and the other two sides being fixed to enable for easy lifting to put the contents. The top polyethylene sheet is provided with Velcro for fixing. The basket is provided with holes on the sides for easy passage of air which avoids formation of water vapor at the top. This design costs just Rs 150 in South India.

The second system is meant for drying small quantities in rural areas. In this, a winnowing basket is provided with similar arrangement as in the previous case. This costs Rs 50.

Experiments reveal that on an average it saves half of the time to dry the contents when compared to open drying.

The advantages offered are:
(a) The contents dry quickly;
(b) The contents will be hygienic as they are protected from dust because of cover;
(c) The contents are free from bird menace like crows as there is a thick covering;
(d) When sudden rain comes, the contents are protected because of the polyethylene covering;
(e) The units are light and easy to carry;
(f) All the materials used in the fabrication of these simple solar driers are available locally and can be fabricated by local people;
(g) Fabrication of this simple gadget helps generate rural employment.

About Dr A.Jagadeesh

Dr A.Jagadeesh
Nayudamma Centre for Development Alternatives, 2/210 First Floor
Nawabpet
NELLORE 524 002, Andhra Pradesh, INDIA
Ph: + 91 861 5518626
E-mail: a_jagadeesh11@rediffmail.com

Dr. Anumakonda Jagadeesh obtained his Bachelors and Masters degrees in Physics from Sri Venkateswara University, Tirupati, Andhra Pradesh, India, and his Doctorate degree in Wind Energy from the prestigious University of Roorkee (now the Indian Institute of Technology Roorkee (IITR)). He has been involved in teaching and research for the last 30 years. He founded the "Society of Science for the People" in 1973, an NGO which has been acting in formulating innovative science and technology programs and projects.

Dr. Jagadeesh has widely interacted with several global and national organizations in Science and Technology projects; his programs have attracted world wide attention, especially in Appropriate Technology, Afforestation, Renewable Energy, Environment, etc. Dr. Jagadeesh also founded the "Nayudamma Centre for Development Alternatives" in Nellore, Andhra Pradesh, India in 1994 which has been acting as a think tank in promoting Energy, Environment, and Appropriate Technology programs and projects. He has been a Resource person to several organizations connected with Sustainable Development in India and abroad.

Dr. Jagadeesh has traveled to over 30 countries and worked in Italy, Denmark, Sultanate of Oman, etc. He has held many important positions such as Director, Murugappa Chettiar Research Centre, Chennai, India; Vice President, Subhash Projects and Marketing Ltd, Bangalore, India; Director, Infrastructure Consulting and Engineers Pvt. Ltd, Bangalore; and is currently Professor and Head, Centre for Energy and Sustainable Resources, R.M.K. Engineering College, Kavaraipettai, Tamil Nadu, India.

Dr. Jagadeesh's pioneering work won him several international and national awards including the prestigious "Margaret Noble Foundation, Seattle" Award for Research in Energy. Dr Jagadeesh has published 110 papers in International and National Journals including presenting papers at International Conferences and Symposia. He has membership in several international and government bodies in India. It is rarely one finds an Innovator, social scientist and crusader for the promotion of Science and Technology for Sustainable Development, all blended into one.