Construction and Filling of a Large-area Deep-tank Solar Pond for Harnessing Solar Energy

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ABSTRACT

There is a growing world-wide interest in promoting renewable energy sources such as wind energy, tidal energy, solar energy etc.. A variety of solar energy collectors have been proposed. One of these is the solar pond which is normally a shallow body of salt water in which an artificially generated salt concentration gradient is maintained. The downward positive salt gradient inhibits heat loss from the pond bottom by convection resulting in the trapping of solar radiation reaching the bottom region. *Solar ponds are of interest as a mean of collecting and storing solar energy as they are found do be a potential application in* several fields. Some of applications include process heating such as textile processing, food processing, boiler feed water pre-heating, diary industry, space heating, drying, desalination, refrigeration, and power generation.

There are several advantages of Solar ponds compared to the other solar collectors. For example solar pond collects and stores energy and its collecting surface area could be in the order of several thousand square meters. The technology involved in the operation of a solar pond is relatively simple and the thermal energy can be extracted continuously. We reported previously the potential use of salt-pans in Sri Lanka for collecting and storing of solar energy. The preliminary research carried out using salt-pans with a depth of about 1 m at Palavi, Puttlam has identified salt-pans as potential solar ponds where a maximum bottom temperature around 64 ^{0}C was observed. Based on these measurements it is speculated that bottom temperatures as high as 90 ^{0}C could be reached with optimized parameters.

We report in this work the construction details of a large-area deep-tank solar pond built at Palatupana salterns in Southern Sri Lanka. The site was selected for the pond construction by considering the availability of

heavy brine and sea water for filling and plenty of sunshine. In addition we considered the usefulness of having a practical solar pond in the area of location with no electricity and adequate supply of drinking water.

The solar energy collecting area of the pond is 35 m x 70 m. The pond can be filled to a maximum height of 2 m. The soil-filled wall of the pond was constructed to retain a maximum water capacity of 4900 m^3 in the pond. By considering these factors the dimensions of the retaining walls were kept at 3 m at the top and 7 m at the bottom. Inside surface of the wall was covered with a metal layer to prevent erosion due to heavy rains. Pond bottom was leveled by applying a layer of sand and it was filled with heavy brine first to obtain a heat insulating layer of salt. This layer also prevents leakage of salt water to the ground. A small wooden platform was built at the centre of the pond to make measurements around the centre region. The center platform is connected to the wall with a wooden railing that provides easy access to the measuring platform.

The filling of the pond is being done systematically to obtain a downward positive salinity gradient across the depth. First the pond was filled with high density brine up to a depth of 30 cm and then low density brine was added to make the total depth to be around 60 cm. Observed density profile shows clearly demarcated three different zones. Also recorded temperature profile indicates a maximum bottom temperature of the pond of around 52^0 C. It is remarkable even for a low depth of 60 cm to observe a stable temperature profile. We are in the process of studying profiles of the pond for various heights to obtain optimum conditions required for maximum possible bottom temperature.

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