

Low cost thermal storage for solar dryers in the Himalayas

by Adam Karlsson, 2022-06-07

This is a popular scientific summary of a degree project for the degree of Master of Science in Engineering has been conducted at the Department of Energy Sciences, Lund University.

Farmers in Nepal and Bhutan suffer from high post-harvest losses. Using water bottles as a heat storage system in a new solar dryer prototype provides a high performance, flexible solution.

Current methods for drying food in the Himalayan region of Nepal and Bhutan are poor. For example, when apples are harvested, they are cut up into pieces and placed in the sun to dry. This exposes the apple slices to rain, dust, solar radiation and insects. By placing the slices inside a solar dryer, this exposure is removed while also improving the drying rate.

Desired drying temperatures are commonly in the range of 40 °C - 60 °C. By placing 20 kg of water inside plastic bottles in a solar dryer prototype, the time spent in this range increased from 141 minutes to 237 minutes per day, an increase of 68 %. Without any water bottles in the system, the temperatures reaches above 80 °C. With the water bottles inside, the drying chamber stays below 70 °C. Since temperatures above 70 °C destroys nutrients in, for example, apples, this is a big improvement as both Nepal and Bhutan suffer from nutrient deficiencies in parts of the population.

The solar dryer prototype used is based on a new design with a built-in heat exchanger, which uses outgoing air to heat new air entering the solar dryer. Previously, leakage issues prevented the design from working to it's full potential. This project reduced losses from around 40 % to around 20 % - 25 % by re-sealing problematic areas.

Previous studies have been conducted on this topic using stones, as well as different types of paraffin wax. Water outperforms stones in terms of heat capacity per kg (C_p), and is cheaper than paraffin wax - which is important, as the project aims to reach poor farmers in Nepal and Bhutan. Water bottles are also easy to work with, and the farmers can add or remove bottles easily.

Currently, the solar dryer has a fan that pushes air through the system set to a fixed speed. Future work in this project could look into varying the speed of this fan depending on the temperature inside the dryer. In addition to the heat storage system, this would allow for even more hours in the optimum drying range. Locally available, cheap wax types could also be a good solution instead of water, but this also needs to be researched further.