AGRO PROCESSING UNITS SAVE ENERGY BY ADOPTING SOLAR TUNNEL DRYING SYSTEMS

Tags	
Sub-sector:	Food processing
Location:	Udaipur and Pali districts (Rajasthan)
Partners:	PCRA; College of Dairy and Food Science Technology, Maharana Pratap University of Agriculture and Technology, Udaipur
Year:	2008–09

Background

Open sun drying has traditionally been practised across the country for drying agricultural produce such as food grains, fruits, vegetables, spices etc. Open sun drying of materials is also practised by agro industries like rice mills, pulse mills and small flour mills, and by cottage industries engaged in making potato/ banana chips, papad, grinding spices, etc. Although there are no energy costs for open sun drying, it has a number of disadvantages. Open sun drying is highly labor intensive, time consuming and requires a large area. Materials may spoil because of exposure to wind, moisture, and dust; materials are also at risk to foraging birds and animals, insect infestations and fungus growth. A few agro industries, particularly those dealing in food products, have adopted mechanized drying systems that substantially reduce the drying time and retain product quality and purity. However, in such cases the investments on the drying equipment, and hence the costs of drying, are very high. In general, the cost of drying using commercial sources of energy is twice to four times that of open sun drying.

An improved method of sun drying is the solar tunnel dryer (STD). It offers the virtually nil-energy cost advantages of open sun drying, and at the same time protects the materials being dried from the effects of exposure to adverse weather conditions and attacks by microbes, insects and animals.

Intervention

In 2008-09, Petroleum Conservation Research Association (PCRA), in association with College of Dairy and Food Science Technology, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, implemented a project titled ‘Energy Conservation through Solar Tunnel Drying System for Large-Scale Drying’, aimed at promoting the adoption of STDs by farms and other agro-based enterprises in Rajasthan. The project focused on identifying organized farms and agro industries that were willing to installed STDs on cost-sharing basis for large-scale drying of their products; for, this would reduce the burden of capital cost of the STD

system on each user and encourage its adoption. The project provided all the required technical specifications free of cost.

Technology

The STD system operates on the principle of the solar green house, popularly called poly house. The STD consists of a hemi-cylindrical metallic frame structure covered with UV-stabilized semi-transparent polythene sheet of 200 micron thickness. The floor of the tunnel, as well as the trays that hold the agricultural produce to be dried, are normally painted black to absorb the sunlight entering into the tunnel. The floor and materials inside the tunnel dryer absorb the incident solar energy and emit long wave thermal radiation, which is reflected by the polythene sheet cover and hence retained inside the tunnel. The trapped thermal energy raises the temperature of the air inside the tunnel and accelerates evaporation of moisture from the materials placed in the trays within. The moist air is removed through natural convection current. The micro-climate inside the tunnel may be controlled by using exhaust fan(s) to regulate the air flow rate through the dryer. The batch size varies from a few hundred kilograms to over a tonne.

Results

Till now, a total of 10 natural convection STD systems of different sizes have been installed and commissioned by agro-based enterprises in Rajasthan (Table 1). These systems are being used for the bulk drying of fruits, vegetables, spices, surgical cotton, rose petals and other agro-industrial products. The batch size varies from a few hundred kilograms to over a tonne.

Table 1. Location of STD systems installed under the project

No.	Installed at	Drying applications
1	Aditya Agro Biotech, Nimaj, Pali District, Rajasthan	Churan, spices and medicinal plants
2	Balasahyogni Sansthan, Village Baghpura, Block Jhadole, Udaipur	Forest Product at village level; adopted through self-help group (SHG)
3	Sunrise Agro Industries, A-112, Road No. 1, I.P.I.A., Kota	Garlic flakes, Aonla powder and tomato powder
4	Nakoda Farm, Gudli, Udaipur	Aonla and other agriculture products
5	Cellulose Waste Recycling Education Project, Ramgiri, Udaipur	Handmade papers
6	SHG constituted through Forest Department, Udaipur, at village Gayaripatha, Jhadole Block	Local forest produce
7	Janouthan Samiti, village baghpura, Jhadole, Udaipur	Aonla and other fruits
8	Chaudhary Biotech, Kothputli, Jaipur	Aonla and other vegetables
9	M/s Shri Amar Singh and Sons, Agricultural & Horticulture Farm, Rajgarh, Kota District	Agricultural products
10	Sun Foods, Aravali Dairy Farm, RIICO, Gudli, Udaipur	Vegetables and other agricultural products

The investment per unit mass of dried product for the ‘walk-in’ type of STD is far lower than that for commercially available forced flow type solar dryers. Typically, the construction cost of an STD of floor dimensions 18 m × 3.75 m, capable of drying one tonne of agriculture produce, is about Rs 225,000. The STD system greatly reduces the cost of drying (in some cases, by more than 50%) when compared to drying methods based on electricity or fossil fuels. Thus, adoption of the STD systems has also helped prevent the emission of greenhouse gases.

STD system

Inside the tunnel - STD system at Chaudhary Biotech, Kothputli, Jaipur

The project tested the performance of an STD system installed at Shri Amar Singh and Sons, Agricultural & Horticulture Farm. This system has been installed for drying 500 kg agriculture and horticulture products in a batch. Data was gathered for both no load and full load during winter and summer seasons. The average temperature inside the tunnel was found to be 18–20°C higher than the ambient temperature. In a single solar day, the moisture content of the produce (aonla) was reduced from 80% to around 9%. Figures 1 and 2 depict the STD system’s performance.

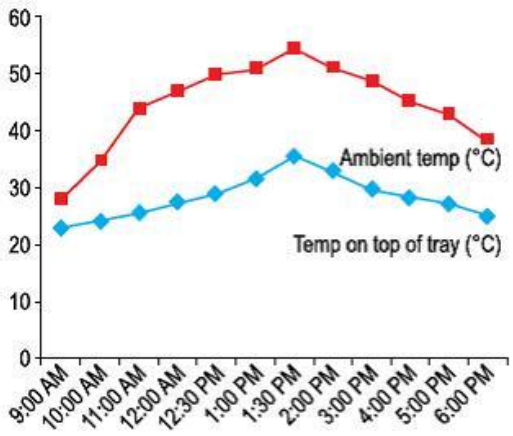

Figure 1. Temperature variation inside STD system under no load testing on a summer day

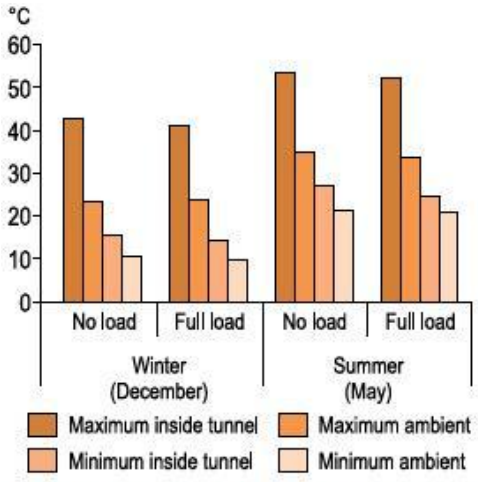

Figure 2. Average seasonal temperatures inside STD system