

Solar Air Heaters

Large Solar Thermal Air Systems for Industrial and Agro Applications

This article highlights two case studies—one for leather auto spray dryer in Kanpur supported by a UNIDO project and another for chilies drying in Kerala run by a women self-help group.

Solar thermal could play a vital role as clean energy development as well as reduction in the production cost in industrial process heat, especially solar, air, and water heater for temperature ranges of 60 to 80°C applications. The emerging solar air heating technology indicates a potential of 0.92 million m² collectors and this is equivalent to savings in 3.52 Mtoe/y (million tonnes oil equivalent/year) in Indian industries and agro-processing sectors, such as leather, pharmaceutical, chemical industry, salt production, processed foods, fruits and vegetables processing, textiles, ceramics, paint-shops, automobile components manufacturing units, hand-made paper products, spices, fish and marine products processing, latex rubber, etc., as per a R&D study carried out by Planters Energy Network—PEN, funded by the Ministry of New and renewable Energy (MNRE R&D project 'Dissemination of Solar Drying Technology for Industrial Sector including Agro-Industries in the Country' sanctioned to Planters Energy Network—2001–2008). To



illustrate the potential of solar thermal both air and water, a few case studies have been presented in this article. The author has an experience of 35 years on the design and development of roof-mounted solar air heaters to provide a large volume of hot air in the range of 10,000 to 30,000 m³/h for applications in industries and agro-processing mostly by retrofitting

with the conventional heating unit, a prerequisite for industries.

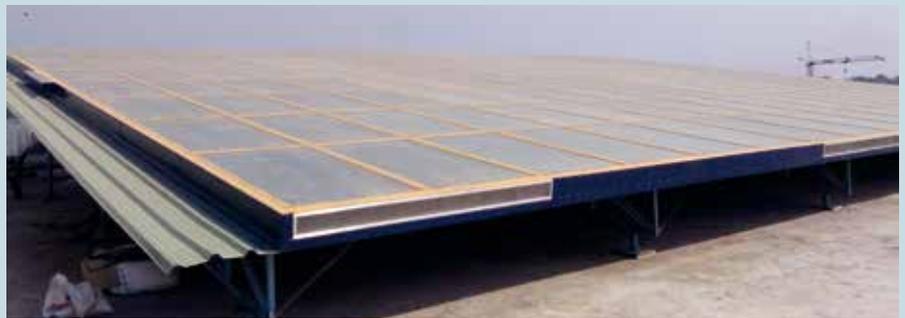
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A solar air heater is similar to solar flat plate water heater, which uses the greenhouse concept to heat air or water through the accumulated heat in the absorber. Unlike solar water heater, where all 2m² panels

are connected externally, the solar air heater modules are fitted together internally to facilitate air to pass through a long path to reach the desired temperature by creating a good heat transfer mechanism within the collector. In a solar water heater, water is recirculated so that at the end of a day the given volume is heated from ambient temperature to say 60–80°C. But in an air heater, the ambient air by passing through the collector should reach 60–80°C in a few seconds. Using the green house basic concept, solar air heaters are installed with integrating multiple modular systems which handles cold air and heats it to 60–80°C.

⚡ Solar Auto-Spray Dryer Saves 1,500+ kg of Steam per Day in a Leather Factory

Among many process machineries in a leather factory, auto sprayer dryers consume a large quantity of fossil fuel source of energy either in the form of steam or thermal oil. UNIDO, Vienna under a project for clean leather processing in Kanpur, has selected one air heating project for Calico Leather Company, Kanpur, as a model project with a partial fund support to reduce coal consumption. An auto sprayer has two sections with a conveyer. In the first section, paint is sprayed on the leather placed on a conveyer. The second section has five compartment dryers. Each compartment has steam coils on

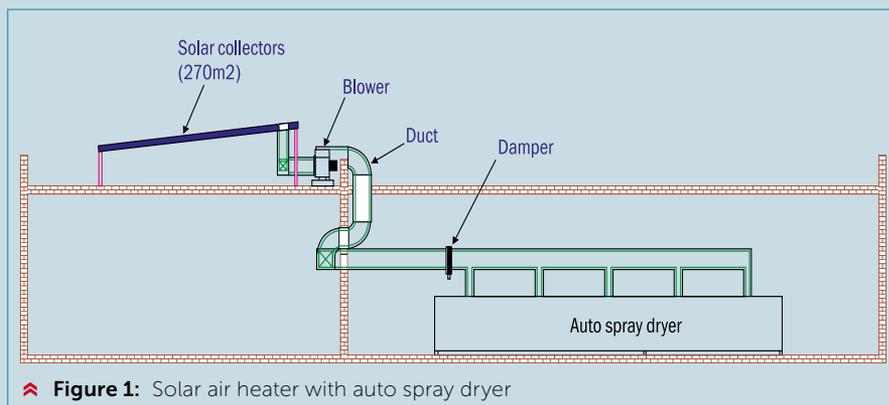


both sides and its top side is fitted with an axial fan, which blows air over the steam coil creating hot air to pass over the leather, moving in the conveyer leading to drying of paint. A detailed energy audit was done to assess the energy flow with steam consumption in each compartment and total demand. Based on the total demand, a solar air collector of area 270m² which could give an average energy delivery of 100–120 kWh was designed. Shadow-free area for 270m² was available on the factory terrace roof and a mild steel support stand for the solar collector was fabricated and fitted in the roof. The 270 m² collector, consisting of 72 numbers of 3.75 m² collectors was installed on the support stand that heats the ambient air to hot air. The solar hot air outlet is connected to an inlet of a 3.75 kW centrifugal blower through an insulated metal duct. The blower outlet duct passes hot air to the auto sprayer with multiple branches to each compartment (Figure 1). The unit is fitted with an energymeter which measures solar energy in kWh based on the air mass flow and temperature

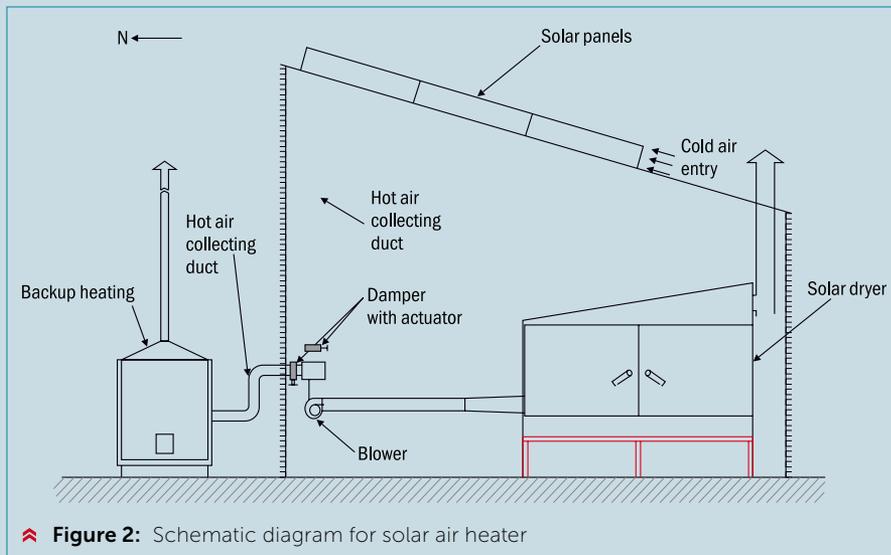
difference. Another control regulates the steam flow and also measures the steam consumption. The project was commissioned in January 2017. On a sunny day, it saves around 1,500 to 1,600 kg of steam (or) 300 kg of coal. The estimated ROI for the project is 3.7 years, taking only into account depreciation benefits and fuel savings. Subsidy from MNRE will make these projects more viable to the leather industry.

⚡ Solar Air Heating Reduces Chilly Drying Time by ~30 Per Cent in a Hygienic Set-Up

Swasthy Food Products, Kerala, has a food processing plant mainly run by womenfolk and manufactures many varieties of dried fruits and vegetables. A special variety of chilly cultivated here is locally dipped in buttermilk and then dried. Dipping and drying are repeated till the given volume of buttermilk is fully absorbed. The construction of the system is shown in Figure 2. It consists of an 18 m² solar collector consisting of tempered glass, special black paint coated aluminium absorber, duct for airflow below the absorber and side insulation. A 0.75 kW centrifugal blower draws the hot air from the solar collector. For non-sunny periods, a biomass oven provides hot air. The hot air from solar or from biomass could be passed to the dryer using an electrical operated actuator damper. The dryer is made up of a double-layered SS 304 box with insulation in between. It has multiple vertical trays with SS mesh through which solar hot air passes



⚡ **Figure 1:** Solar air heater with auto spray dryer



and exhausts through a chimney. The dryer has 25 m² spreading area for the products to be dried. The exhaust air is taken away from the building through a metal duct. The hot air carrying duct is installed with 50 mm insulation. Prior to the solar installation, open sun drying took around 14 days and also due to intermediate weather, the products also get spoiled. The solar dryer had been successfully installed and the

drying time for 100 kg buttermilk chilly is reduced to 10 days. Apart from the drying reduction, the product quality improved with better hygiene.

Diffusing the concept of solar drying with roof-mounted collector with a backup heating to process many cash crops in a hygienic way will help more women entrepreneurs gain employment in rural areas of India, thereby avoiding wastages in fruits, vegetables, fish, and other



food products. Also, it will lead to the availability of hygienic and nutritious food. This has been demonstrated in Ladakh, Kargil, Mizoram, and many other regions in India with many installations by our organization. Moreover, more than 12,600 m² solar air heater collectors for industrial and agro processing applications have been installed in India and some of the installation done in 1992 in the tea industry still works showing the sustainability of these projects.

Conclusion

The worldwide energy scenario indicates that industry and services consume almost 50 per cent energy in the form of thermal. Often neglected by industry due to a lack of expertise or investment capacity, heat is a powerful vector for financial savings, capable of making a difference in the race for competitiveness. Large-scale adaptation of solar air heating and water heating in industries and agro processing will lead to clean energy processing as well as reducing the production cost for these industries. Solar air heaters have a great potential in saving the fossil fuels. Also, solar dryers could impact our food-processing sector in a great way creating employment as well as nutritious and hygienic food. MNRE's 30 per cent subsidy for the whole solar dryer cost, instead of the collector part only being given now, will go a long way in helping the farmers to adopt this technology for value addition to their farm products, such as chilly, cash crops, spices, etc., especially in the northeastern region of the country where a large quantity of ginger, turmeric, and fruits are being wasted due to a lack of processing facility. A major effort from MNRE and all other stakeholders are needed to take the technology to the farm level so that farmers can enjoy value addition to their products. **AU**

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