International Journal of Agricultural Engineering, Vol. 4 No. 2 (October, 2011) : 189 -192

Research Paper :

Design and development of roof integrated forced convection type solar dryer for drying industrial product

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Received : June, 2011; Accepted : September, 2011

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ABSTRACT

Roof integrated forced convection type solar dryer for drying 2500 kg/day dibasic calcium phosphate (DCP) has been designed and installed at M/S Phosphate Pvt. Limited, Jhamar Kotra Road, Udaipur. In this paper attempt has been made to design and development of roof integrated forced convection type solar dryer for drying DCP. The arrangement has been made to circulate air within drying chamber using exhaust fan of 2 kW capacity. The study showed that DCP took eight hours to dry at 10% (wb) moisture content. The average temperature inside the drying chamber was about 65^0C.

Naik, Sonali, Rathore, N.S., Kothari, Surendra, Jain, S.K. and Singh, P.K. (2011). Design and development of roof integrated forced convection type solar dryer for drying industrial product. *Internat. J. Agric. Engg.*, **4**(2) : 189-192.

Key words : Heat utilization factor, Forced convection dryer, DCP

In India many industries are using conventional energy for drying *i.e.* electricity, coal and diesel fired hot air generator etc. Considering sharp increase in fuel prices, uncertainties in supplies, research work was conducted to design and develop a simple and efficient roof integrated forced convection type solar dryer for drying dibasic calcium phosphate (DCP) from 40% moisture content to 10% moisture content. This material is being used as animal feed since it is rich in phosphorus and calcium for poultry bird. The whole system was designed and installed at M/s Phosphate Zinc Pvt. Limited, Jhamar Kotra Road, Udaipur for drying 2 ton of DCP per day.

The rotary dryer is a type of industrial dryer employed to reduce or minimize the moisture content of the material by bringing it into direct contact with a heated gas or air. The hot air required for drying of produce in rotary dryer can be supplied by various means. When solar air heaters are used for heating air for drying, orientation and space for installation of solar air heaters are important parameters. Roof space can be effectively utilized for installation of solar air heaters with minimum obstacles to receive solar energy.

Forced convection solar drying system designed and fabricated comprising of an array of 40 solar collectors and three drying cabinets with a blower to yield 300 kg of dry product of custard powder in a normal sunshine day in Pune. It was found that such a system is feasible and has an ability to save large amount of conventional fuel. It was also observed that forced convection solar drying systems are suitable in food and chemical industries where large scale drying is required (Panwar *et al.*, 1995).

Roof integrated forced convection solar dryer has developed for drying herbs and spices using hot air from solar collector having area of 72 m^2. The performance of the dryer was conducted to dry four batches of rosella flower and 3 batches of lemon grass. For drying of 200 kg of rosella flowers and lemon grasses total 4 and 3 days were required, respectively. The solar air heater has an average daily efficiency of 35 %. (Janjai and Tung, 2005).

An indirect forced convection solar dryer integrated with sensible heat material (gravel) has developed and its performance was tested for drying of pineapple slices. The moisture content (wet basis) of pineapple was reduced from about 87.5% to 14.5% in about 29 h in bottom tray and 32 h in top tray (Mohanraj and Chandrasekar, 2009).

A forced convection solar cabinet dryer was designed