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Performance of forced convection type solar drier with thermal storage for ginger drying

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ABSTRACT : Thermal energy storage is one of the most efficient ways to store solar energy for heating air by energy collected from sun. An indirect forced convection solar drier with thermal storage has been developed and tested its performance for drying ginger under the metrological conditions of Udaipur, India. Agricultural food materials can be dried at late evening, while late evening drying was not possible with a normal solar dryer. So that, solar dryer with storage unit is very beneficial for the humans and as well as for the energy conservation. The system consisted of a flat plate solar air collector, heat storage unit, a drying chamber and a DC fan. Drying experiments have been performed at an air flow rate of 0.0025 kg/s. Drying of ginger rhizomes in a forced convection solar drier reduces the moisture content from around 84 per cent (wet basis) to the final moisture content about 9.63 per cent in 36 h. Average drier efficiency was estimated to be about 30 per cent.

KEY WORDS : Solar drier, Ginger drying, Heat storage material

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In India, sun drying is the most commonly used method to dry the agricultural materials like grains, fruits and vegetables. In sun drying, the crop is spread in a thin layer on the ground and exposed directly to solar radiation and other ambient conditions. The rate of drying depends on various parameters such as solar radiation, ambient temperature, wind velocity, relative humidity, initial moisture content, type of crops, crop absorptivity and mass of product per unit exposed area. This form of drying has many drawbacks such as degradation by wind blown, debris, rain, insect infestation, human and animal interference that will result in contamination of the product. Drying rate will reduce due to intermittent sunshine, interruption and wetting by rain (Jain *et al.,* 2004).

Solar thermal technologies have been used in various applications either, as natural convection type dryer, or with forced convection type dryer (Das and Sarma, 2001). For commercial applications, the ability of the drier to process continuously throughout the day is very important to dry the products to its safe storage level and to maintain the quality. Normally thermal storage systems are employed to store thermal energy, which includes sensible heat storage, chemical energy storage and latent heat storage.

The solar drier is an energy efficient option in the drying processes. Many experimental studies reported the various methods used for drying of agricultural materials using solar drier for copra drying, for onion drying, and for pineapple drying. Use of forced convection solar driers with thermal storage seems to be an advantage compared to traditional methods and improves the quality of the product considerably. Normally thermal storage systems are employed to store the heat, which includes sensible and latent heat storage. Common sensible heat storage materials used to store the sensible heat are water, gravel bed, sand, clay, concrete, etc.

The objective of the present work is to develop a forced convection solar drier with thermal storage for drying of ginger under the metrological conditions of Udaipur, India. The experiment was conducted in April 2012. The performance of a forced convection solar drier with rock as heat storage material and drying characteristics of ginger rhizomes are discussed in this paper.

METHODOLOGY

Fabrication and dimensional features of dryer (Fig. A and B):

Frame structure :

The frame structure consisted of legs, base frame and supporting frame. MS angle of 30 x 30 x 5 mm was used to