

A Review of Solar Air Heater for Drying of Agricultural Products

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Keywords: Flat plate collector, drying, air heater, single pass, double pass, multi-pass collector

Abstract. Bulk of farm products need to be preserved because of their perishable nature. The cheapest and environmental friendly means is indirect usage of solar irradiance to reduce the moisture content of these products to a level that cannot sustain the activities of micro-organisms. The research on solar collector has gained its popularity over the years due to man's quest for green energy which has led to increase in demand for the utilization of solar energy. Harnessing of solar energy by man for drying purposes was predominantly by direct method which reduces the quality and quantity of the dried products. This work presents the most recent contributions on solar air heater of flat plate absorber category. Various models, material of component parts and performance efficiency of these air heaters were discussed and there is need for collector optimization. The study was concluded with a focus on multiple pass approach of solar harvesting.

Introduction

The exposition of some significant successes that have been recorded [1,2] in single pass and double pass solar collectors were covered in this paper. The modeling techniques and its contribution on overall efficiency of the solar air heater were also discussed. Enhancement of collector design through searching for optimum air mass flow rate and energy storing media [3-6] were focused. Latest novelties on solar dryers were critically examined and suggestions were made for future improvement. Transformation in solar collector achieved by Jain and Jain [7] which was earlier suggested by Karim and Hawlader [8] represents a remarkable turning point in designing of solar collector.

Models Used in Design of Flat Plate Solar Air Heater

Transient model reflects details condition of the solar systems rather than steady state situation. Aboul-Enein et al. [9] presented a transient model for a flat plate solar air heater with and without thermal storage. The temperature was varied with time and space coordinates and the mean temperature was proportional to the plate dimension up to a typical value for these parameters. It was found that, as the space between the absorber and glazing materials increases, the outlet temperature decreased. Paisarn [10] studied the thermal transfer features and performance of double pass flat plate solar air heater with and without porous matrix numerically. The use of porous materials has been a means of extending the period of system operation but the performance and cost optimization needs to be done in order to select a perfect choice. Though, Sopian et al. [1] advised that it should be cheap and available locally.

Coating of absorber has effect on absorption, reflection and emission properties of the collector. Few contributions have been noticed in the coating aspect of solar collector system such as El-shebaei and Al-Snani [11] investigated using transient mathematical model, the effects of some of selected coatings of the collector plate on annual thermal performance were considered. Coatings used were black paint, copper oxide, chromium black, nickel-tin, and cobalt oxide. The best performance was achieved using nickel-tin.

Ho et al [12] reported an absorber and insulation plate were inserted horizontally and vertically respectively into a parallel plate channel to divide the open duct into four sub channels. Nonlinear