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Design and Experimental Studies on Modified Solar Dryer

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Abstract

Experimental studies on conventional and solar type have been verified. Under the same operating conditions, the stone type dryer has high heat gain and absorber plate temperature compared to conventional one. Results show that the overall efficiency of the stone type dryer is 13.88% when compared to conventional and is 10.97%.

Keywords: Conventional, Stone, Heat gain, Efficiency, Plate temperature.

Introduction

"Drying is an excellent way to preserve food and solar food dryers are an appropriate food preservation technology for a sustainable world." Actually, solar food drying is one of the oldest agricultural techniques related to food preservation, but every year, millions of dollars' worth of gross national product is lost spoilage. Drying generally refers to the removal of moisture by evaporation rather than by pressure or other physical means. The factures that are affecting the drying can be identified as the temperature, humidity, pressure, velocity of air and the size and the shape of the wet surface and their air moment respect to it.

The new empirical model for single layer drying process, which has been verified with experimental data repots by Midilli [1]. An exegetic analysis of three basic types of solar drying systems has been analyzed by Bolaji[2]. The dryers were installed side by side and tested simultaneously to eliminate influence of solar radiation and environmental changes in comparing their performances. The results obtained show that mixed mode and indirect mode solar dryers are more effective in utilizing the captured energy than direct mode dryer. The overall exegetic efficiencies of mixed mode, indirect mode and direct mode systems were found to be 55.2%, 54.5% and 33.4%, respectively.

Drying air velocity is one of the major source for dryers which has been experimentally verified by Yaldýz [3]. Three different drying air velocities were

applied to the process of drying to determine their effects on drying time. drying time was between 48.59 and 121.81 hours for the natural sun drying. Drying curves could be explained by determined thin layer drying models satisfactorily with very high determination coefficients. Performance of the solar tunnel dryer for drying of fish has been analyzed by bala and mondol[4]. Conventional dryer compared with tunnel dryer for 5 days and finally the moisture level decreasing 32.84%.

Cost-effective natural convection solar dryer has been developed by Adelaja [5]. The thermal and drying analyses were done and tested to obtain some performance evaluation parameters for the system in order to examine its efficiency and effectiveness by drying some plantain fillets. Results reports that the moisture removal of 77.5% was achieved by this model. A design procedure was proposed for sizing solar-assisted crop-drying systems and assessing the combination of solar collector area and auxiliary energy needs that meets the requirements of the load has been analyzed by Santos et.al.[6]. Empirical correlations developed and verified. Results report that annual savings of 30% in fuel consumption for 1.80m^2 collector area.

Experimental Description

The Fig.1. Shows the schematic layout of conventional solar dryer. The dryer has a dimension of 1.2 m length, 0.31 m width and 0.36 m height covered by transparent plastic cover. The bottom of the dryer has 5mm thickness aluminum sheet coated by black paint. The stone coated by black paint kept in the absorber plate is called as stone dryer which is shown in Fig.2.

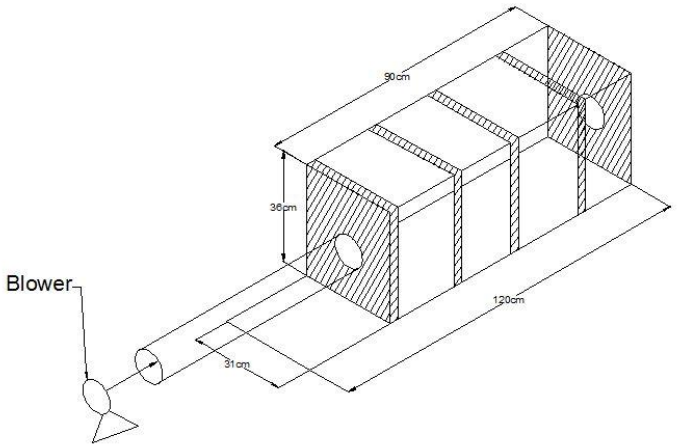

Figure 1: Conventional Solar Dryer

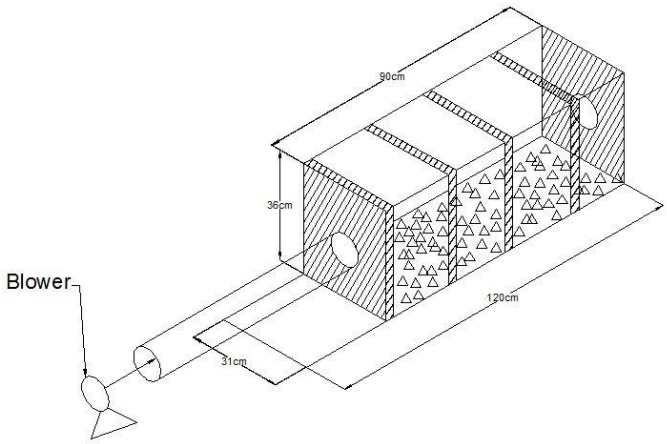

Figure 2: Stone Type Solar Dryer

The two setups kept in open atmosphere readings are recorded under the same condition. For various mass flow rate absorber temperatures, atmosphere temperature, solar intensity has been recorded. The photographic view of the dryer shown in Fig.3**.**

Figure 3: Photographic view of Solar Dryer

Result and Discussion

The Fig.4. explains about the mass flow rate Vs absorber plate temperature. Compared the above conventional solar dryer has lower temperature ,lower absorber temperature, than stone dryer because the stone absorb the heat and retains in the absorber plate.

Fig.5. deceits the mass flow rate Vs heat gain. It is clear from that increasing mass flow rate increases the heat gain. Compared to conventional dryer stone dryer obtained maximum heat gain.

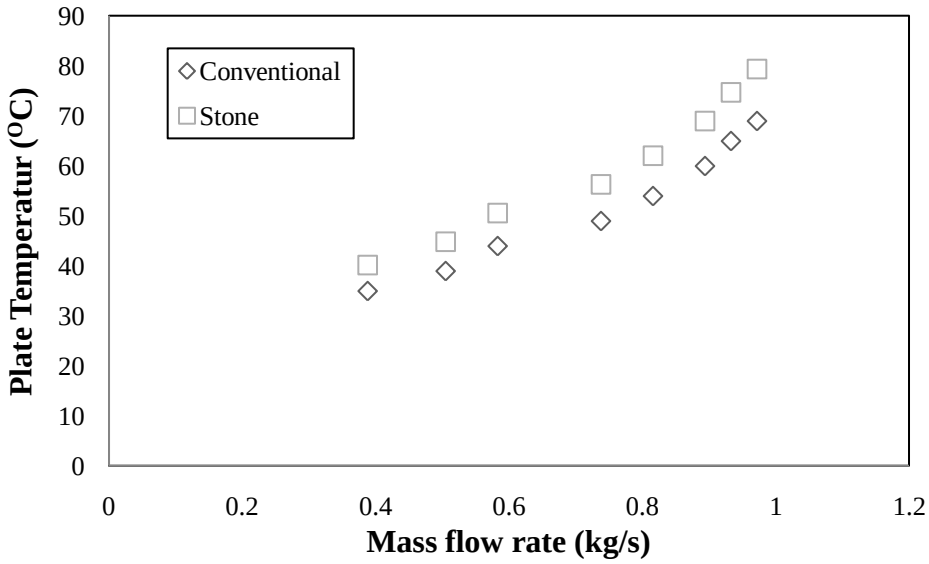

Figure 4: Mass flow rate Vs absorber

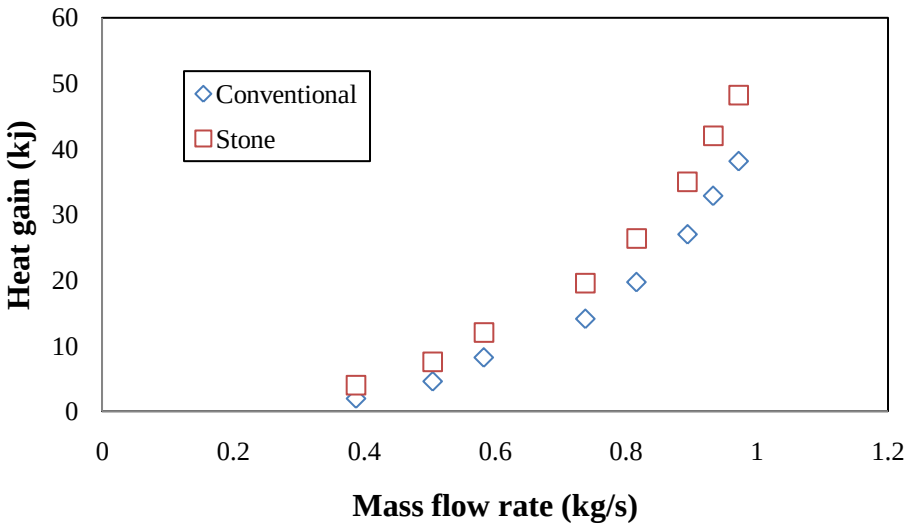

Figure 5: Mass Flow Rate Vs Heat Gain

Fig.6. explains bout mass flow rate Vs efficiency of solar drying system, when the increasing mass flow rate increasing the efficiency of the dryer when compared the above he overall thermal efficiency is higher in stone dryer compared to conventional one. Because solar intensity absorbs by the stone retains and conduct to the plate. But in conventional system no heat retains material. Hence the overall system efficiency is higher in stone dryer compared to conventional one.

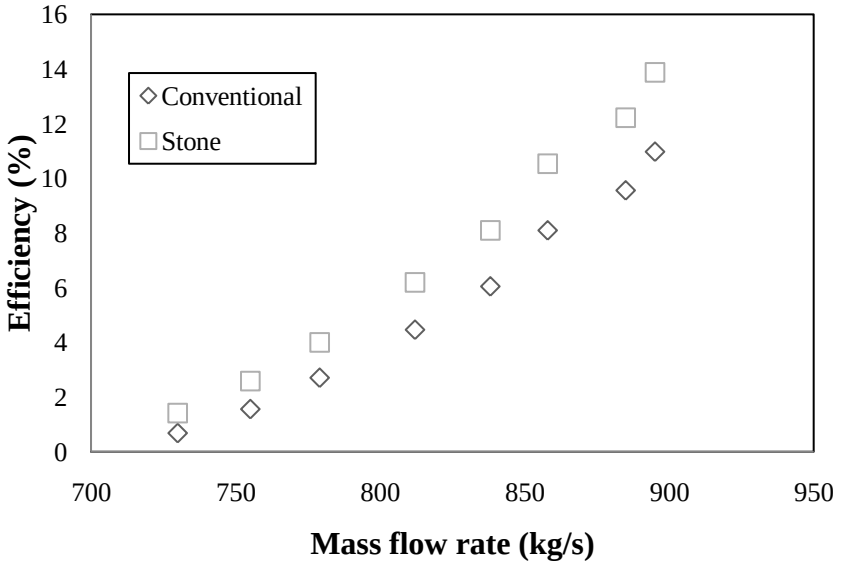

Figure 6: Mass flow rate Vs efficiency

Conclusion

The overall efficiency for conventional and stone dryer for the particular mass flow rate is 10.97% and 13.88%. Hence nearly 3% has been increased in stone dryer when compared to conventional dryer.

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