International Journal of Processing and Post Harvest Technology
Volume 3 | Issue 2 | December, 2012 | 203-205

RESEARCH PAPER

Experimental analysis of thermal performance of solar food dehydrator

■ G.R. CHAVHAN, S.S. BALKAR, M.S. PAWAR AND R.K. RATHOD

SUMMARY : A solar food dehydrator were designed and fabricated from a galvanized steel sheet with a slope of 20^0. Experiments were conducted at different time of day in the month of February and March in India. The performance was also studied by connecting flat plate collector to solar food dehydrator. It has been found that coupling of solar collector with food dehydrator has decreased the moisture content. The installations of combine flat plate collector and solar food dehydrator simplicity of design, cheapness of manufacturing, convenience of operation and high quality of drying agricultural production.

KEY WORDS : Thermal performance, Solar food dehydrator, Experimental analysis

How to cite this paper : Chavhan, G.R., Balkar, S.S., Pawar, M.S. and Rathod, R.K. (2012). Experimental analysis of thermal performance of solar food dehydrator. *Internat. J. Proc. & Post Harvest Technol.,* **3** (2) : 203-205.

Research chronicle : Received : 21.03.2012; **Revised :** 28.07.2012; **Accepted :** 18.09.2012

Since its evolution man has needed and used energy for his sustenance and well being. Up till 18th century man was utilizing energy from wood, wind and water. Till this time we say that sun was supplying energy needs of man directly or indirectly and that man was only utilizing renewable energy sources.

With discovery of steam engine in AD 1700 man began to use new sources of energy *viz.*, coal, in large quantities. A little latter,(AD 1870)internal combustion engine was invented and the other fossil fuels, oil and natural gas began to be used extensively. The fossil fuel era of using nonrenewable sources had begun and energy was now available in concentrated form.

Renewable energy sources are the sources that are replenished by natural processes on a sufficiently rapid time scale so that they can be used by humans more or less indefinitely, provided the quantity taken per unit of time is not too great. Examples are the animals dung, ethanol, wood, wind, falling water and sunlight.

Many groups and individuals are proposing that our government spend tax money on research and development of systems to utilize solar energy. They urge construction of vast solar energy collectors to convert sunlight to electricity to supply our energy needs. They would even put solar collectors on roofs of homes, factories, schools, and other buildings. Proponents of this technology claim that energy obtained from the sun will be safer and cleaner than coal, oil, or nuclear energy sources.

EXPERIMENTAL METHODS

Experimental setup and operation :

A cross sectional view of a solar food dehydrator was fabricated of galvanized sheet is shown in Fig.A. Build a box as a base for solar dryer. Measure and cut 2 pairs of pieces of 0.826 m x 0.13m and 0.776m x 0.13m of 19mm thick plywood,

MEMBERS OF THE RESEARCH FORUM

Author for Correspondence :
R.K. RATHOD, Krishak Bahvan, Zonal Agricultural Research Station, SOLAPUR (M.S.) INDIA
Email : signkiran@gmail.com

Coopted Authors:
G.R. CHAVHAN, Department of Mechanical Engineering, Government College of Engineering, CHANDRAPUR (M.S.) INDIA
Email : ganeshchavhan007@gmail.com

S.S. BALKAR, Department of Chemical Engineering, Government Polytechnic College, JALNA (M.S.) INDIA

M.S. PAWAR, MIT College of Food Technology, Rajbag Educational Complex, Loni Kalbhor, PUNE (M.S.) INDIA
Email : mangalpawar32@gmail.com

Fig.A: Fabricated solar food dehydrator

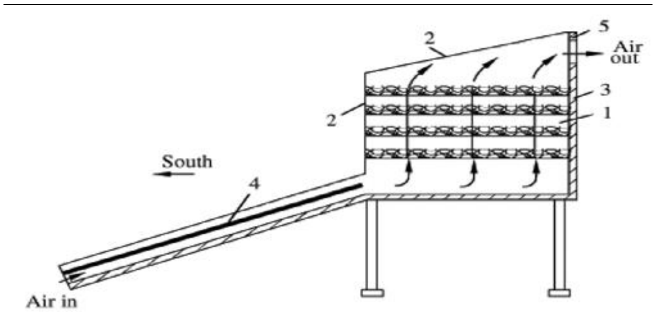

Fig. B: Schematic diagram of solar food dehydrator

respectively. Two sides will be the length of the air heater, while the remaining sides will be the width of the air heater .Mark the ply at the cutting lines using your carpenter's square. Saw with a hand or circular saw along the cutting lines. Assemble the frame by lapping the two length sections over the two width pieces at the corners and nail securely. Also nail a ply of 0.776mx 0.826m on either side of the frame prepared. Also insulation is made by means of glass wool and thermacol at the base. Fins made up of GI sheet of dimension 0.751m x 0.27m are used as absorber plates. The whole frame is covered by the 4.5mm glass. Measure and cut 2 pairs of pieces of 0.776 m x 1.1m and 0.38m x 1.1m of 19mm thick plywood, respectively. Two sides will be the length of the drying chamber, while the remaining sides will be the width of drying chamber inlet and outlet vents of 6 cm dia is provided at two extreme ends of the chamber, respectively. Trays made up of wire mesh of 0.700m x .35m are made. Insulation with the help of thermocol is made. Door of 1.1m x 0.38m is attached to the whole frame by the means of hinges. The main principle behind food dehydration is simple: to remove an ample quantity or the majority (depending on the desired product), of water content from food products. Since the water content of foods is high, 80-95 per cent in many fruits/ vegetables, the product weighs much less and its volume is reduced. Also, without water, the food becomes an unfavourable medium for the growth of bacteria or fungi. If dehydrated when ripe, determined from a nutritional standpoint, the maximum quantity of nutrients can be preserved.

The process goes in the chain as such that air enters the inlet vents due to natural circulation, the GI sheets absorbing the incident radiation gets heated up which in turn heats up the inlet air. Due to this heating the density of air reduces with an increase in its temperature. This heated air climbs up in the drying chamber which absorbs the moisture from the food products.

EXPERIMENTAL FINDINGS AND ANALYSIS

Various food products were kept in the dehydrator assembly, then readings of the ambient temperature, chamber temperature and the weight reduction for various day timings were noted down and these readings are produced in tabular form shown in Table 1. Also inter-relation between various parameters are shown graphically (Fig. 1, 2 and 3). Biondi *et al.* (1988) conducted the investigation on the performance analysis of solar air heater of conventional design.

Table1: Experimental observations of product Product: Fenugreek

Time	Ambient temp.	Dryer temp.	Weight (g)	I.T
10 AM	27.6	33.2	1000	931.34
12 PM	29.8	39.9	902	1079.2
1 PM	32.3	46.7	680	1040.45
2 PM	35.1	51.1	593	967.23
3 PM	32.1	47.2	514	792.47
4 PM	31.2	46.8	474	650.12

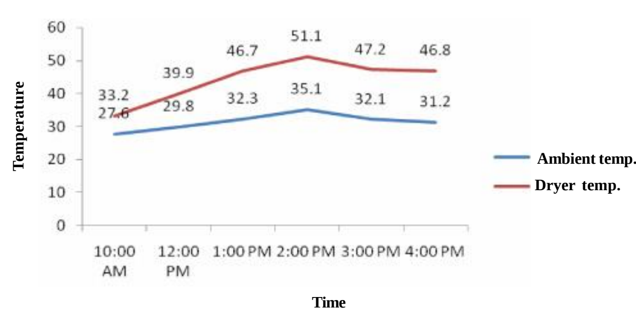

Fig. 1: Time vs. temperature

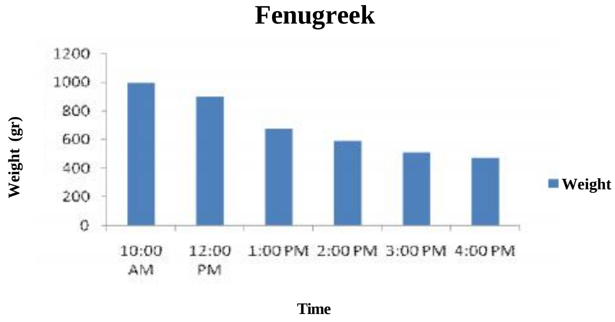

Fig. 2: Time vs. weight of product

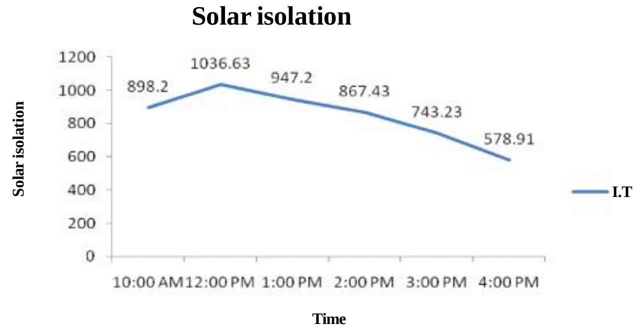

Fig. 3: Time vs. solar isolation

Conclusion :

Unit does not require external power. Typical design which uses solar collector panels as roofing and provides large covered utilizable area for store and processing unit. Quality of goods processed on solar dryer is much superior in terms of colour, aroma and taste. As the unit uses energy from sun and wind this design has come out as a genuine renewable energy gadget. The installations, given in the report, combine simplicity of design, cheapness of manufacturing, convenience of operation and high quality of drying agricultural production.

LITERATURE CITED

Biondi, P. *et al.* (1988). Performance analysis of solar air heaters of conventional design, *J. Solar Energy*, **41**(1):101-107.

Duffie and Beckman (1991). Solar engineering of thermal processes. (IInd Ed.), John Wiley & Sons, INC.; NEW YORK.

Garg, H.P. (1987). Advances in solar energy technology. D. Reidel Publishing Company, Volume **III**, HOLLAND.

Klein, D.A. (1975). Calculation of flat plate collector loss co-efficients, *J. Solar Energy*,**17**: 79-80.

Nejat, T. Veziroglu (1989). Alternative energy sources VIII, Hemispheric Publishing Company, Volume **I**, NEW YORK.

Sharma, V. K.,Colangelo, A. and Spagna, G. (1992). *Renewable energy,* **2**:577-586.

●●●●●