



Experimental Conditions to Identify the Ideal Shape of Dryer Investigation of Six Shapes of Solar Greenhouse Dryer in No Load

IHIRENKUMAR AMRUTBHAI PATEL

1Student

1GTU

ABSTRACT

Solar energy plays a vital role in improving the shelf of the agricultural product through drying, solar greenhouse drying is more optimal than using an open air drying, in this study selecting a ideal shape, Quonset is capable of generating 64% more temperature when compared to atmosphere,. Quonset shape generates 7% more temperature The ideal shape of the solar greenhouse dryer is Quonset Shape, it generates a maximum of 72 Deg C in summer and 66 DegC in winter also the concept of a high-temperature solar dryer with an internal bed storage. Granite was selected as the material for filling the bed storage, and an emphasis was put on its versatile use and favourable thermal and mechanical properties. The use of a granite storage bed could prolong the operation of the considered dryer by two hours.

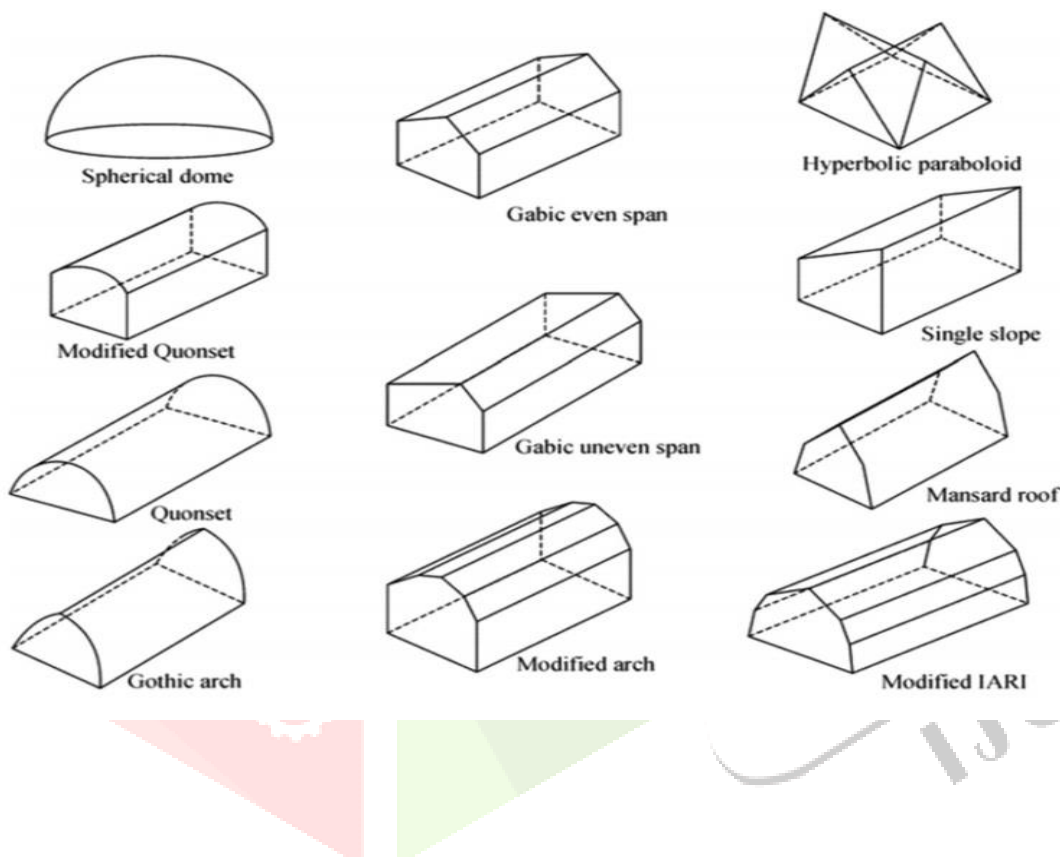
KEYWORD: solar dryer, Quonset, Heat transfer, granite sphere

WORKING





Malnourished population in the world is about 15% according to the survey, whereas on the other side food losses occurs during production, post-harvest and shelf life of the food products, reducing of these food losses is challenging in the developing countries. The current measures for preservation of food material are through open air sun drying. The traditional open air sun drying is a slow process, product quality will be affected due to rain, wind, dust, insects, microorganism growth, reactions due to enzymatic and mycotoxin reactions. Some farmers switch to energy intensive mechanical thermal drying which is not viable . Neutralization the effect of microorganism can be possible through solar greenhouse drying, drying improves the shelf life of the product dried Through drying losses in post-harvest, prolonged storage and product life improvement can be achieved. The solar greenhouse dryer works with the principle of greenhouse effect where the polycarbonate used to cover the dryers allow the incoming short wave length and long wave solar radiation and traps the long wave radiation with the dryer, thus producing the heat inside the dryer . Solar greenhouse dryer works with different shapes like spherical dome, hyperbolic paraboloid, Quonset, modified Quonset, gothic arch, mansard roof, gabic even span, gabic uneven span .A drying of pepper is compared with solar greenhouse and open air drying. A good quality pepper is obtained in the solar greenhouse dryer, solar greenhouse dryer is nearly 2.5 times more efficient that open air drying.compared the solar greenhouse drying and open air drying for tomatoes, dryer dried tomatoes in 4 days and open air dried it in 5 days, overall quality and texture was good in solar greenhouse dryer.

Here we are using the compared open air dryer only Quonset shape and Quonset with granite sphere. In Quonset shape we found that it is better for drying but after sunshine it is not working properly so that we can use the Quonset shape with granite sphere. We know that the properties of granite distinguish it from other standard materials:

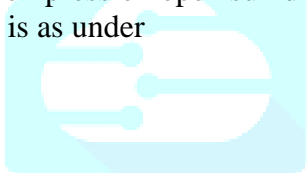
- heat storage—stone absorbs heat well, stores it for a long time, and most importantly releases it at an even rate. For this reason, it is frequently used as a component of packed beds. It is worth mentioning that granite must not be subjected to rapid changes of temperatures, as this may cause it to break.
- temperature resistance—up to 1000 °C.
- hardness—depending on the quartz content, this type of stone has a number of six or seven in the 1–10 Mohs scale of mineral hardness, which means that it is harder than steel.
- density—granite has a high density: approximately 2700 kg/m³.
- safe when in contact with food (used both in dryers and solar cookers).
- durable even with many cycles and use in high temperatures.



Instruments used.

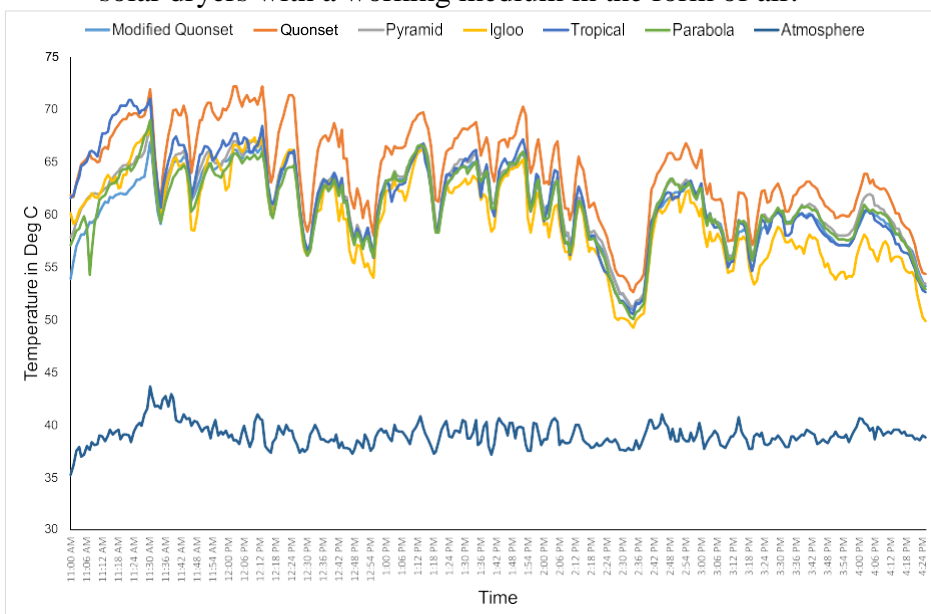
Instrument Name	Specification	Range	Image
PICO Temperature Data logger (Calibrated)	TC-08 8 channel thermocouple data logger	-270 to +1820 °C	
K Type Thermocouple	-	-270 to +1820 °C	
MCP Digital Humidity Meter with probe	KT-908	20-99%	
PYRA 300 V solar pyranometer	±5% of full scale	0-1800 w/m ²	

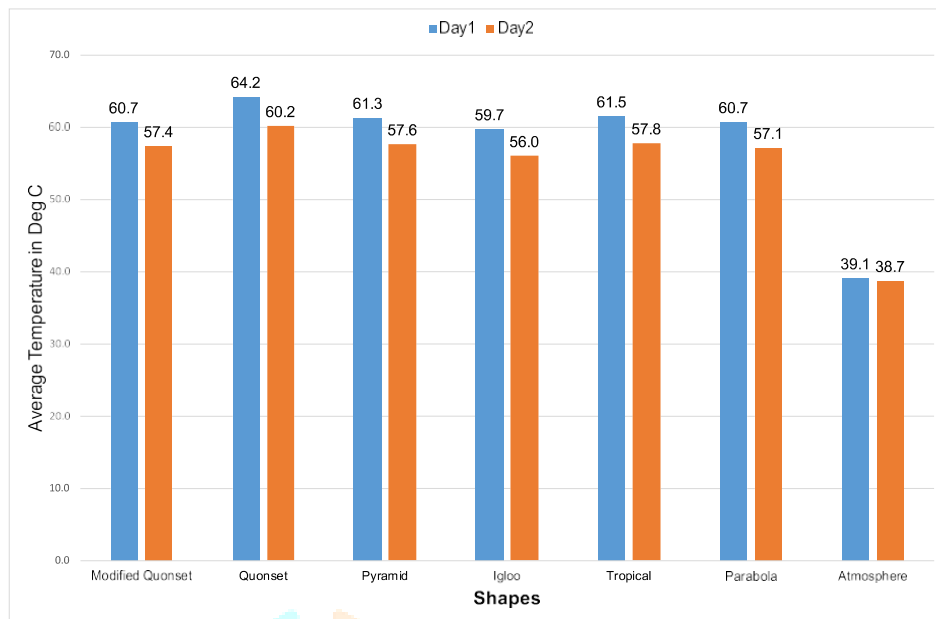
to compared with others materials the granite sphere is very better because of this properties. Now compression open sun drying , Quonset shape and Quonset shape with granite sphere Graph is as under



After concluding that Quonset shape with Granite Sphere is very effective and better to drying

- The ideal shape of the solar greenhouse dryer is Quonset Shape, it generates a maximum of 72 DegC in summer and 66 DegC in winter.
- Quonset is capable of generating 64% more temperature when compared to atmosphere, whereas tropical generates 57%, pyramid generates 56%, parabola and modified Quonset generates 55% and igloo generates 53% more temperature when compared to atmosphere temperature during summer.
- The inside temperature of greenhouse dryer is in the following order from maximum to Quonset.
- due to its thermal and mechanical parameters, can be used as a filling of bed storage, as well as in solar dryers with a working medium in the form of air.





CONCLUSION

The following conclusions are obtained from the six shapes of solar greenhouse dryer for summer and winter seasons for identifying the ideal shape of the greenhouse dryer.

- The ideal shape of the solar greenhouse dryer is Quonset Shape, it generates a maximum of 72 DegC in summer and 66 DegC in winter.
- Quonset shape generates 7% more temperature when compared to its rival tropical shape during summer.
- Quonset shape generates 5% more temperature when compared to its rival pyramid shape during winter.
- The inside temperature of greenhouse dryer is in the following order from maximum to minimum, Quonset, Tropical, Pyramid, Parabola, Modified Quonset and igloo during summer season.
- Quonset is capable of generating 64% more temperature when compared to atmosphere, whereas tropical generates 57%, pyramid generates 56%, parabola and modified Quonset generates 55% and igloo generates 53% more temperature when compared to atmosphere temperature during summer.

REFERENCES

- [1] Kumar Anil, Prakash OM, Kaviti Ajay and Tomar Abhishek, experimental analysis of greenhouse dryer in no-load conditions, *Journal of Environmental Research And Development*, Vol. 7 No. 4, April-June 2013.
- [2] A. Kumar, G.N. Tiwari, Effect of mass on convective mass transfer coefficient during open sun and greenhouse drying of onion flakes, *J. Food Eng.* 79 (2007) 1337–1350.
- [3] P. Barnwal, G.N. Tiwari, Grape drying by using hybrid photovoltaic-thermal (PV/T) greenhouse dryer: an experimental study, *Sol. Energy* 82 (2008) 1131–1144.
- [4] P.S. Chauhan, A. Kumar, B. Gupta, A review on thermal models for greenhouse dryers, *Renew. Sustain. Energy Rev.* 75 (2016) 548–558.
- [5] R.K. Sahdev, Open sun and greenhouse drying of agricultural and food products: A Review, *Int. J. Eng. Res. Technol.* 3 (2014) 2278–10181.
- [6] S. Janjai, V. Khamvongsa, B.K. Bala, Development, design, and performance of a pv ventilated greenhouse dryer, *Int. Energy J* 8 (2007) 249–258.
- [7] T. Koyuncu, An Investigation on the performance Improvement of greenhouse- type agricultural dryers, *Renew. Energy* 31 (2006) 1055–1071.
- [8] R. Venkatesh, W. Christraj, Performance Analysis of Solar Water Heater in Multipurpose Solar Heating System, *Applied Mechanics and Materials* 592–594 (2014) 1706–1713.
- [9] K. Sacilik, R. Keskin, A.K. Elicin, Mathematical modelling of solar tunnel drying of thin layer organic tomato, *J. Food Eng.* 73 (2006) 231–238.
- [10] M. Condori, L. Saravia, Analytical model for the performance of the tunnel-type greenhouse drier, *Renewable Energy* 28 (2003) 467–485.
- [11] R. Venkatesh, W. Christraj, Experimental Investigation of Multipurpose Solar Heating System, *J. Energy Eng.* (2013), 10.1061/(ASCE)EY.1943-7897.
- [12] Horticulture Statistics. International greenhouse vegetable production— statistics (2015 edition). www.cuestaroble.com/statistics.htm, 2016-9-10.
- [13] Ravinder Kumar Sahdev, Ashwani Kumar Dhingra, Mahesh Kumar, A comprehensive review of greenhouse shapes and its applications, *Front Energy* (2016) 1–12.
- R. Venkatesh, V. Vijayan, Performance evaluation of multipurpose solar heating system, *Mech. Mech. Eng.* 20 (4) (2016) 359–370