EXPERIMENTAL CONDITIONS GET MORE ENERGY USING QUONSET SHAPE OF DRYER BY USING GRANITE SPHERES BED

HIRENKUMAR AMRUTBHAI PATEL

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.

Key words: solar dryer, Quonset , Heat transfer , granite sphere

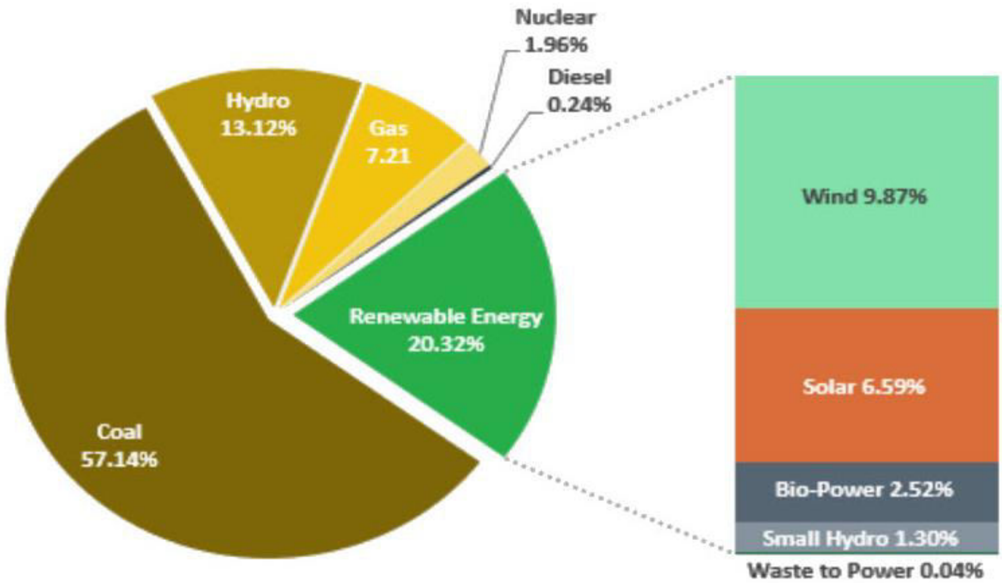
INTRODUCTION

Energy is the ability to do work. Energy comes in different forms like thermal, radiant, kinetic, electrical, chemical and nuclear. People use energy for everything from walking to sending astronauts into space.

We know that there are two types of energy sources are available renewable and non renewable.

A non-renewable resource is a limited natural resource that cannot be re-made or re-grown in a short amount of time at a scale comparable to its consumption so we can used renewable energy sources.

Renewable resources are unlimited natural resources that can be replenished in a short period of time.



Data from CEA, MNRE, Mercom India Solar Project Tracker (Intalled Capacity as on 31 Mar 2018)

RENEWABLE ENERGY SOURCES

Solar energy – Energy from the Sun is referred to as solar energy. Solar energy could be used as either active solar or passive solar. Active solar is directly consumed in activities such as drying clothes and warming of air. Technology has provided a number of ways to utilize this abundant resource.

Geothermal energy – This refers to heat energy stored under the ground for millions of years through the earth formation. It utilizes a rich storage of unutilized thermal energy that exists under the earth's crust.

Hydro-power – This is a major renewable energy source used all over the world today to produce electricity. Hydro power refers to the conversion of energy from flowing water into electricity. It is considered a renewable energy source because the water cycle is constantly renewed by the sun.

Wind energy – Wind energy is a form of solar energy. Wind energy describes the process by which wind is used to generate electricity. Wind turbine converts the kinetic energy in the wind into mechanical power. A generator can convert mechanical power into electricity.

Ocean energy - Marine and hydrokinetic energy systems, a new generation of water power technologies offers the possibility of generating electricity from water without the need for dams and diversions.

The ocean can produce two types of energy:

- Thermal energy from the sun's heat.

- Mechanical energy from the tides and waves.

The three most well-known generating technologies for deriving electrical power from the ocean are:

- Tidal power
- Wave power
- Ocean thermal energy conversion (OTEC).

Biomass energy –Biomass is organic material that comes from plants and animals, and it is a renewable source of energy. Energy contains stored energy from the sun. Plants absorb the sun's energy in a process called photosynthesis. When biomass is burned, the chemical energy in biomass is released as a heat.

Advantages of using renewable sources of energy are −

- Less maintenance cost as most sources entail few or no moving parts, hence, less mechanical damages.
- They are economical and can cut costs spent on fossil fuel.
- They emit little or no waste in the environment.
- Renewable energy sources do not deplete. Therefore, these have a better prospect for the future.

SOLAR ENERGY

Solar energy is the energy obtained by capturing heat and light from the Sun. Energy from the Sun is referred to as solar energy. Technology has provided a number of ways to utilize this abundant resource. It is considered a green technology because it does not emit greenhouse gases. Solar energy is abundantly available and has been utilized since long both as electricity and as a source of heat.

Solar technology can be broadly classified as −

- **Active Solar**–Active solar energy is a method of heating with solar energy that requires mechanical power, such as pumps and fans, to circulate heat from solar collectors.
- **Passive Solar**–Passive solar energy is a method of heating with solar energy that does not require mechanical power to circulate heat.
- Instead, structural designs are used that help to absorb solar energy and allow the heat to circulate by natural convection.

Example of passive solar energy system is a solar cooker, which is a device that uses sunlight to cook food.

SOLAR DRYING

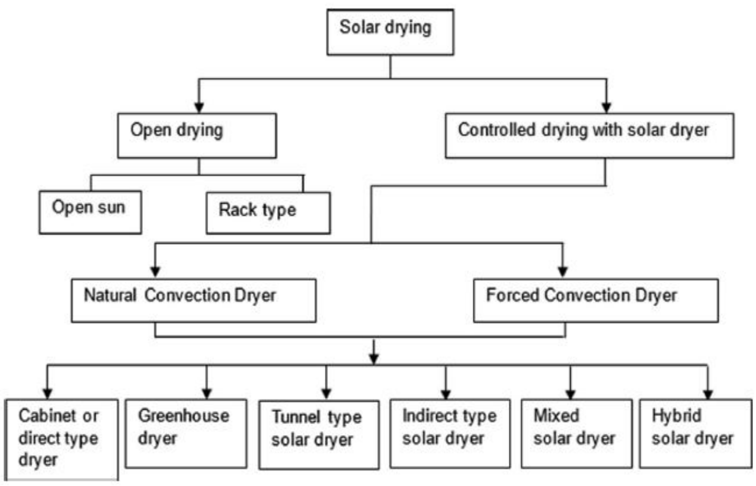
In our country energy consumed for drying is the oldest preservation technique of agricultural products, and sun drying is still widely used for preservation of agricultural products in the tropics and subtropics. Previous efforts on solar drying of cereal grains, fruits, vegetables, spices, medicinal plants, and fish are critically examined. Recent developments of solar dryers such as solar tunnel dryer, improved version of solar tunnel dryer, roof-integrated solar dryer, and greenhouse-type solar dryer for drying of fruits, vegetables, spices, medicinal plants, and fish are also critically examined in terms of drying performance and product quality, and economics in the rural areas of the tropics and subtropics.

SOLAR DRYER

The solar drying system utilizes the solar energy to heat up a air and to dry any food substance which is loaded, which is not only beneficial but also it reduces wastage of agricultural products and helps in preservation of agricultural products, but it also makes transportation of such dried product easily and promotes the health and welfare of the people.

The dryer is composed of solar collector (air heater) with the baffles and a solar drying chamber containing rack of four net trays both being assimilated together. The air allowed in through air inlet is heated up in the solar collector chamber and channelled through the drying chamber where it is utilized in drying.

TYPES OF SOLAR DRYER



ADVANTAGES OF SOLAR ENERGY

- ✓ Solar drying involves no recurring expenses on fuel as the solar energy is absolutely free.
- ✓ It saves time, as the dried need not be present during drying in a solar dryer.
- ✓ There is no fear of scorching the food.
- ✓ It provides better and more nutritious food due to drying.

- ✓ It is durable and simple to operate.
- ✓ It does not pollute the environment and conserves conventional energy.

DISADVANTAGES OF SOLAR ENERGY

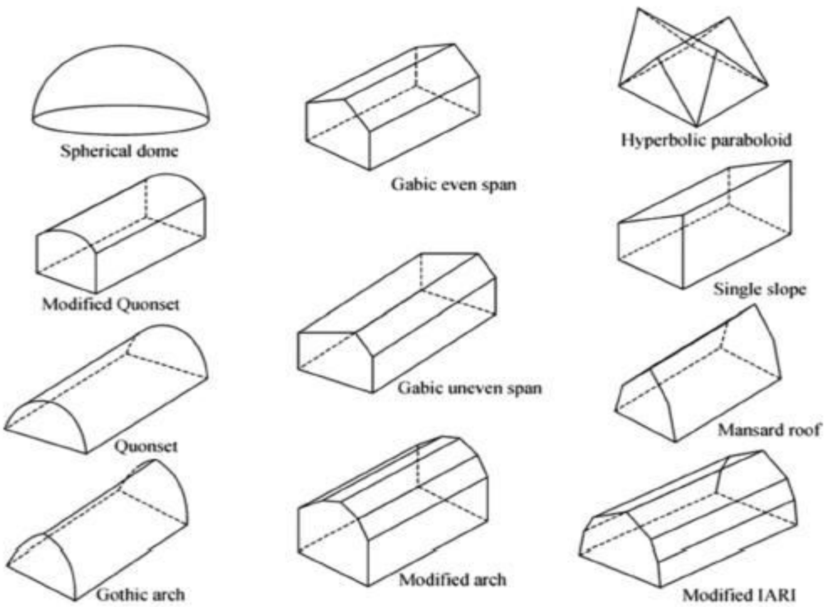
- ✓ Most do not work at night.
- ✓ Some require constant attendance while drying.
- ✓ Solar dryers are less useful in cloudy weather.

APPLICATION OF SOLAR ENERGY

- ✓ Solar drying
- ✓ Solar cooking

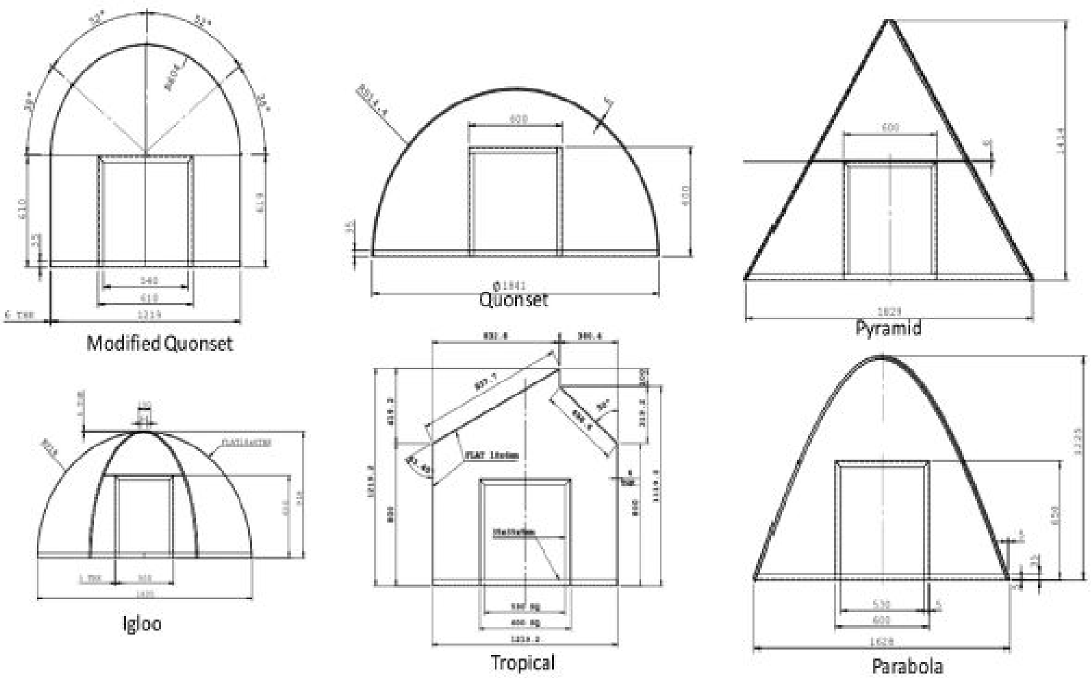
LITERATURE REVIEW

in this study selecting a ideal shapeof greenhouse dryer among the other shapes is investigated. Six shapes of solar greenhouse dryers aredesigned in such a way that each dryer maintains the same volume of 30 ft3. The six shapes areParabola, Quonset, Modified Quonset, Pyramid, Igloo and tropical. The inside temperature of greenhousedryer 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 temperaturewhen compared to atmosphere, whereas tropical generates 57%, pyramid generates 56%, parabolaand modified Quonset generates 55% and igloo generates 53% more temperature when compared toatmosphere temperature during summer. Quonset shape generates 7% more temperature when comparedto its rival tropical shape during summer and 5% more temperature during winter. The ideal shapeof the solar greenhouse dryer is Quonset Shape, it generates a maximum of 72 DegC in summer and 66DegC in winter.



Solar Greenhouse Dryer based on different shape

Six shapes of solar greenhouse dryers are designed in such a way that each dryer maintains the same volume of 30 ft3. The six shapes are Parabola, Quonset, Modified Quonset, Pyramid, Igloo and tropical, the Fig. 1 shows the actual images of the six shapes and Fig. 2 shows the dimensional of the shapesAll the shapes skeleton are made up of 35x35x2mmL angle andthe shape is covered with commercially available double glazing polycarbonate sheet with an opening at the front..



Dimensional details of six shapes.

Actual shape

The article presents the concept of a high-temperature solar dryer with an internal bedstorage. Granite was selected as the material for filling the bed storage, and an emphasis was put onits versatile use and favourable thermal and mechanical properties. Experimental tests were carriedout for the charging process of the bed storage, which was filled with granite spheres with threedifferent diameters. The influence of the sphere's diameter on the charging and discharging processof the bed storage was analysed. The results of the experiment allowed a conclusion to be drawn thatthe use of a granite storage bed could prolong the operation of the considered dryer by two hours.

Granite spheres used in the experiment.

The number of granitespheres in the packed bed was dependent on their mass: for each of the three diameters, the total massof spheres was 25.6 kg. The temperature was measured with thermocouples, which were positioned atthe inlet of the packed bed, at the outlet of the packed bed, and also outside the experimental set-up,in order to determine the ambient temperature. The time of each of the experiments exceeded threehours, and lasted until the temperature of the air at the inlet to the packed bed stabilized. The spheresthat were used in the experiment are shown in Figure

The material, in the shape of spheres, was selected for the tests since in the calculations of heatexchange in rock bed storages, the equivalent diameter is determined and the material is treated asa sphere. This allowed any error related to determining the equivalent diameter to be avoided,which is troublesome.

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(a) (b) (c)

Figure shows spheres of various sizes arranged in the packed bed. The bed was filled inconfigurations with either 26 large spheres, 58 medium-size spheres, or 142 small spheres.In order to determine the heat loss flux for each of the configurations, an additional measurementseries were performed for a configuration without granite filling. The investigations covered themass air flow rate, as well as the air inlet and outlet temperatures. In the next step, second-degreepolynomials were determined for the relation between the temperature decrease and temperaturedifference for each of the three investigated air flow rates.The tests carried out for three different types of bed storage filling showed that the size of granitethat is used as a storage material has a big impact on the efficiency of the process. The authorsused granite that was previously prepared in the form of spheres, which allowed its characteristicdimensions to be precisely determined. Due to the preparation of the experiment plan, the numberof required measuring series was decreased, and it was shown that the efficiency of charging thebed storage filled with granite is similar for all of the sizes of the filling material after the first hourof charging.

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.

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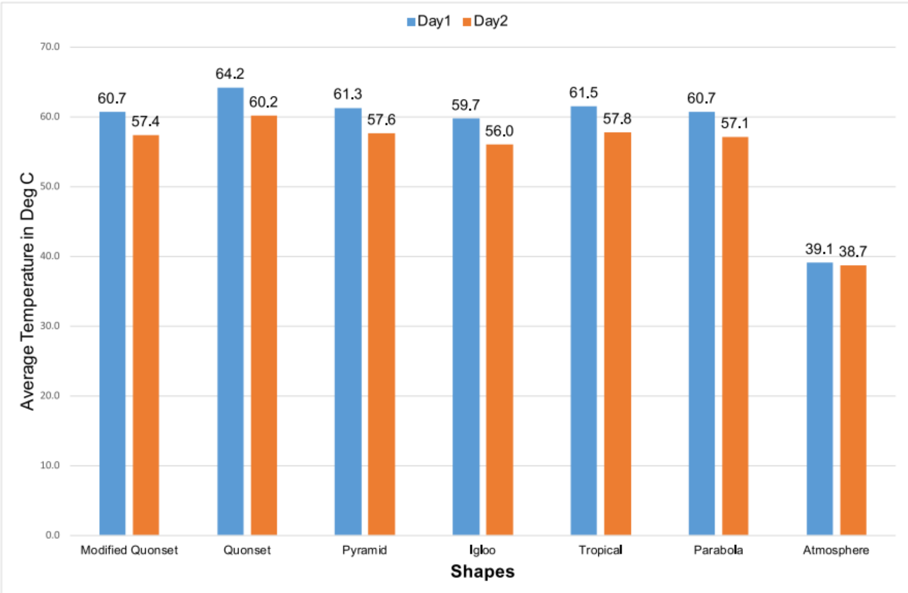
Instruments used.

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	



Comparison for average Inside Temperature for Six shapes and ambient temperature for summer.

max. and min. inside temperature of greenhouse dryers.

Shapes	Modified Quonset	Quonset	Pyramid	Igloo	Tropical	Parabola	Atmosphere
Max. Temp.	62.938	66.153	63.716	61.163	60.621	62.142	38.13
Min. Temp	33.037	32.562	32.312	32.168	26.779	32.326	29.113

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.

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