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Solar Food And Seed Dryer

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Abstract- The solar drier was designed to overcome the limitations of traditional sun drying methods such as direct sunlight exposure, liability for pasting, intrusion of birds and insects and lack of proper monitoring..The solar dryer uses solar energy to heat up the air and dry the material packed into it. The system consists of an air heater or solar heater and a solar drying chamber with tray rack. Heated air in solar collector forced by blower i.e. internal use of solar panel energy to flow in chambers where it is used for drying means removing the moisture content from the loaded collector substances and connecting chamber. Tilt angle is main parameter for the calculation of efficiency of the dryer. So, firstly we have calculated angel of tilt for the absorber plate. The tilt angle should be less than lattitude facing north side. So we got the latitude 19.01°N in Mumbai accordingly we got the tilt angle 15°C. By taking this tilt angles a reference we got the length of total length of the solar dryer system which is 116.41cm and Collector area about (80.4*40)cm^2.

Index Terms— sun drying, solar collector, solar panel, absorber plate, tilt angle, latitude.

I. INTRODUCTION

Drying is an excellent way of preserving crop, and solar food dryers are a perfect technology for food preservation for sustainable development. This involves removing moisture from agricultural products in order to produce a commodity that can be stored safely for a longer period of time.Sun drying is the first method ever used to dry farm produce and it involves simply placing the agricultural products in the sun on mats, rooftops or drying grounds.There are many drawbacks, because the farms are kept open sky and because of adverse climate conditions such as rain, wind, humid and dust, the loss of development of birds, insects and rodents there is more chance of decline. There is a completely climate dependent drying rates that are very slow and dangerous for the moulds to increase, thereby making the products worse and putrefied.It also takes time and work intensively for the system to involve a wide area of land. Artificial mechanical drying came into effect with social and engineering growth, but this process is extremely exhaustive and expensive in terms of energy, which ultimately increases product expenditure. Efforts to accelerate "sun drying" have recently been targeted at solar drying.

II. PROBLEM DEFINATION

The limitations of traditional sun drying method such as the risk of spoilage as agricultural product directly laid into open sky because lack of proper monitoring. Also wind born dust, moist interference Birds, insects and rodents(pests) interference.This traditional method required large area and land ,Time consuming and highly labour intensive .

III. OBJECTIVE

The project's main objective is to study and analyze the solar dryer concept and to present a simplified way of using solar dryer in different fields. Learning to use the concept of solar dryer in the application of food storage. It is necessary to provide backup heating system in order to require continuous drying of products.The objective of the project was to make a dryer of low cost with good efficiency, At the same time it should acquire less time. initially we were planning to go with natural convection As according to calculation of natural convection basis it was being a little time consuming process. Hence we analyse & got in discussion with guide and finally made the decision of providing force convection through blower of optimum range. So the design and calculation was finalized. we analyzed requirement of market and availability of tools and materials. we were planning to make it as much lighter as we can and at the same time it should be easily movable to give better performance according to surrounding conditions. As per discussion with our guide and after his suggestion we raferred G.D Rai and renewable energy source. Many concepts of solar radiation and sunlight reflection at upper surface shorter and longer wave radiation emitted by sun were studied by us.The outer structure of the model was made of wooden frame .

<u>Application of solar dryer in various solar dryer in different field:</u>

1. Drying of agricultural crops.

2. Industries of food processing for fruit, potatoes, onions and other vegetables dehydration.

3. Dairy industries for milk powder production, casein, etc.

4. Textile industry for textile material drying.

IV. METHODOLOGY

There are three major compartment i.e absorption chamber, drying chamber and exhaust. We calculated the angle of tilt upon which the glass surface and aluminium sheet is mounted. Maintain the certain gap between glass surface and aluminium sheet.The sun rays are going to incident on absorption plate and further heat is going to be trapped in heat trap zone area between absorbing plate and glass plate. At the inlet of absorption chamber a blower is mounted in such a way that it force the trapped heat(heated air) to passes through the drying chamber where series of plate are placed upon which product get dried as moisture content is removed from the product due to heated air now the air is allowed to pass out through the exhaust at upper level of drying chamber. A solar panel is being used to supply the power to the blower at the inlet. Solar panel is placed at the top of the model.

V. Calculations:

Sr.no	Items	Conditions and assumptions
1.	Location	Mumbai(latitude 19.07°)
2.	Agricultural product	Maize
3.	Product porosity	.42
4.	Drying Time	April-July
5.	Surrounding temperature of air	27°C
6.	Maximum Temperature	70°C
7.	Total Solar Radiation	1451.88W/m^2 K
8.	Beam radiation Ib	937.45W/m^2K
9.	Incidence angle θ	5.786
10.	Solar altitude angle α	84.20°C
11.	Tilt factor	.99
13.	Declination δ	13.28°C
efficiency	33.73%	

Table .A Parameter for calculation

I -INTENSITY OF RADIATION
N- NO OF DAYS

$I=1+0.033 \cos (360 \times N)/365$

ACCORDING TO OUR CONDITION
15 APRIL (116 DAYS)

$I= 986.361$ watt/m^2

Solar Declination (δ)
$\delta = 23.45 \sin [360*(284+n)/365]$
$=13.28°$

HOUR ANGLE (Ws)
$Ws=15 (12-Hr)$

CONSIDER 12:00 PM
$Ws = I5(12-12)=0$

LATITUDE OF MUMBAI (Φ)
=19 060°C

SINCE
IN SUMMER DAY
ANGLE OF TILT $(\beta)=15°C < \Phi$

SOLAR ALTITUDE ANGLE(α)
$\sin(\alpha)=\cos\Phi.\cos\delta.\cos(Ws) + \sin\Phi.\sin\delta$

$\sin(\alpha)= 0.9948$
$\alpha=84.20°C$

INCIDENT ANGLE

$= \pi/2-\alpha$

$=5.396$ °C

Ib -BEAM RADIATION
$Ib = I [\sin(\Phi-\beta) \sin\delta +\cos\delta \cos(Ws).\cos(\Phi-\beta)]$

$= 937.45$ watt

TILT FACTOR (Rb)

$$Rb = \frac{[\sin(\Phi-\beta) \sin\delta +\cos\delta \cos(Ws).\cos(\Phi-\beta)]}{[\sin(\Phi) \sin\delta +\cos\delta \cos(Ws).\cos(\Phi)]}$$

$=0.990$

$It = Ib (1+0.5C)$

$$C=\frac{1+\cos(\beta)}{2}$$

Then ,
$It = 1451.88$ watt

Now, Energy Balance By Solar Collector

It.Ac = Quseful + Qconduction + Qconvection + Qradiation + Qabsorber

Quseful = [(αT).It - UL.(Tc-Ta)]

α= 0.9 T = 0.88
From this we got ,
UL = 19.189 w/m2.K

Therefore, Quseful = 325.14 watt

Efficiency of collector ,

$$= \frac{\text{Quseful}}{\text{It.Rb}}$$

= 33.73 %

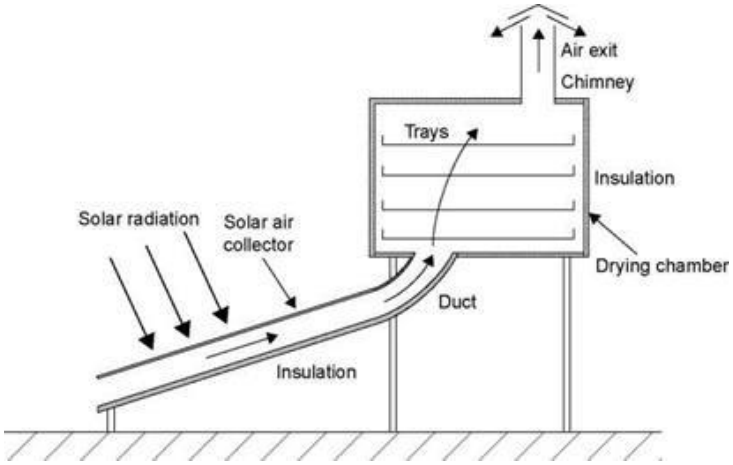

Fig. 1 schematic dig. of model

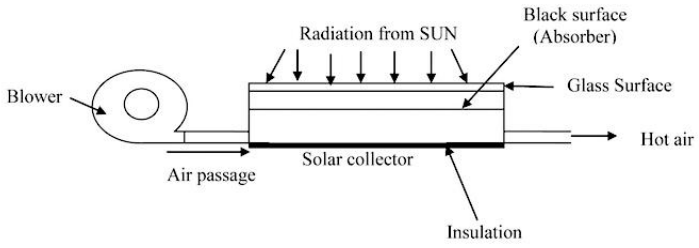

Fig. 2 schematic Solar collector

VI. Material and cost analysis:

Aluminum Sheet : 1mm thickness 210INR/kg

Insulation : 95INR/sq.m

Glass : 5-8mm 40INR/sq.ft

Blower : 200–350INR

Wooden frame : 1500INR/piece

Tray(perforated) : 200INR/sq.ft

Black paint : 1L-200INR

Solar panel : 50watt-2sq.ft - 2600INR

Result:

The solar assisted dryer with the collector area of (0.8*.40)m^2.According to the many resources we can take the tilt angle in the summer should be less than the latitude angle. In summer the latitude angle around 19.017°C and we take the tilt angle will be 15°C which is less than latitude value. According to the calculation our useful heat will be 325.14 Watt. Also we get the efficiency of the collector should be 33.73%.

Conclusion:

Solar dryer rises the atmospheric temperature of air to higher level such as 65 degree celius due to which drying rate of agricultural product increases. Hence the time taken to dry the product has been reduce and it saves the product from interference of animal, insects. It gives Ease of operation compared to normal sun drying .Hence we got the efficiency around 33.73% .

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