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Automatic Temperature Control Solar Dryer

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Abstract: *With this project we plan to introduce a working model of 'Automatic Temperature Control Solar Dryer'. This would be an advanced model in sense that it can work Throughout the day as well as during the night time too. It would receive solar energy during the day Time and would be harnessed in two fashion. A transparent glass panel at front would ensure sunlight reaches the fruit and warm up atmosphere is created as per the current traditional solar dryer.*

Keywords: Solar, Fruits, vegetable, drying, preserve, temperature

I. INTRODUCTION

Solar dryer is one of the best way to dry food. Food being an essential commodities has been the basic neccesities of the human life apart From clothing and shelter. Although the foods continue to be harvested throughout the year in Different parts of the world, some areas face shortage during off season period. Also external Weather conditions, extreme temperature and drought situations causes disturbance to the food Supply chain. Also, foods are highly perishable. They cannot be stored for a long period of timeline a normal environment. They tend loose to their nourishing content over time period.

II. LITERATURE REVIEW

a) https://ieeexplore.ieee.org/document/8658770

D.K. Rabha and P. Muthukumar from Department of Mechanical Engineering, IIT Guwahati, India in a paper titled "Feasibility Study of the Application of a Latent Heat Storage in a Solar Dryer for Drying Green Chili" Published in: 2018 2nd International Conference on Power, Energy and Environment: Towards Smart Technology (ICEPE) on 1-2 June 2018 has studied About the green chili drying process using solar dryers. They did a comparison about the direct And indirect drying of the foods using sunlight and heat and outlined the advantages and Disadvantages of both the methods for various parameters. They did a deep research on the Enclosed solar dryer concept which is categorized under the indirect solar drying part. They did The feasibility study on the latent heat storage capacity of the enclosed solar dryer and its Behaviour on the green chilly inside the chamber.

b) https://ieeexplore.ieee.org/document/8635684

D.V.N. Lakshmi; Apurba Layek; Palanisamy Muthukumar, et. All in a paper titled "Evaluation of Convective Heat Transfer Coefficient of Herbs Dried in a Mixed Mode Solar Dryer" Published In: 2018 International Conference and Utility Exhibition on Green Energy for Sustainable Development (ICUE) dated 24-26 Oct. 2018 had developed a mixed mode solar dryer to test on Herbs drying process. A mixed mode forced convection solar dryer (MMFCSD) integrated with Double pass counterblow solar air heaters was developed in-house for drying of high valued Moringa Oleifera and Stevia rebaudiana leaves. Experiments were carried out to evaluate the Convective heat transfer coefficient of the samples in the developed solar dryer and under open Sun drying (OSD). From the analysis, the average convective heat transfer coefficient of the Leaves in the MFSCD were found to be 4.93 and 4.22 W/m 2 -K for Moringa and
Stevia leaves And in OSD the average values were 1.31 and 1.25 W/m 2 -K, respectively. The efficiency of the Mixed mode solar dryer was found to be 26.4 %. Their conclusion states that the proximate Analysis for the protein and fiber content of the experimental samples concludes that the crude Protein and crude fiber of solar dried samples are better than the sun-dried ones.

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c) https://ieeexplore.ieee.org/document/9073826
Shakil Ahmed Jiskani; Iftikhar Ahmed Chandio; Ghazanfar Mehdi; Abdul Hameed Memon; Abdul Raqeeb Bhutto; Urooj Gul Sandilo, et. All in a paper titled
"Fabrication & performance Analysis of direct type passive solar dryer for chilies and grapes drying" Published in: 2020 3rd International Conference on Computing, Mathematics and Engineering Technologies (iCoMET) Dated 29-30 Jan. 2020 had done a performance analysis on the chillies and grapes drying process Using solar dryer. For this purpose a direct type passive solar dryer was fabricated using metal Pipes and its allied structure. They found out that this drying technique not only evaporates but Also provides a controlled and safe storage of products. A closed wooden casing along with glass And black colored metallic sheet was employed to achieve the maximum temperature. An Average inside air temperature of 60-70°C was achieved, whereas an average outside air Temperature of 33-44°C was noted in the months of October and November. Solar illuminance Was measured by a lux meter. The maximum value for illuminance was between 8000-12000 lux From 10:30 am to 4:30 am. 20-40% moisture lost per day for three days of drying session. Chilies And grapes were used as a test product. For chili's 85% of moisture evaporated in 15 hours, while Maximum air temperature gained inside the dryer was 70 °C. And for Grapes 75% moisture was Dehydrated in 15 hours, while maximum inside air temperature noted within the dryer was 68°C.i

III. CONSTRUCTION AND WORKING

3.1 Metal frame

The frame was constructed in a rectangular box shape of size 762 (l) * 457(b) *152 (h) . The metal pipe of 25* 25 mm was used for this purpose. The frame was constructed using metal fabrication process of electrical welding.

3.2 Metal Stand

The support stand for the dryer is constructed such that the solar dryer boxshould have inclination towards the sun rays. It is also constructed using fabrication of metal pipe of 25mm * 25 mm.

3.3 Metal sheet enclosure

The box is surrounded on the outside using metal sheet enclosure. The sheetwould be painted black, so as to absorb more amount of latent heat and helpdrying process easier. It would prevent inlet of air. The mesh is provided to install exhaust fan.

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3.4 Glass Topping

The sun rays should pass on to the food uninterrupted, but at the same time should not be contaminated by the external environment pollutants. Hence, aglass covering would be used fot that purpose. The glass would be 3mm thichmax for easy penetration of sunlight.

3.5 Solar panels

The solar panels would be placed on the box alongside its frame pointing towards the sun rays. They would be each of 50 mm (width) * 120 mm (length). It would power the exhaustion system to make it self sustainable.

3.6 DC Motor Fans

Fan is a device which is converting the electrical energy into mechanical energyproducing air. The shape of the fan blades is such that the air should be easily taken out from the panel.

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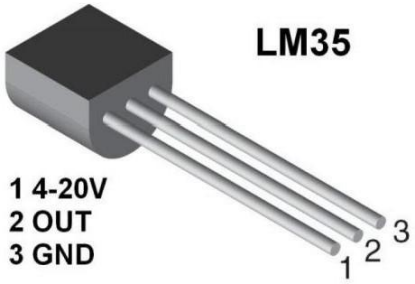
3.7 Temperature Sensor

The temperature sensor is LM35. It is in tp-22 package. It would be used to detect the temperature inside the solar dryer box and would send the signal tothe exhaust fan to operate



IV. DESIGN/WORKING

Design consists of application of scientific principles, technical information andimagination for development of new or improvised machines or mechanisms to perform a specific function with maximum economy and efficiency. Hence a careful design approach has to be adopted. The total design work has been split up into two parts;

4.1 System Design

System design mainly concerns various physical constraints, deciding basic working principle, space requirements, arrangements of various components etc. Following parameters are looked upon in system design .Selection of system based on physical constraints. The mechanical design has direct normswith the system design hence system is designed such that distinctions and dimensions thus obtained in mechanical design can be well fitted in to it. Arrangement of various components made simple to utilize every possiblespace .Ease of maintenance and servicing achieved by means of simplified layout that enables quick decision assembly of components Scope of futureimprovement.

4.2 Mechanical Design

In mechanical design the components are listed down and stored on the basisof their procurement. For designed parts detailed design is done and dimensions obtained are compared to next dimensions which are already available in the market. This simplifies the assembly as well as the post production and maintenance work. The various tolerances on work are specified. The process charts are prepared and passed to the manufacturing stage. The parts to be purchased directly are selected from various cataloguesand are specified so as to have a case of procurement In mechanical design at the first stage selection of appropriate material for the part to be designed for specific application is done. This selection is based on standard catalogues or data books;

4.3 Frame Material selection

- Glass selection
- Sensor selection
- Fan selection

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V. ADVANTAGES

1. The solar food dryer would help preserve food for a longer period oftime.
2. The food dryer would be totally free to run, considering it depends solelyon the free energy available from the sun.
3. The metal sheet enclosure would ensure the food dryer gets warm upquickly.
4. The black color ensures the heat does not get out easily once it getstrapped inside the box
5. The sensors and exhaust fan would help release the moisture to the outside of the solar food dryer box.
6. The system would be fully self-sustainable, since it doesn't depend on any other source, than the freely and abundantly available sunlight.

VI. DISADVANTAGES

1. Although the running cost of the solar food dryer is Zero, The High initial cost makes it a challenge to widely adopt.
2. The brittleness of the glass topping and the heaviness of the metal enclosure, makes it cumbersome for portability.
3. Compared to modern machines, this process is slow one.

VII. APPLICATIONS

1. In drying of grapes, for production of resins.
2. In drying potato slices to convert it into edible wafers ships.
3. In converting the food powder for liquor and soft drink industry.
4. For production of dyes used for various purposes.
5. For drying of leaves to be used in the pharmaceutical industry.

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VIII. CONCLUSION

1. The system was constructed as per our plan.
2. The sunlight and black metal enclosure combination helped accelerate the food drying process.
3. The sensors and exhaustion system ensure no production of moisture in the food.
4. The whole project is self sustainable in any environment and can be easily portable.

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