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Solar Dryer

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ABSTRACT:-

The Solar drying system utilizes solar energy to heat up air and to dry any food substance. Drying reduces wastage of agricultural produce and helps in preservation of agricultural produce. Based on the limitations of the natural sun drying such as exposure to direct sunlight, liability to pests and rodents lack of proper monitoring, and the escalated cost of the mechanical dryers, a solar dryer was therefore developed to cater for these limitations. This project presents the design and construction of a portable solar dryer, the dryer is composed of a drying chamber containing rack of two trays. Air is allowed through air inlet and is heated up in the solar chamber where it is utilized in drying (removing the content from the food substance or agricultural product loaded). The design was based on the geographical location which is pandharpur and meteorological data were obtained for proper design specification. The solar dryer systems can play a crucial role in reducing energy consumption, mitigating environmental impact, and improving the overall sustainability of agricultural products drying.

INTRODUCTION:-

Drying is a complicated process involving simultaneous heat and mass transfer. The required amount of energy to dry a particular product depends on many factors. Fossil fuels, which take millions of years to form, are being depleted at an alarming rate due to heavy reliance on non-renewable energy sources, leading to environmental problems such as global warming, air pollution, and water contamination. This situation threatens global energy production and highlights the need for alternative energy sources, as emphasized in agreements like the Kyoto Protocol and Paris Agreement. Solar energy emerges as a prominent renewable option, with daily sunlight availability vastly exceeding humanity's energy consumption. If harnessed effectively, it could meet all energy needs. One traditional use of solar energy is food drying, an ancient preservation technique that relies on heat and mass transfer processes. However, conventional open sun drying has significant drawbacks, including susceptibility to pests, weather, and the inability to control drying conditions, leading to quality inconsistencies and post-harvest losses. Advanced solar drying systems have been developed to address these issues by trapping solar radiation in closed devices, enhancing control over the drying process. Tomatoes, a highly perishable crop, are often dried to extend shelf life, but achieving quality comparable to fresh tomatoes presents challenges. With global tomato production reaching 184.7 million tons and losses up to 17 million tons, finding sustainable and effective drying solutions is increasingly vital for food preservation and waste reduction.

LITERATURE SURVEY:-

Solar dryer can be used for farmers to dry the agro products during off sunshine hours. Solar dryers will reduce the use of traditional electrical and fossil fuels, thereby reducing environmental issues caused by their use. The thermal performance of the solar dryer was improved by absorbing the high solar radiation, Chauhan, et al. [1].

Solar dryer was designed with sensor to control the drying environment. The system was entirely powered by solar energy, which was used in both thermal and electrical effects. Thermal energy was stored in paraffin wax, while electrical energy was stored in a solar battery. This system was designed with a capacity of 10-15 kg with 6 trays and maintained a temperature of 55-60 °C, Devi, et al. [2]. Experimental investigation of soapstone and granite as energy storage materials and found that soapstone rock performed better than granite as a TES material for solar drying technology and solar power generation applications, Kakoko, Jande, and Kivevele [3]. Soapstone rock has a higher density of about 2.98 g/cm 3 , which is higher compared to other natural rocks, and a specific heat capacity ranging 0.9–1.1 kJ/kg °C that is about 20% more than that of other typical natural rocks, Pirinen [4]. The air inlet area of the dryer was found to have a significant effect on the dryer's performance. The dryer's performance improved when the air inlet area was increased, and vice versa, Montero, et al. [5]. It has been demonstrated that an increase in radiation causes an increase in the temperature of the chamber for a constant air flow, whereas an increase in air flow implies a decrease in the temperature of the chamber for a constant value of solar radiation. For ambient temperature 30.5 °C, the operating temperature of the dryer was
74.5 °C and the mass of water removal in vegetable was 199.9g in the solar dryer ,Shalaby and Bek [6].

Need of Renewable Energy:-

The use of renewable energy in a solar vegetable dryer is essential for sustainable and cost-effective food preservation. Solar dryers operate without relying on electricity or fossil fuels, making them an energy-efficient and environmentally friendly solution. They help reduce carbon emissions and contribute to climate change mitigation. By utilizing solar energy, these dryers offer a low-cost method for drying vegetables, making them especially beneficial in rural areas with limited access to electricity. Additionally, solar drying helps preserve the nutritional value of vegetables while extending their shelf life, reducing food waste, and improving food security. This makes solar vegetable dryers a practical and sustainable alternative to traditional drying methods.

Proposed Methodology:-

1. Design of the solar dryer with flat plate solar collector for storage material.
2. Finding drying time of agriculture product.
3. Determining efficiency of solar dryer, finding weight of water removed from the product.
4. The drying experiments were conducted flat plate collector with material in day time.
5. comparing Performance of solar dryer working on flat plate collector with open sun drying for drying agri product.

BLOCK DIAGRAM:-

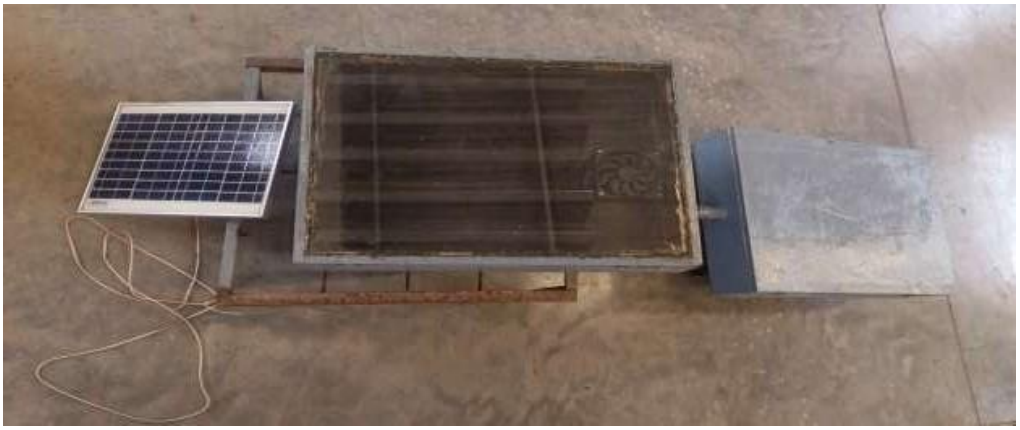


Fig 1.1 Solar dryer

COMPONENTS:-

1. PV CELL:-

A 12V system refers to electrical devices or circuits that operate on 12 volts of electrical potential. It's commonly seen in automotive systems, where cars use 12V batteries to power lights, radios, and other accessories. Many renewable energy setups, such as small solar power systems, also use 12V to operate various devices. In electronics, 12V is often used for devices like LED lighting, power supplies for routers or CCTV cameras, and in small gadgets. This voltage is also found in certain battery-powered systems, where a 12V battery provides the necessary power for those devices to function effectively. It's a standard voltage in many low-power applications because of its reliability and versatility.

2. ALUMINIUM PLATE:-

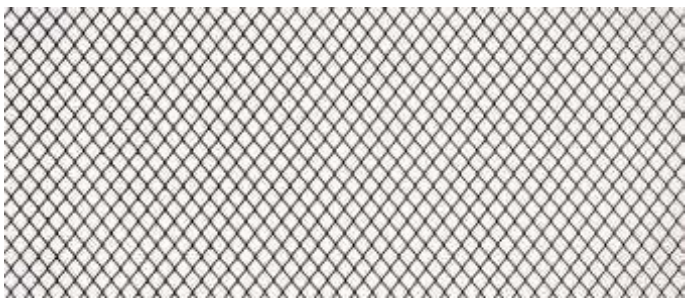
An aluminum plate is a flat, thin sheet of aluminum metal, typically used in a wide range of industrial, commercial, and manufacturing applications. Aluminum is lightweight, durable, and corrosion-resistant, making it ideal for use in environments where these properties are important. These plates come in and can various thicknesses be cut, shaped, or welded to fit specific needs.

3. BLOWER:-

A blower is a device used to move air or gases by increasing their pressure and directing them to a specific location. It is commonly found in applications like HVAC systems, cooling systems, dust removal, and air circulation. Blowers work by using a fan or rotor mechanism powered by an electric motor or engine, creating high-volume airflow. There are different types, such as centrifugal, axial, and positive displacement blowers, each suited for specific needs like high volume, high pressure, or controlled airflow. Blowers are essential in industries like manufacturing, automotive, and agriculture.

4. NET:-

A steel net, also known as wire mesh or metal net, is a structure made of interwoven or welded steel wires. It is commonly used in security, construction, and industrial applications. Welded wire mesh consists of steel wires welded at intersections, making it rigid and strong. Woven wire mesh is made by weaving wires in a crisscross pattern, offering flexibility. Chain link fencing is a popular steel net used for security and enclosures. Expanded metal mesh is created by cutting and stretching a single steel sheet into a mesh-like pattern. Stainless steel mesh is corrosion-resistant and used in harsh environments. Steel nets are widely used for fencing, reinforcement in concrete, safety barriers, filtration, machine guards, and agricultural protection. They provide high strength, durability, weather resistance, and versatility for various applications.



5. PLYWOOD:-

Plywood is an engineered wood product made by gluing together thin layers of wood veneer with alternating grain directions for strength and stability. It is used in construction, furniture, cabinetry, packaging, and boat building. Common types include softwood plywood for construction, hardwood plywood for furniture, marine plywood for water-resistant applications, flexible plywood for curved designs, and fire-retardant plywood for enhanced safety. It is durable, lightweight, and versatile, making it a popular choice for various structural and decorative applications.

ADVANTAGES:-

1. Better drying Quality of Products are obtained
2. Farmer get better market price to his products.
3. Products are protected from insects, rain, birds.
4. Prevent fuel dependence and Reduces the environmental impact
5. This method is more efficient and cheap.
6. Shelf life of fruits, vegetables can be increase up to eight months.
7. They have low operation and maintenance costs.

APPLICATIONS:-

1. 1 .Solar dryers can be used to dry fruits, vegetables, meat, fish, and other foods
2. Solar dryers can be used to dry household items like pickles, lemon, papad, potatoes, and bananas.
3. Solar dryers can be used to maintain the proper air temperature in house in winter season.

CONCLUSION:-

A solar vegetable dryer is an efficient, eco-friendly, and cost-effective solution for preserving vegetables by using renewable solar energy. It helps reduce post-harvest losses, extends shelf life, retains nutrients, and supports sustainable agriculture. With applications in households, farming, and commercial food production, it promotes food security and reduces reliance on artificial drying methods. Its low operating cost and environmental benefits make it a practical choice for long-term food preservation.

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