Thermal energy storage based solar drying systems

Is solar drying system effective for continuously drying agriculture and food products?
Developed solar drying systems with sensible and latent heat storage are described. Abstract Solar dryer based on thermal energy storage materials is quite effectivefor continuously drying agriculture and food products at steady state in the temperature range (40 °C-60 °C).

How efficient are solar dryers based on thermal storage?
The authors reached a maximum drying efficiency of 85%with these systems. Despite the advantages of using dryers based on solar energy with thermal storage,the heat and mass transfer mechanisms of these systems and the flow regime are very complex.

What are solar-thermal driven drying technologies?
Solar-thermal driven drying technologies,herein referred to as Solar Dryers(SD) for brevity,includes both large-scale SDs for industry,termed Large Industrial SDs (LISDs) herein,and small-scale SDs for small-scale industrial and non-industrial applications,termed small-scale SDs herein.

How can thermal energy storage improve the reliability of solar energy?
Thermal energy storage techniques can increase the reliability of solar energy for drying. These techniques allow the stored energy to be used in periods of no solar incidence. The complex processes involving each element of the solar drying process have made experiments quite expensive.

Why do dryers use solar energy?
Dryers based on solar energy have gained more space,as this energy source is free and abundant. Thermal energy storage techniques can increase the reliability of solar energy for drying. These techniques allow the stored energy to be used in periods of no solar incidence.

Can solar energy be used to dry agricultural products?
Solar drying is one of the most studied,as the search for renewable sources for thermal energy generation is highly relevant. Despite the benefits of using solar energy for drying agricultural products,the low drying capacity compared to conventional dryers limits the development of solar dryers [16].

Atalay, H. Assessment of energy and cost analysis of packed bed and phase change material thermal energy storage systems for the solar energy-assisted drying process. Sol. Energy 2020, 198, 124-138. [Google Scholar] ...

The black pepper samples dried using proposed thermal energy storage-based solar drying systems are observed to show improved (about 8.8 % for mixed type and 59.87 % for indirect type) antioxidants and TPC (about 38.57 % for mixed type and 39.06 % for indirect type) retention characteristics relative to

corresponding OSD products

This paper mainly presents a review on the important contributions made so far in the field of solar drying systems based on the thermal energy storage medium, with a focus on recent updates in thermal energy storage technology available in terms of materials capable of storing heat as sensible and latent heat.",

The phase change materials (PSM) store the thermal energy during sunshine hours and releases it after sunset which can reduce the heat losses and improve the thermal efficiency of the drying systems.

The energy efficiency enhancement of solar dryers has attracted the attention of researchers worldwide because of the need for energy storage in solar drying applications, which arises primarily from the irregular nature of solar energy that leads to improper drying which will reduce the quality of the products being dried. This work comprehensively reviews the state-of ...

This review endeavors to bridge this gap by offering an exhaustive analysis of solar-based drying systems, encompassing both domestic and industrial sectors. ... Assessment of energy and cost analysis of packed bed and phase change material thermal energy storage systems for the solar energy-assisted drying process. Solar Energy (2020) A ...

The study focused on the design, fabrication, and thermal performance investigation of a solar dryer integrated with a thermal energy storage system using a parabolic solar dish concentrator, in Bahir Dar weather conditions, with the following components: solar concentrate and cavity receiver, drying chamber trays made of meshed stainless-steel wire.

Developing efficient and cost effective solar dryer with thermal energy storage system for continuous drying of agricultural food products at steady state and moderate temperature (40-75. °C) has become potentially a viable substitute for fossil fuel in much of the developing world.. Solar energy storage can reduce the time between energy supply and ...

Research and Innovation (R& I) on Large-scale Industrial Solar-thermal driven Drying technologies (LISDs) is one of the strategies required to transition to a low-carbon energy future. The objective for this work is to guide future R& I on ...

A brief description of the proposed building-plant scheme is reported in this subsection. As shown in Fig. 1, the BIPV/T system provides both electrical and thermal energy, where the first one is directly delivered to the grid, while the second is used to provide both make up air in the inner zones and heat at the evaporator of a heat pump.With this configuration it is ...

More work on developing effective and economical PCMs with less decaying effects for solar thermal energy storage systems is needed. More research work is needed to develop an economical, highly efficient,

ecofriendly, less payback time for large scale applications. ... Nayak S, Kumar A, Mishra J, Tiwari GN (2011) Drying and testing of mint ...

Thermal energy storage based solar drying systems: A review. Innov. Food Sci. Emerg. Technol. (2016) ... Assessment of energy and cost analysis of packed bed and phase change material thermal energy storage systems for the solar energy-assisted drying process. Solar Energy, Volume 198, 2020, pp. 124-138.

PDF | On Oct 31, 2020, Johannes. P Angula and others published Optimization of Solar Dryers through Thermal Energy Storage: Two Concepts | Find, read and cite all the research you need on ResearchGate

The available literature data on different TES materials show the importance of energy storage in drying applications. A lot of TES materials such as paraffin wax [8], [9], [10], Zinc nitrate hexahydrate, lauric acid [11], HS-58 (an inorganic salt-based phase change material, PCM) [11] are used in solar dryers. Paraffin wax is the mostly used TES material in solar dryers.

Open sun drying has some limitations but these limitations can be overcome in solar dryers. Thermal energy storage (TES) systems for solar dryers receive wide attraction as the TES system enhances ...

Solar heat is an attractive alternative in industrial processes. However, the intermittent and stochastic nature of solar energy necessitates the use of heat storage systems to bridge the gap between heat production and demand. This study introduces a validated numerical analysis approach to investigate the performance of latent storage tanks filled with spherical ...

Atalay, H. Assessment of energy and cost analysis of packed bed and phase change material thermal energy storage systems for the solar energy-assisted drying process. Sol. Energy 2020, 198, 124-138. [Google Scholar] Le, T.S.; Le, T.H.; Pham, M.T. A review of the indirect solar dryer with sensible heat storage mediums. J. Mech. Eng. Res.

This study aims to fill that gap by conducting a life-cycle assessment of two new solar drying systems built in Udaipur, Rajasthan, India. The environmental implications of an innovative cylindrical solar-assisted drying system and a phase-change material-based solar drying system were evaluated using cradle-to-gate life-cycle analysis.

Summary Because of the unstable and intermittent nature of solar energy availability, a thermal energy storage ... Combined thermal energy storage is the novel approach to store thermal energy by combining both sensible and latent storage. Based on the literature review, it was found that most of the researchers carried out their work on ...

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In general, the thermal energy of the solar irradiation is applied to supply the required heat for drying the crops and other materials. Moreover, by using solar facilities such ...

The drying time was reduced by about 60.7% compared to the most used drying method (sun drying) [101]. performed the energy and economic analysis of two energy storage systems for drying. The thermal storage evaluated was a packed bed system with pebble stones (PBTES) and a PCM system with paraffin (PCM).

Especially in higher value-added drying processes where high-availability and reliability of the dryer are required, further research to integrate thermal energy storage and to hybridize solar thermal with other thermal energy sources in a cost effective manner is required.

The limitations of traditional drying can be overcome by selecting an efficient drying system. The requirement for high fuel or power to run the drying system has encouraged sunlight-based drying systems, particularly during reap and harvest seasons [13]. Solar energy for crop drying is harmless to the ecosystem and viable in most emerging ...

Furthermore, hybrid systems based on solar energy for drying purpose are reflected here with details, and their findings are provided which would be useful for the scholars and scientists working on the reliability and performance enhancement of dryers. ... Solar dryer with thermal energy storage systems for drying agricultural food products: a ...

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The assistance of solar drying systems with a water storage system and water-air heat exchanger can make the dryer more efficient for a wide range of applications in the area of solar drying Fig. 5 shows a generalized technic for thermal energy conservation that can be implemented for various drying applications. Solar collectors are used to ...

Jain D, Tiwari P (2015) Performance of indirect through pass natural convective solar crop dryer with phase change thermal energy storage. Renew Energy 80:244-250. Article Google Scholar Kant K, Shukla A, Sharma A, Kumar A, Jain A (2016) Thermal energy storage based solar drying systems: a review.

The thermal energy storage unit employed in solar dryer consists of either sensible, latent heat storage systems or the combination of these two. The article provides an extensive review on the various sensible and latent storage units and materials used in different solar dryers viz., direct type, indirect and mixed-mode type dryers operated ...

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