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Experimental study and simulation of Hybrid-Active solar thermal cylindrical chamber for Citrus Hystrix leaves drying

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Abstract

This article presents a study of a modular hybrid active solar drying system (MHASD) with parallel collector configuration for the dehydration process of the Citrus Hystrix plant in a cylindrical drying chamber. The system utilized a novel cylindrical drying chamber for solar and low temperature drying integrated into the MHASD system. The experiments were conducted outdoors and exposed to the external environment. The dryer performance was studied by measuring the heat recovered in the drying chamber, the moisture removal capacity, and the efficiency of the MHASD system based on the drying load of Citrus Hystrix sheets. The effectiveness of air flow and temperature distribution in the cylindrical drying chamber was investigated using the computational fluid

dynamics (CFD) method. The air temperature in the drying chamber with the hybrid system reached 45 °C to 60 °C on a day with clear skies and variable weather. The drying time of the leaves was 6.5 h when collectors were used, while with the hybrid system it took 4 h to reach the final mass of 16 g. In intermittent weather conditions, the highest drying efficiency of 35.24 % was observed with the hybrid system, while drying with collectors was 17.26 %. © 2024 International Solar Energy Society

Author keywords

Citrus Hystrix leaves; Hybrid dryer; Solar collector; Solar dryer; Solar thermal

Indexed keywords

Engineering controlled terms

Air; Collector efficiency; Computational fluid dynamics; Dehydration; Drying; Passive solar; Plants (botany); Solar dryers; Solar heating; Temperature

Engineering uncontrolled terms

Active solar; Air temperature; Citrus hystrix leaf; Cylindrical chambers; Dehydration process; Drying chambers; Hybrid dryers; Modulars; Solar drying systems; Solar thermal

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air temperature; airflow; computational fluid dynamics; dehydration; low temperature; simulation

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Abstract

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