

Vegetables and Fruits Solar Tunnel Dryer for Small-Scale Farmers in Kassala

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Abstract : The current study focuses on the design and construction of a solar tunnel dryer intended for small-scale farmers in Kassala, Sudan. To determine the appropriate dimensions of the dryer, the heat and mass balance equations are used, taking into account factors such as the target agricultural product, climate conditions, solar irradiance, and desired drying time. In Kassala, a dryer with a width of 88 cm, length of 600 cm, and height of 25 cm has been built, capable of drying up to 40 kg of vegetables or fruits. The dryer is divided into two chambers of different lengths. The air passing through is heated to the desired drying temperature in a separate heating chamber that is 200 cm long. From there, the heated air enters the drying chamber, which is 400 cm long. In this section, the agricultural product is placed on a slightly elevated net. The tunnel dryer was constructed using materials from the local market. The paper also examines the solar irradiance in Kassala, finding an average of 23.6 MJ/m²/day, with a maximum of 26.6 MJ/m²/day in April and a minimum of 20.2 MJ/m²/day in December. A DC fan powered by a 160Wp solar panel is utilized to circulate air within the tunnel. By connecting the fan and three 12V, 60W bulbs in series, four different speeds can be achieved using a speed controller. Temperature and relative humidity measurements were taken hourly over three days, from 10:00 a.m. to 3:00 p.m. The results demonstrate the promising technology and sizing techniques of solar tunnel dryers, which can significantly increase the temperature within the tunnel by more than 90%.

Keywords : tunnel dryer, solar drying, moisture content, fruits drying modeling, open sun drying

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