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Investigation of Solar Roof Collectors for Preheating of Air at Drying Facilities in Northern Thailand

FRANZ ROMAN¹, MARCUS NAGLE¹, HERMANN LEIS¹, SERM JANJAI², BUSARAKORN
MAHAYOTHEE³, METHINEE HAESUNGCHAROEN⁴, JOACHIM MUELLER¹

¹University of Hohenheim, Institute of Agricultural Engineering, Tropics and Subtropics Group, Germany

²Silpakorn University, Department of Physics, Solar Energy Research Laboratory, Thailand

³Silpakorn University, Department of Food Technology, Thailand

⁴Chiang Mai University, Department of Food Engineering, Thailand

Abstract

Longan (*Dimocarpus longan* Lour) is an important product in northern Thailand that is a supporting component of the local economy. A significant amount of the annual harvest is dried and commercially exported as a commodity. Conventional longan drying is done in convection dryers at a temperature of 80°C using petroleum fuels for heating the air. Lately, the increasing price of these fuels threatens the competitiveness of Thai longan in the international market. Nevertheless, with the ample solar radiation in Thailand, the roofs of the drying facilities could be adapted to serve as solar collectors to preheat the drying air and reduce the energy requirement from fossil fuels.

In this study, the availability of materials suitable to construct solar collectors, as well as their market prices and relevant optical properties were determined. Ten longan drying facilities were visited to study their general characteristics and configuration, as well as the orientation, surface area and slope of the roofs. Process parameters including actual drying temperature and airflow rate were documented. The simulation software for solar processes, TRNSYS, was used to predict the air temperature rise that can be achieved daily throughout the drying season. Parameters such as local climate, processing conditions and collector characteristics were considered for optimal collector design. For each facility, collector size, duct line requirements, useful heat, collector efficiency and fraction of total energy demand that can be met were determined. According to the price of fuel and its current consumption, the potential monetary savings by using the proposed solar collector were also calculated. Recommendations are given, including a detailed economic analysis to determine the optimum size of collector and materials to minimise costs during the lifetime of the facilities and installed collectors.

Keywords: Collector design, Dimocarpus, longan, renewable energy, simulation, TRNSYS