Fig1: CIFT solar hybrid fish dryer with electrical backup system

Biomass Gasifier

An Alternative Thermal Backup System For Solar Dryers

Solar drying system is an improved form of traditional open-airsun drying method in which a simple structure is used to harness the solar thermal energy and the natural flow of wind to obtain the desired drying conditions. This method of drying is cheap, renewable, easy to operate and affordable. However, during off-sunshine hours i.e. night, rainy and cloudy days, it is difficult to operate due to insufficient drying air temperature resulting in improper drying and poor quality dried products. In order to overcome these limitations,solar dryers with different thermal backup systems were developed by CIFTi.e.Electrical, & LPG (Figs. 1

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Fig 3: Biomass gasifier system with blower assembly

& 2). A performance evaluation study of hybrid solar dryer integrated with an electrical backup system was carried out by Murali et al. (2019) using mackerel. Similarly, performance of solar dryer coupled with LPG heat backup system was studied using shrimps by Murali et al. (2020). However, availability of electricity and LPG, and their cost were the major drawbacks with the existing thermal backup systems.

Biomass gasifier unit as a thermal backup system

Biomass gasifier (Fig.3) isan equipmentused to obtain

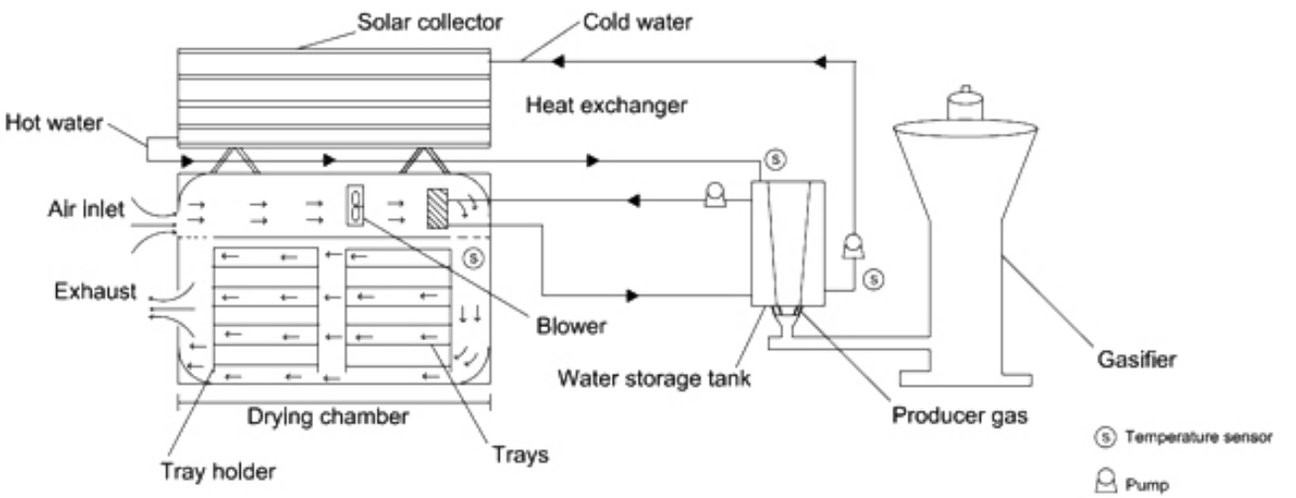

Fig 4: Schematic diagram of solar dryer integrated with biomass gasifier backup unit

producer gas through the gasification process. It is a thermochemical process that can convert any carbonaceous material into producer gas by burning the biomass under restricted air supply(Patra et al., 2016).The producer gas consists of carbon monoxide (CO - 18% to 22%), hydrogen (H2 - 8% to 12%), carbon dioxide (CO2 - 8% to 12%), methane (CH4 - 2% to 4%) and nitrogen (N2 - 45% to 50%). The calorific value of producer gas is about 1000 to 1200 kCal/Nm3. It can be considered as an alternative thermal backup system due to its thermal efficiency, cost effectiveness and being environmentally friendly. One of the most suitable raw materials for the operation of biomass gasifier is coconut shell, because it is readily available and it costs very less or negligible amount. The calorific value of coconut shell is about 17 MJ/kgweight. In addition, output of the gasifier unit, charcoal can be converted into activated charcoal and can be sold in the market to gain the additional benefit(Dhamodaran andBabu, 2011). The activated charcoal is widely used in the water treatment plants.

The producer gas obtained from the biomass gasifier unit can be fired directly and the resultant hot gas can be forced to the drying chamber(Jangsawang, 2017).

It has been reported that the temperature of hot flue gas upon burning of coconut shell is about 150-170°C. On the other side,hot flue gas can be used to heat water and store the energy in the form of sensible heat. The heat energy required can be drawn to the drying chamber from the stored sensible heat with the help of heat exchanger (Fig. 4).Further, biomass gasifier can be operated during unfavourable weather conditions (rainy and cloudy) and off-sunshine hours (during night), thus continuous drying is possible in the low-cost energy efficient gasifier based thermal backup system. The authors suggest that biomass gasifier can be effectively utilized as a thermal backup system for solar dryers in areas where abundant biomass is available at very low or negligible cost i.e. Andaman and Nicobar Islands, Kerala.

References

- Murali, S., Sathish Kumar, K., Alfiya, P. V., Delfiya, D. A., & Samuel, M. P. (2019). Drying Kinetics and Quality Characteristics of Indian Mackerel (Rastrelliger kanagurta) in Solar–Electrical Hybrid Dryer. Journal of Aquatic Food Product Technology, 28(5), 541-554.
- Murali, S., Amulya, P. R., Alfiya, P. V., Delfiya, D. A., & Samuel, M. P. (2020). Design and performance evaluation of solar-LPG hybrid dryer for drying of shrimps. Renewable Energy, 147, 2417-2428.
- Patra, T. K., Nimisha, K. R., &Sheth, P. N. (2016). A comprehensive dynamic model for downdraft gasifier using heat and mass transport coupled with reaction kinetics. Energy, 116, 1230-1242.
- Jangsawang, W. (2017). Utilization of biomass gasifier system for drying applications. Energy Procedia, 138, 1041-1047.
- Dhamodaran, T. K., &Babu, S. (2011). Potential of community level utilization of coconut shell and stem wood for charcoal and activated carbon in Kerala. Journal of the Indian Academy of Wood Science, 8(2), 89-96.