Chapter 15

Application dryers in fishery sector

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In India, Fish production has increased manifold since independence. About 16 million people are involved in the fishing industry in India. Fishermen in India catch fish as major aquatic products and are intended mainly for domestic consumption and sale in the local market. However, in the case of over catch, tremendous losses occur because the fishermen have neither access to markets in big cities nor to the international market due to poor product quality and the absence of good marketing and distribution system. As an alternative, fishermen can convert the catch into value-added products *viz.*, dried fishery products, smoked fish, etc, with enhanced shelf life and market value.

Traditional drying method and its drawbacks

Drying preserves fish from decay by removal of moisture from fish, thereby arresting the growth of bacteria, the action of enzymes, and chemical oxidation of the fat. Out of total catch, 30-40 % of fish is dried or processed for export and local consumption. Open-air sun drying is the traditional method employed in India to dry fish and fishery products, known for higher microbial load and lower product quality. It denotes exposure of the commodity to direct solar radiation and the convective power of the natural wind for the removal of moisture. But it often results in inferior quality of product due to its dependence on weather conditions and vulnerability to the attack of dust, rains, insects, pests, and microorganisms. Also, it requires a longer drying time.

Solar dryers for high-quality products

Solar drying is an alternative that offers numerous advantages over the traditional method, apart from being environmentally friendly and economically viable. In solar drying, a structure, often of very simple construction, is used to enhance the heating effect of solar radiation. Compared to sun drying, solar dryers can generate higher air temperatures and consequential lower relative humidity, which are conducive to improved drying rates and hence lower moisture content of the final products.

Major parts of Solar dryers and its advantages

The essential parts of the solar dryer (Fig. 1) include the solar collector, drying chamber, and airflow system (Inlet & Exhaust). The solar collector consists of a glass cover and an absorber plate. The drying chamber consists of trays stacked one above another at an equal distance in which the material to be dried is placed. The ambient air enters into the solar collector in which air gets heated up and moves to the drying chamber and flows across the trays. The heated air after removing moisture from the material moves out through the exhaust system. The advantages of solar drying are,

- Uniform and hygienic drying
- Eco-friendly / No GHG emissions
- Low cost
- Energy efficient
- Quality and food safety
- Reduced drying time

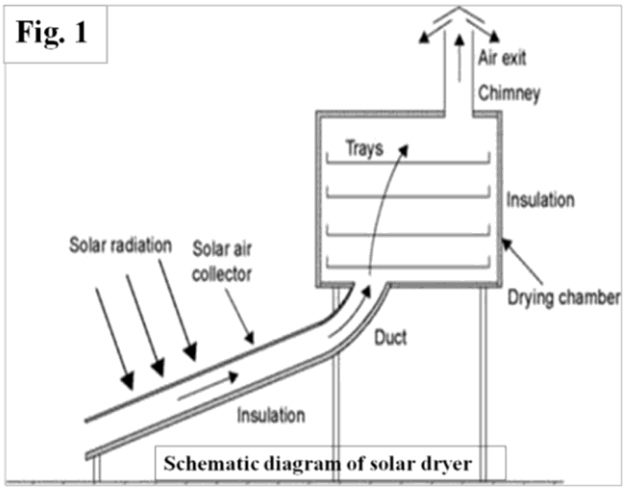

Fig 1. Schematic diagram of basic solar dryer

Different types of CIFT dryers

ICAR-Central Institute of Fisheries Technology (CIFT), Cochin, has been in the service of the nation since 1957 under the Indian Council of Agricultural Research (ICAR), New Delhi. CIFT

has developed low-cost, energy-efficient, and eco-friendly dryers like Solar tray dryer, Solar cabinet dryer, Solar tunnel dryer, etc based on solar energy for quality drying of fish. Apart from fish, this dryer is also suitable for drying other agricultural products like fruits, vegetables, spices, and condiments. All of these dryers are provided with alternative heating sources to continue the drying process during off sunshine hours especially during night time, cloudy and rainy days.

In the CIFT Solar dryers, the labor requirement is considerably reduced compared to open sun drying in beaches/coir mats because of the elimination of the cleaning process due to sand and dust contamination. The re-handling process like spreading, sorting, and storing because of non-drying or partial drying due to unfavorable weather conditions and spoilage due to rain is also not required. The drying time is reduced considerably with improved product quality. Improved shelf life and value addition of the product fetches higher income for the fisherfolk. The eco-friendly solar drying system reduces fuel consumption and can have a significant impact on energy conservation.

The design of solar dryers varies from simple direct dryers to more complex hybrid designs. Hybrid model solar dryers are having LPG, biogas, biomass, or electricity as alternate backup heating sources for continuous drying of fish even under unfavorable weather conditions. ICAR-CIFT has developed different models and capacities of solar dryers for the hygienic drying of fish. The capacity of these hybrid solar dryers varies from 6 to 110 m^2 of tray spreading area for drying various quantities of fish varying from 10 kg to 500 kg.

Solar dryer with LPG backup (50-60 kg)

ICAR-CIFT designed and developed a novel system for drying fish using solar energy supported by environment-friendly LPG backup (Fig. 2). In this dryer during sunny days fish will be dried using solar energy and when solar radiation is not sufficient during cloudy/ rainy days, LPG backup heating system will be automatically actuated to supplement the heat requirement. Water is heated with the help of solar vacuum tube collectors installed on the roof of the dryer and circulated through heat exchangers placed in the PUF insulated stainless steel drying chamber. Thus, continuous drying is possible in this system without spoilage of the highly perishable commodity to obtain a good quality dried product.

This dryer is ideal for drying fish, fruits, vegetables, spices, and agro products. It helps to dry the products faster than open drying in the sun, by keeping the physicochemical qualities like color, taste, and aroma of the dried food intact and with higher conservation of nutritional value. A programmable logical controller (PLC) system can be incorporated for automatic control of temperature, humidity, and drying time. Solar drying reduces fuel consumption and can have a significant impact on energy conservation (Murali et al. 2020; Murali et al. 2021).

Fig.2. ICAR-CIFT Solar-LPG hybrid dryer

Solar dryer with electrical backup (20 kg)

Effective solar drying can be achieved by harnessing solar energy by specially designed solar air heating panels and proper circulation of the hot air across the SS trays loaded with fish (Fig. 3). Food grade stainless steel is used for the fabrication of chamber and perforated trays which enable drying of fish hygienically. Since the drying chamber is closed, there is less chance of material spoilage by external factors. An alternate electrical backup heating system under controlled temperature conditions enables the drying to continue even under unfavorable weather conditions like rain, cloud, non-sunny days, and in night hours so that the bacterial spoilage due to partial drying will not occur. Improved shelf life and value addition of the product fetches higher income for the fisherfolk. The eco-friendly solar drying system reduces fuel consumption and can have a significant impact on energy conservation.

Fig. 3. ICAR-CIFT Solar-electrical hybrid dryer

Solar dryer with electrical backup (40 kg)

The dryer consists of four drying chambers with nine trays in each chamber (Fig. 4). The trays made of food-grade stainless steel are stacked one over the other with a spacing of 10 cm. The perforated trays accomplish a through-flow drying pattern within the dryer which enhances drying rates. Solar flat plate collectors with an area of 7 m^2 transmit solar energy to the air flowing through the collector which is then directed to the drying chamber. The capacity of the dryer is 40 kg. Electrical backup comes into a role once the desired temperature is not attained for the drying process, particularly during rainy or cloudy days.

Fig. 4. ICAR-CIFT Solar- electrical hybrid dryer

Solar tunnel dryer

ICAR-CIFT developed a low-cost, energy-efficient solar tunnel dryer for bulk drying of fish and fishery products. This dryer can be used by fishermen or small-scale fish processing units for

bulk drying during seasonal higher catch/excess landing of fish. The capacity of the solar tunnel dryer is 50 kg with a floor area of 12 m^2 (Fig. 5). The materials of construction are UV stabilized transparent polythene sheet for roof cover, black absorber sheet for the floor, supporting frames of CPVC, and GI rod. Three ventilator fans of 0.5 hp were provided for air inlet and moisture removal. The trays with tray holders were placed inside the dryer for spreading and hooking the fish for drying. This tent dryer was designed as a stand-alone system as it does not require any external power source/electricity. The fans were operated through a solar PV panel fitted on the rooftop of the dryer and associated battery setup. It is also affordable and suitable for Indian fisherfolks.

Fig. 5. ICAR-CIFT Solar-tunnel dryer

References

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