
EQUIPMENT AND INSTRUMENTS FOR SMALL-SCALE FISH PROCESSING INDUSTRIES

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Post-harvesting processing of fish is important to reduce wastage, increase shelf-life, add more value to the products and ensure higher returns. The major engineering interventions in post-harvest operations are the design and development of fish processing equipment and machinery, the design of indigenous electronic gadgets/instruments, and energy and water optimization techniques for fish processing industries. The equipment used for different unit operations in post-harvest handling of fish and fishery products can be broadly classified into the following areas.

- Preprocessing operations– Cleaning, sorting, skinning, scaling, gutting, beheading, cutting, and filleting operations
- Processing operations – Drying, steaming, baking, blanching, frying, retorting
- Preservation – Chilling, freezing, ice manufacturing
- Packaging – Band sealer, hand sealer etc.

1. Equipment and machinery for preprocessing operations

1.1. *Size grader and washer*

The preprocessing operation of fish starts from cleaning followed by grading of fish by species and/or size. Sorting by species or based on freshness and physical damage are still manual processes, but grading of fish by size is easily done with equipment. Mechanical graders yield better sorting precision for fish and fish products. In the size graders, two smooth rotating rollers are installed above the surface of the conveyor belt and the distance between the rollers and belt can be adjusted according to the maximum thickness of the fish to be sorted. Thinner fishes fall off the belt while the thick ones are retained on it until the end of the line. The device serves a dual purpose simultaneously by being a grading machine and a conveyor system.



Fish washing machine



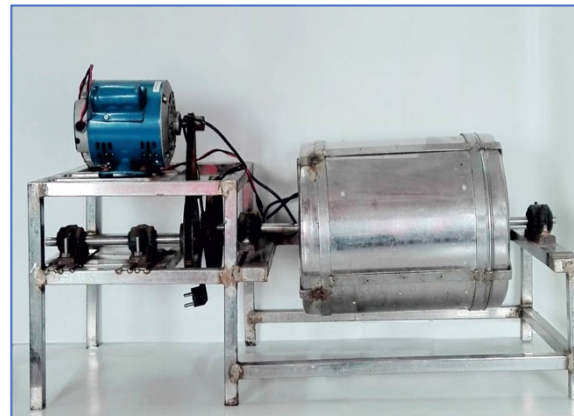
Fish size grader

1.2. Fish descaling machine

The fish descaling machine is designed and fabricated to remove the scales of fish easily. This equipment can remove scales from almost all types/sizes/ species of fishes ranging from marine to freshwater species like Sardines, Tilapia to Rohu. The machines are made of SS 304 and have a 5-10 kg capacity. It comes in two variants. In the hand-operated machine, a pedal is fitted on the side to rotate the drum manually and the same machine is motorized with a 0.5 hp motor with fixed rotation of the drum.



Hand operated machine



Motorized machine

2. Equipment and machinery for processing operations

2.1. Fish meat bone separator

A Fish Meat Bone Separator with variable frequency drive (VFD) to separate pin bones from freshwater fishes was designed and developed. This can be used at a range of 5-100 rpm. With a unique belt tighten system developed; the new machine can be easily adapted to any species and need not be customized for specimens during the design stage. In existing imported models, only two speeds are possible which restricts the yield efficiency in a single-span operation and also limits easy switching of the system for utilizing specimens other than for which the yield has been originally customized.



Fish meat bone separator

2.2. Solar hybrid dryers

ICAR-Central Institute of Fisheries Technology (CIFT), Cochin, has already developed low-cost, energy-efficient, and eco-friendly dryers like Solar cabinet dryers, Solar tunnel dryers, Infrared dryers, etc. for uniform and hygienic drying of fish. These dryers are also suitable for drying agricultural products like fruits, vegetables, spices, and condiments. The design of solar dryers varies from simple direct dryers to more complex hybrid designs. Hybrid model solar dryers have LPG, biogas, biomass, or electricity as alternate backup heating sources for the continuous drying of fish even under unfavourable 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 m² of tray spreading area for drying various quantities of fish varying from 10 kg to 500 kg.



Solar-LPG hybrid dryer



Solar-electrical hybrid dryer

2.3. *Battering and breading machine*

The basic purpose of a coating machine is to achieve a uniform coating. Also, it is necessary to make all the operations in a uniform style till the product is packed. Battering and Breading Machine is a conventional machine where the two applications viz. battering and breading can be carried out continuously. This equipment is a combination of one battering unit and a breading unit coupled together so that after the application of the batter, the fish portions are transferred to the breading unit by the conveyor system.



Battering and breading machine with integrated forming unit

2.4. *Fryers*

Frying is one of the fastest heat transfer methods available for cooking. It is a simple and commonly used technique for developing flavour, colour and unique product characteristics that cannot be duplicated by any other methods. Frying can be accomplished in a batch or continuous system. A batch system is recommended for small-scale production and a

continuous system for large-scale commercial production. The type of product and its sensory qualities and physical dimensions all have to be considered while selecting a frying system.



Fryer

2.5. Retorts

All canned fish products are sterilized at temperatures above 100 °C. Thermal process sterilization takes place in retorts, with or without water. Overpressure is between 2-3 kg/cm². The simplest and most common retorts today are horizontal, or vertical, batch retorts. The most frequently used style of retort found in commercial fish canneries today is the static batch system for processing cans in saturated steam. The most significant difference between static retorts and continuous systems is that the latter must have container transfer mechanisms to regulate the movement of cans at a predetermined rate through the heating and cooling sections. Batch retorts heated with water under pressure are vertical or horizontal and are most frequently used for sterilization of products packed in aluminium cans with score-line easy open ends.



Steam retort and water immersion retort



Horizontal retort

3. Equipment and machinery for fish preservation

3.1. Plate freezers

In a contact freezer or plate freezer the fish is frozen by direct contact with a refrigerated surface, typically between two hollow metal plates cooled by a refrigerant, such that the distance between the plates can be varied up to 100 mm or more. Horizontal and Vertical types of plate freezers are available. Horizontal freezers are generally used in processing plants in which fish, especially in flat packs such as laminated blocks, is frozen between two or more hollow, horizontal, parallel plates through which refrigerant passes. In a vertical plate freezer, the refrigerated, parallel plates are vertical and it is used mainly at sea or onshore for freezing large 25 or 50-kg blocks of whole, gutted, or headed gutted fish.



Horizontal plate freezers



Vertical plate freezer

3.2. Air blast and tunnel freezer

In an air blast freezer, fish is frozen in a stream of high-velocity cold air either in a batch or continuously, typically in a duct or tunnel in which a stream of cold air is guided over the product on shelves (batch) or a conveyor (continuous air blast freezer); also called blast

freezer, freezing tunnel, tunnel freezer. The advantage of the blast freezer is its versatility. It can cope with a variety of irregularly shaped products and whenever there is a wide range of shapes and sizes can be frozen. Continuous air blast freezers and batch air blast freezers are used. The equipment has a food-grade conveyor belt passing through an insulated chamber. It has an air-cooling system and an air blower to blow the air through the tunnel. Cold air is blown to the tunnel counter to the movement of the belt. The product to be frozen is passed through the belt. Circulating cold air at high speed enables the product to be frozen at a moderately rapid rate. Usually, the air temperature is between 18 and -34°C or lower. The moving of the product counter current to the cold air at a speed of 1 to 20 meters/second enables freezing to take place at a rapid rate. It is the popular method to prepare frozen fish products as IQF (Individually Quick Frozen).



Air blast freezer



Tunnel freezer

4. Machinery for packaging of fish and fishery products

4.1. Sealers

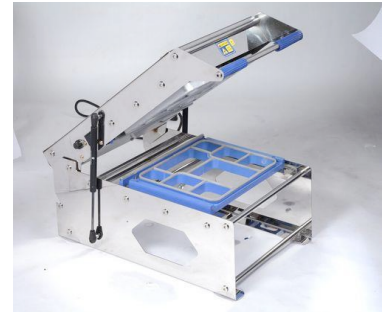
Sealers are used in multiple forms of flexible packaging applications. A heat sealer uses heat to melt plastic or adhesive together to seal off a package. Heat sealers are used for many different products to help protect from product tampering and contamination. They can be used in small operations and fully automatic operations. Heat sealing systems use a combination of heat, time and pressure to create a seal with a set of crimp seal heating bars. When the jaws come together, this melts a layer of plastic and bonds the two layers of film together. There are different types of sealers such as band sealers, hand sealers, blister sealers tray sealers, vacuum sealers and vertical form fill sealing machines.



Hand sealer



Band sealer



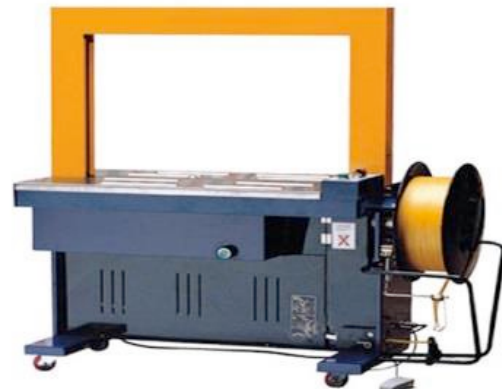
Tray sealer

4.2. Labelling, coding and bundling machines

Labelling and coding machines are used for industrial and retail packaging applications. Most packaged products use some form of labelling or coding. Labelling machines are used for applying branded labels for advertising and/or bar codes for inventory and batch management. The most popular use for strapping machines is a reinforcement of heavy boxes during shipping and retail sales. Polypropylene strapping is commonly used. Strapping machines use heat to mend ends together for durable reinforcement. Another use for a strapping machine is bundling applications. Strapping can help unitize multiple products together and secure products for transport.



Labelling and coding machine



Strapping and bundling machine

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