EXPERIMENT 2 FAMILIARIZATION WITH FISH MEAL MANUFACTURING EQUIPMENTS

Structure

2.1 INTRODUCTION

Commercially, fish meal is manufactured on a large scale, usually by the continuous wet rendering process. Therefore, the equipments used are sophisticated and of high capacity. Although similar in working principle, the design and construction of these equipments are very different from those used on a small scale. We shall discuss some of them that are commonly used.

Objective

After performing this experiment, you will be able to:

- understand the working principle and construction of important equipments used for fish meal manufacture.

2.2 EXPERIMENT

2.2.1 Principle

There are several equipments required for a fish meal plant. For a smooth and continuous operation, these are to be installed in the plant at the appropriate locations, generally according to the steps for manufacturing fish meal. Thus, at one end the raw material is received, which goes through different equipments and ultimately the product is obtained at the other end of the plant. For the smooth functioning of the system, the equipments are connected by conveyors. There must also be facilities for collection/utilization of waste material, pollution control, etc.

2.2.2 Requirements

- Diagrams/ photographs/ models of various equipments
- Visit to a fish meal plant

2.2.3 Procedure

The equipments shall be dealt with separately. Both photographs of actual equipments and diagrams to show their internal parts and working principle are given.

a) Cooker

For large scale continuous operation, an indirect steam cooker (Fig.2.1) is used.

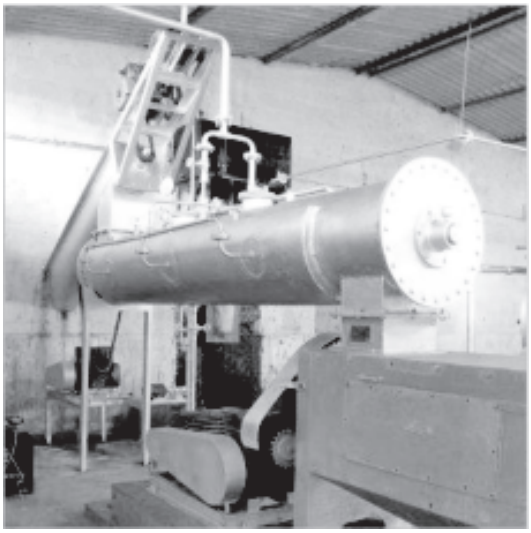

Fig.2.1:Steam cooker

This consists of a two-walled cylindrical body that is horizontally mounted. A screw is fitted inside the inner chamber. Steam produced in a boiler is passed through the (annular) space between the two walls of the equipment. Fish is ground or cut up into small pieces and put into the inner chamber through a hopper situated at one end of the chamber. As the screw is rotated at a low rpm, the material gets mixed and moves forward. In the meantime, heat from the steam cooks the material. However, steam is not allowed to come into direct contact with the ground fish because of the inner wall that separates the two. This is to prevent any condensed steam (water) mixing up with the fish and hence the equipment is called an indirect cooker. In some, the screw is made hollow and steam is passed through this space in addition to the outer space. This will greatly improve the heating efficiency of the cooker. The material would be sufficiently cooked by the time it reaches the other end (outlet) of the cooker. You may note in the photograph that the outlet of the cooker is directly connected to the inlet of the next equipment, i.e. the screw press.

b) Press

The twin screw press (Fig.2.2) is the most widely used press for a continuous operation. Once the material is cooked, much of the oil and water must be removed by mechanical pressing. The equipment consists of a sturdy perforated body. Inside two screws are fitted with their axes parallel and they can rotate in the opposite directions. The cooked material is transferred to the hopper of the press at one end. As the screws rotates, the material moves forward. The design of the screw is such that the space between the body and the screws progressively reduces from the hopper end to the outlet. This together with the combined action of the

screws effectively squeezes out the liquid fraction from the cooked material. The liquid (press liquor) comes out through the perforators and may be collected. At the other end of the screws, the solid material comes out as pressed cake.

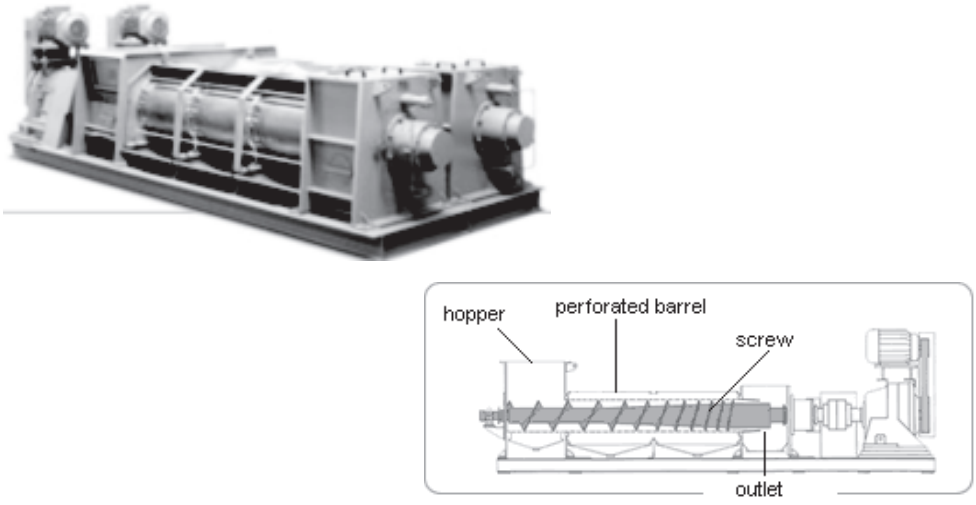

Fig.2.2: Twin screw press

The cake may still contain about 50% moisture. It must be beaten to small particles using a disintegrator before the next step of drying. This is for efficient drying of the material.

c) Drier

Various types of driers are used for fish meal production; the direct heating rotary drier (also called flame drier) is one (Fig.2.3). The function of the drier is to reduce the moisture content sufficiently in order to make the product stable at room temperature. This drier consists of a long, cylindrical drum supported on rollers. It can be rotated by a motor and reduction gear system at a low rpm.

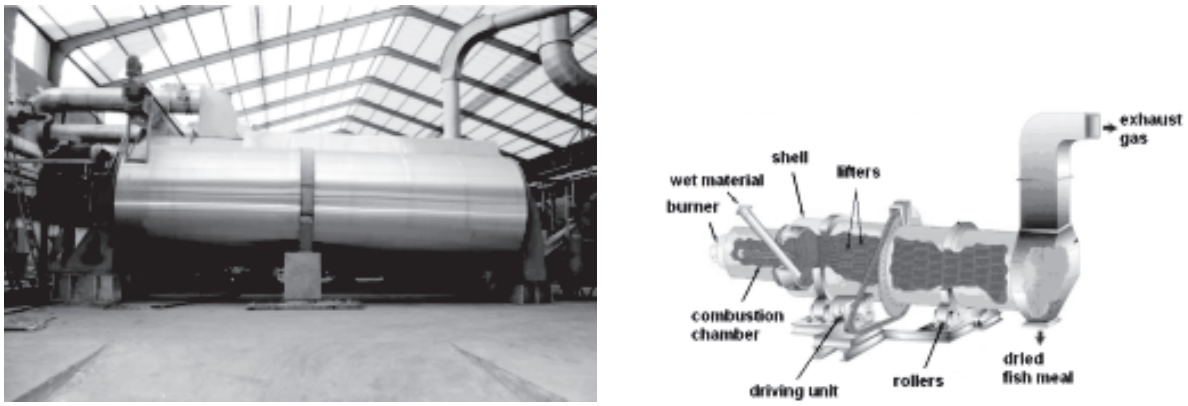

Fig.2.3: Flame drier

The material to be dried (beaten cake) is fed in at the beginning of the drum. The equipment also has provisions for sending in oil and air. These are mixed and blown as a fine spray and fired. The flame is continuously blown into the tunnel that heats up the air inside to a temperature of 400-500°C at the beginning of the tunnel. The temperature reduces to 70- 80°C at the exit. The high temperature causes quick evaporation of moisture from the material. However, the temperature

of the material never exceeds 100°C as the latent heat of the vaporization of water is continuously absorbed from the hot air. Thus, overheating of the product is prevented. The inner surface of the tunnel is fitted with either a helical band or strips of metal called lifters. As the tunnel rotates, the band or lifters lift up the material. Once near the top, the material is dropped down. This tumbling action increases the efficiency of drying further. In addition, because of the helical shape, the fish meal is also given a forward push by the band. The drum may be fitted slightly inclined to facilitate movement of the material forward. Finally, the material reaches the outlet and by this time it is properly dried to a moisture content of less than 10%.

d) Grinder

The equipment generally used is called a hammer mill (Fig.2.4) that is mounted just below the outlet of the drier. The equipment is used to reduce the particle size of fish meal. A shaft with heavy iron pieces (hammers) attached is fitted inside a cylindrical body. The dried material is fed in through the inlet at the top. As the shaft is rotated at a high rpm, the material is subjected to hammering action that reduces its particle size. A screen of required mesh size (e.g. 2.8mm) is provided at the bottom of the body of the equipment. The pulverized particles come out through the screen.

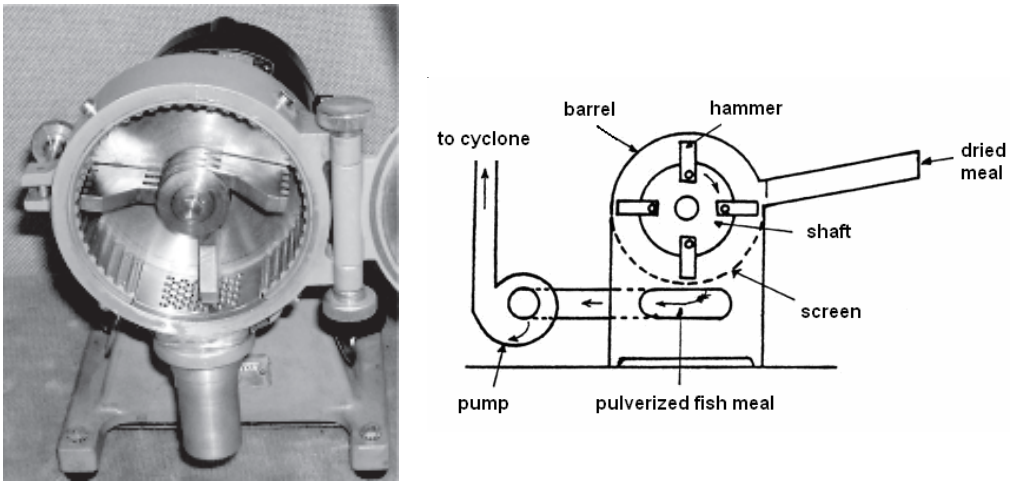

Fig.2.4: Hammer mill

e) Packing

After pulverization, fish meal must be cooled, weighed and packed in sacks. However, handling large quantities of the product in dry powder form requires special equipments. A cyclone with pneumatic conveyor system (Fig.2.5) can be used for this purpose. Fish meal from the mill is mixed with air which acts as a carrier gas. This suspension is pumped through a duct that is the pneumatic conveyor (Fig.2.5). The conveyor opens up into a cyclone. This is a large, tall cylindrical chamber with a conical shaped bottom. The fish meal-air mixture is blown in through the side of the cyclone tangentially near its top. This creates a circular motion that develops centrifugal force (see diagram of Fig.2.5). The fish meal particles are subjected to greater force because of their greater density and are thrown against the wall of the cyclone. From here, the particles slide down to the conical bottom where the material is stored temporarily. Air will get collected at the centre and is sent out through a duct.

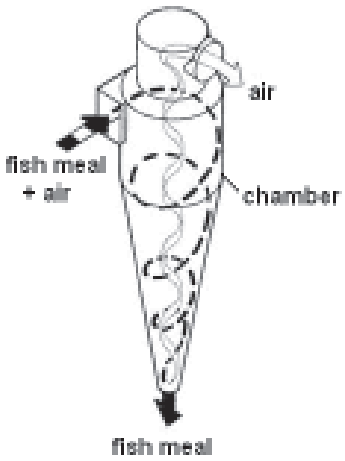

Fig.2.5: Cyclone

Below the bottom of the cyclone, sacks can be placed on a balance. By opening a valve provided at the bottom of the cyclone, the required amount of fish meal can be filled into each sack. A sealer is also provided by the side of the balance in order to close the mouth of the sack after filling.

f) Centrifuge

This equipment is used for the separation of various immiscible components of the press liquor, namely, oil, aqueous fraction and solids. The bowl-type centrifuge is continuous-type equipment (Fig.2.6.)

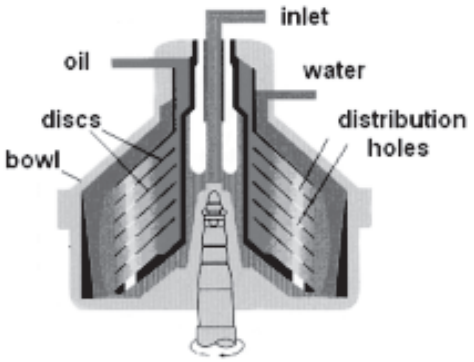

Fig.2.6: Bowl-type centrifuge

It consists of a rotating bowl inside which is fitted with a stack of conical shaped discs, each provided with holes. The press liquor is pumped into the bowl from the top along its axis of rotation at a particular rate. As it flows up through the bowl the different components are subjected to different centrifugal forces. The solids which are the densest are thrown to the wall of the bowl. Oil which is the lightest will be collected near the axis of rotation. The aqueous fraction (stickwater) gets collected in between. The stack of discs reduces the distance to be traveled by the components in the mixture for separation, thereby quickening the separation process. The fractions separated can be collected through separate outlets provided as shown in the diagram.

g) Evaporator

Evaporator is used for concentrating stickwater (aqueous fraction) to the product, fish solubles. Various types of evaporators are in use; one is the rising film evaporator (Fig.2.7).

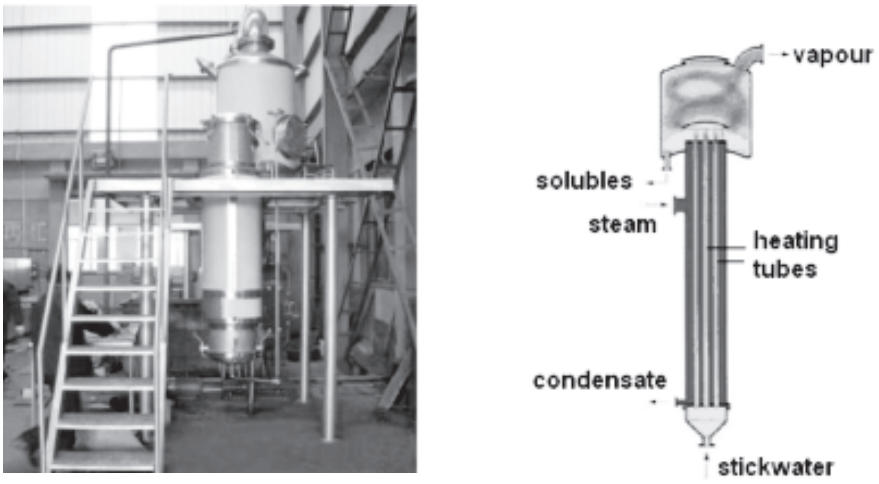

Fig.2.7: Rising film evaporator

The stickwater is fed into the evaporator from the bottom and allowed to move up through a number of tubes that are surrounded by steam. The water in the material evaporates and escapes out as vapour/ steam. The ascending force of the vapour produced causes liquid and vapours to flow upwards. The pressure exerted by the vapours forces the liquid to form a thin film on the walls of the tubes. The purpose of providing several pipes is to increase the surface area for heat exchange. This together with the low thickness of the film quickens the evaporation process. The liquid gets concentrated to about 50% solids by the time it reaches the top of the equipment. The product can be collected from here. The vapour is let out separately.

2.2.4 Observations

After observing each equipment/ its model/ appearance, record the important parts and mention the function of each part. Show your observations in a tabular form.

Equipment Name	Name of Part	Function

2.2.5 Results

The equipments familiarized with are: .....

2.3 PRECAUTIONS

- For proper understanding of the equipments a visit to a fish meal plant must be undertaken.