

Special Methods of Processing

In previous sections we have described the most common processing methods used in large and medium sized factories. For smaller factories and under special circumstances, simplified or entirely different installations may prove economical. In the following we shall give a few examples of different approaches, some of which aim at products with special properties.

1 Centrifugal methods

In these systems, the separation of the coagulated fish pulp is based on centrifugation instead of pressing. In one of these systems (Centrifish, DeLaval pat, Sweden), the fish is cooked in an indirect apparatus heated by flue gases, and the coagulated material separated into an oil-stickwater phase, containing some suspended sludge, and a solid phase in a decanter centrifuge. The liquid phase from the decanter is separated into oil, stickwater and sludge by means of self-cleaning centrifuges. The solids are dehydrated in an indirect tube dryer heated by flue gases.

The compact arrangement, which does not require a steam boiler, has made this system attractive for installation on board the ship. Without evaporation, however, about 20% to 30% of the solids is lost with the stickwater.

2 Packaged fishmeal plants

Packaged fishmeal plants of the traditional "press" type have also been developed for shipboard use. The processing capacities of compact plants range from 5 t to about 60 t of raw material per 24 h. Often the equipment is built in units to suit the requirements of the user and to facilitate installation. Such units may be cooker, press and dryer unit, separator and oil unit, evaporator unit, etc. Figure 20 illustrates a cooker, press and dryer unit, with the cooker at the top, the press below it and the dryer at the bottom. This unit has a processing capacity of 60 t of raw fish per 24 h.

Because of the relatively low installation costs and minimum operation attendance, packaged fishmeal plants are also of interest for stationary operation.

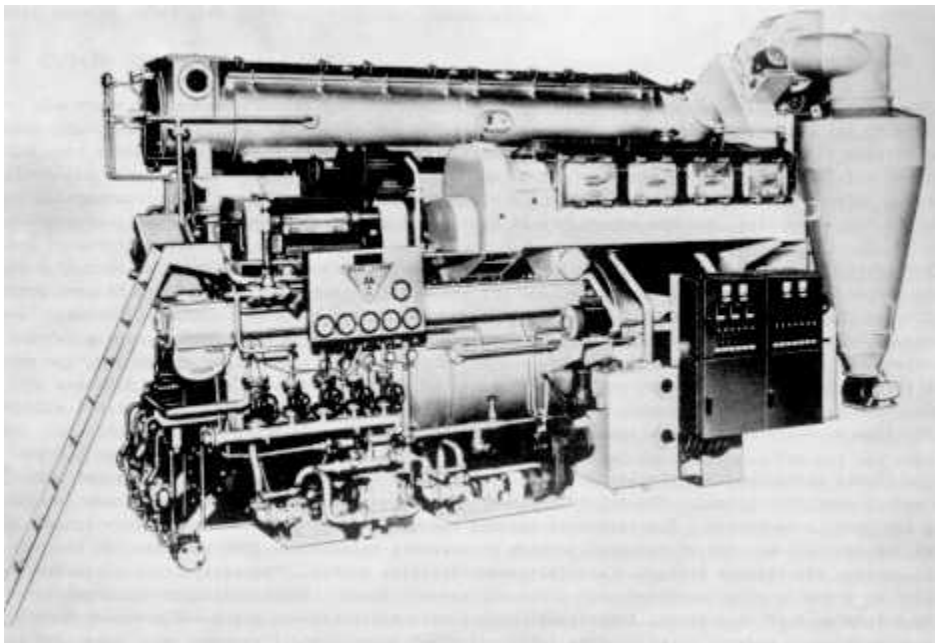


Figure 20 Packaged-fishmeal plant

3 Meal production without cooking

A number of methods have been devised where the raw materials are dried without preliminary cooking. These are particularly suitable for lean fish (less than 3% fat) and offal, but may, in some circumstances, also be adapted to treat fatty fish species.

By the Schlotterhose method, lean fish is dried in two stages, using indirect steam dryers. In stage 1, the moisture is generally reduced to about 55% under reduced pressure. The low pressure eases the removal of vaporized water and the relatively low temperature prevents meal from sticking and reduces lump formation. In stage 2, when sticking is less of a problem, drying is completed at atmospheric pressure.

Other methods (for example, Vega) employ two direct rotary dryers operated in series at atmospheric pressure. The feed to the first dryer may consist of a mixture of wet, raw, lean fish and semi-dried material. Due to decreased moisture content through mixing, this compounded feed is less prone to sticking than the wet raw material alone. The semi-dried material is dehydrated to the desirable moisture content in the second rotary dryer.

Dry rendering methods are applicable to some oily raw materials, mainly fish offal. If, however, the raw material contains highly reactive oils, for example from pilchard, there is a risk of inefficient oil removal during pressing.

In one such method (Hartman) the raw material is dehydrated batchwise in a single stage steam dryer to the desired moisture content, whereupon the dried material is treated in a hydraulic press. In order to achieve good pressing, the drying must be properly controlled. If the dried material contains less than 8% of water, there is a risk of inefficient oil removal. There is also a risk of oil darkening by direct contact between oil and meal during the drying process. Such degradation could limit the use of oil or require extra oil refinement and thus decrease profitability.

4 Simplified wet processing

A simplified version of the traditional wet processing method has been developed in recent years. It is applicable only to lean fish, where equipment for oil recovery serves no purpose. Furthermore, it is appropriate only for plants with low rates of throughput, where capital costs have to be reduced to the lowest possible level.

The process starts with cooking the raw material in a conventional indirect steam cooker. The cooked material is then dried to whole meal in a dryer with rotating heating surfaces. Finally, the meal is milled to the desired particle size, and bagged.

Since the evaporation of all the water removed is carried out in one stage, the heat economy is, of course, much inferior to that of the conventional method based on multiple stage evaporation of the stickwater. This drawback, however, should be more than compensated for by reduced investments in equipment.

5 Solvent extraction

For certain special purposes, fish meal from oily fish may not be used because of extremely low tolerance to fat of marine origin. In such cases, the fat content of the meal can be further reduced or practically eliminated by extraction with solvents. This treatment introduces an extra cost that has proved difficult to retrieve from the actual markets, represented particularly by the pig-feeding industry. Solvent extraction for the production of an odourless fish meal for human consumption has so far had little success, but new approaches in this field are still being tried.

Dry extraction of meal is carried out in reaction vessels where meal and heated solvent (for example, ethanol, isopropanol or a hydrocarbon) are given sufficient time for adequate oil

extraction. Reduction of the oil content from 10% to 1% in menhaden, pilchard or anchovy meal would require about 4 litres of hexane per kilogramme of meal. More thorough extraction is achieved by successive re-extractions, up to five times or more, or by counter current extraction. After extraction, the meal is put through a process of solvent removal, which may be effected by steam stripping followed by hot air ventilation in a dehydrator. The permissible amount of residual solvent in the meal differs with the type of solvent used, the limits for chlorinated hydrocarbons being very low.

The liquid withdrawn from the extractor is fractionated to separate the fish oil, expel the water and recover the solvent. The oil is frequently dark and polymerized and not suitable for refining for human consumption. The recovered solvent requires additional treatment before it may be re-used for extraction. One of the best methods of removing undesirable fishy odours from the solvent is to pass the vapours through a special grade of active carbon. The active carbon can be regenerated by steaming when saturated with these unpleasant odours. Relatively high temperature boiling solvents, such as ethanol, isopropanol and certain hydrocarbons, are usually employed to obtain more thorough extraction of phospholipids and other odorous and flavorful substances, and on grounds of safety.

Wet extraction is the term given to the process of extracting oil and water from the wet raw material (fresh fish or presscake). From a technical standpoint, ethylene tetrachloride, which forms an azeotrope with water at 87.7°C, is suitable. At this temperature, water boils off together with the solvent, while the oil is simultaneously removed by extraction. As the tolerance for chlorinated solvents generally is very low, adequate removal of these solvents requires extra processing, details of which depend upon the ultimate use of the product.

Because of these objections to chlorinated solvents, alcohols like ethanol and isopropanol present more acceptable alternatives, particularly where products for human consumption are concerned.

6 Enzymatic treatment

Several methods have been developed for producing FPC or dried powder for animal feed by proteolysis of fresh whole fish. These methods are suitable for use on board the trawlers. In one method the fresh fish are pasteurized and put into a reaction vessel with papain (or other enzymes) at 55°C for about 1.5 h. The solubilized material is filtered and the cake dried and microground into a greyish product, which has a slight smell. The filtrate is treated in a separator and the oil withdrawn, while the aqueous phase (about 70%) is dehydrated in a spray dryer. The product is light yellow and has a faint smell.