



4. POLLUTION ABATEMENT

4.1 Pollution from Emission of Malodours 4.2 Pollution from Liquid Effluents

Legislation on pollution requires the abatement of malodours and of liquid effluent from the fish factories.

4.1 Pollution from Emission of Malodours

Pollution by malodours from fishmeal factories is not considered hazardous to health, but is disagreeable, and measures to diminish or eliminate inconveniences are required in most cases, specially if a factory is placed near denser population centres.

The human nose is very sensitive to bad smells and the smell impression is reduced to only half if the concentration of odorous components in a gas is reduced to 10%; in other words, a 99.9% reduction in concentration reduces the smell impression to only one eighth. A substance like trimethylamine may be detected at concentrations of down to 0.0002 ppm, which is the so-called threshold value. It is therefore imperative that the procedures for the abatement of malodours are very effective.

The odour from fresh fish of human consumption quality is generally acceptable, but during storage bacteriological and enzymatic decay result in the formation of highly obnoxious substances, such as trimethylamine, ethylmercaptan and even of poisonous ones such as hydrosulphide, which have to be removed from the exhausts from the factory by special techniques. It is therefore important that the fish raw material is as fresh as possible before entering the process, preferably by preservation by means of ice and, in this connection, it should be remembered that the velocity of decay roughly doubles for each $4\frac{1}{2}^{\circ}\text{C}$ increase in temperature.

During processing, malodours may be formed, specially by oxidation and pyrolysis in direct fired dryers.

In considering deodorizing possibilities special attention should be given to the following factors:

- freshness of raw material as mentioned above;
- volumes and odour load of gases handled. Gases with high concentrations of odorous substances result from the cooking, pressing and drying operations and their volumes should be kept to a minimum in order to facilitate treatment, but also in order to increase their value for waste heat recovery. Gases with low concentrations of odorous substances (and those which contain less disagreeable ones), but with rather large volumes, may result from conveyors, milling, meal cooling and room ventilation;
- centralization of exhausts. It is very important to collect the gases with high loads of odour in as few exhaust points as possible, preferably only one or two, in order to facilitate treatment. Special attention should also be given to diffuse exhausts at ground level which, for instance, may occur during unloading of raw fish;
- method of drying. Effluent gases from direct rotary dryers can be difficult to handle because in some circumstances (poor fish, wet milling too finely, etc.) they are prone to form aerosols; and the vapours are emitted in larger amounts than from indirect dryers. In addition, if temperature is not carefully controlled, scorching of the fines of fish meal could occur, and this would greatly increase the problem of abating the odours;
- location of the fishmeal factory. Factories in remote areas may operate without deodorizing, while in some areas regulations may be strict. Clearly then, the solution in one area may not necessarily be the solution in another area;
- meteorological conditions. Prevailing wind directions in connection with the pattern of wind velocity is important when considering the possibilities of efficient dilution in the atmosphere of gases with low odour content by exhaust from chimneys of reasonable height. Winds of low velocity carrying odours into populated areas will almost certainly result in many complaints.

In industry, several methods are practised to minimize odours that would otherwise escape to areas around the factories; it is virtually impossible to abate odours present within the factories.

Scrubbing of effluent gases. In properly designed, water-film type scrubbing towers leads to a marked reduction in odour. As cooling condenses most of the water and other condensable vapours, it cuts down the gas volume by some 40% and eliminates the characteristic white vapour from the stack. The vapours are admitted at the bottom and the cooling water (fresh or sea water) at the top of the tower. In order to produce a large contact area between gas and cooling water, the tower is filled with packing material such as corrugated plates. Vapour emissions may also be reduced by means of indirect scrubbing towers, that is the gases are not brought in direct contact with the cold water. The main advantage of this method is the conservation of water, as it may be recooled and re-used. The vapours escaping from the scrubber may be burnt in the steam boiler, or the odiferous gases may be oxidized by chemical treatment with chlorine or other oxidizing reagents.

High temperature combustion. Heating the gases to $750\frac{1}{2}^{\circ}\text{C}$ for about one second effectively destroys the content of malodorous components. This observation is the basis of the most widely used method of deodorization today. All equipment from which heavily loaded gases may evolve, such as cookers, presses, dryers, tanks and centrifuges, are completely encapsulated and kept at a small under pressure by means of a ducting system, leading to a water scrubber followed by a fan, which in turn delivers the uncondensed gases to the boiler plant, where they are used for combustion in the furnace, the conditions in which comply fully with the above conditions. During starting and stopping of operations the supply of air to the boiler may be surplus to its requirements. The odorous gases will then need to be treated by some other method such as chemical inactivation.

Decades of operation of the system have proved that there is no additional risk of corrosion in boilers when using the washed gases as combustion air.

Deodorizing by combustion is of course specially applicable to plants operating with steam dryers. The system may also be applied to plants using direct fired dryers, but in these circumstances heat exchangers will normally need to be installed or, alternatively, the system may need to be converted to indirect hot air drying.

Surplus air with a low odour intensity such as from the milling and meal cooling plants, and which could not be fully used in the boiler, may in many cases after treatment in a scrubbing tower be satisfactorily dispersed by a chimney of sufficient height.

Chemical inactivation has found some application in the fishmeal industry. The effluent gases leaving the scrubbing towers are brought into contact with strong oxidizing agents such as chlorine releasing compounds or permanganate. These are applied in the gaseous or aqueous state. The use of chlorine gas is generally cheaper than other oxidizing agents.

In view of the corrosive nature of chlorine in aqueous media, the contacting equipment should be made of stainless steel or reinforced plastics. Moreover, a final scrubbing stage is required, after oxidation, to remove all traces of chlorine from the treated vapours. The escape of chlorine to the atmosphere would be a hazard to health and indeed to life.

An effective deodorizer scrubber for a vapour discharge of about 1 200 m³/min consists of four superimposed units, each having an internal cross-section of approximately 8.5 m², and having 144 corrugated sheets each (3 m long and 1 m wide). The sheets are placed vertically, with the corrugations horizontal (that is on their sides) and spaced about 1.25 cm apart. Water is sprayed downward on the sheets so that the water flows as a downward film and the vapours pass upward in countercurrent, and are chlorinated between the third and top stage of scrubbing. The total sea water consumption is about 4 500 litres/min. Electric power for pumping water and for air movement is of the order of 50 kW. The amount of chlorine used depends on factors such as the quality of the raw fish material and operating temperature.

In another chemical inactivation system the gases are washed with pH adjusted sodium hypochlorite solution in vertical wash towers of acid resisting fibreglass.

In all chemical deodorizing systems it is imperative that the pH and the proper concentration of active reagent are constantly controlled, possibly automatically, as the system may otherwise be utterly inefficient.

Catalytic combustion is also being attempted in the fishmeal industry. In the presence of platinum, alloys of platinum and metallic oxides, the malodorous components are decomposed at $350\frac{1}{2}^{\circ}\text{C}$ to $400\frac{1}{2}^{\circ}\text{C}$. The process may be carried out in two different ways:

- the active material adsorbs the odorous components at normal temperatures and is then heated at intervals to the point of combustion;
- the gases are continuously heated to the combustion temperature.

Catalytic combustion still needs to be justified by practical experience.

Adsorption by active carbon. This method may be used for treatment of gases with low odour intensity. The applicability of the technique will largely depend upon economic factors which are largely determined by the number of possible reactivations of the active carbon charge.

4.2 Pollution from Liquid Effluents

For environmental and economic reasons the organic effluent is kept to a minimum in properly managed factories. Unloading by pumping with addition of sea water and fluming will normally not be allowed inside harbours, for which reason dry unloading by elevators or pneumatic unloaders is preferred in such places. Polluted water, originating from cleaning fish holds, pound boards, etc., can be minimized by using high pressure spraying equipment and can be cleaned in strainers followed by grease separators. In cases where fresh water is used for cleaning, the effluent can be pumped to the blood water tank of the factory and thus enter into the normal production. This procedure could also, in many cases, be applied to blood water from the bottom of the fishing boats.

Pollution of fresh water from factory operations occurs from the centrifuges, pumps and specially from the cleaning of equipment. When high pressure spraying is used for the last mentioned purpose, the quantity will be rather small and it can therefore be collected and pumped to the blood water tank for further processing. This in fact means that the stickwater concentrator is the ultimate purifier for the fresh water effluent. Ample capacity, however, is normally at hand and the contaminating dry matter and oil, which would otherwise be a nuisance, are thereby recovered.

Sea water is used in large quantities in the condensers of the stickwater concentrators and in the deodorizers. Contamination in the effluent stems from volatile components in the raw fish, from dust particles from the dryers and meal equipment and from possible carry-over from the concentrators. It appears that minimizing of the pollution is directly connected with strict control of raw fish quality and with the efficiency of cyclone and concentrator operations. Even if the sea water effluent represents by far the largest part of the total liquid pollution, it usually causes no problem, as the polluting components are easily decomposed, as their concentration is normally low and as the receiver conditions in the sea are generally favourable. In cases of low depth and poor current flow authorities may demand that a pipeline should be laid out to a certain distance and/or depth.

Spent caustic solutions used for cleaning concentrator calandrias and cookers can be gradually discharged together with the seawater effluent or possibly treated in a municipal effluent plant.

Stickwater should, for economic and environmental reasons, never be discharged to the sea or to rivers. The contamination from a 500-124 h fishmeal plant that does not utilize stickwater may easily correspond to one million personal equivalents in sewage terms.

