Aquatic Animal Health Standards Commission
Report

October 2008

CHAPTER X.X.X.

~~GUIDELINES ON~~ HANDLING AND DISPOSAL OF CARCASSES AND WASTES OF AQUATIC ANIMALS

Article X.X.X.1.

Introduction

~~In the event of any aquatic animal dying due to disease or accidentally due to different causes during aquaculture operations, or in the wild,~~ The scope of this Chapter ~~these guidelines~~ is the handling and *disposal* of carcasses and wastes of *aquatic animals* in the course of routine aquaculture operations, as well as in exceptional situations such as mass killing and mass mortality (including in the wild).

In the event of *aquatic animal* mortalities of a significant nature in aquaculture or in the wild, the *Competent Authority* should be notified so that necessary steps can be taken to dispose of the dead *aquatic animals*, in order to minimise the risk for possible spread of disease.

~~The method for disposal should be based on judgments depending on the cause of mortality of aquatic animals (disease, intoxication, environmental changes, etc.) and the possible risk of introducing a listed disease if no precautionary steps are taken..~~ *Disposal* methods should take into consideration a range of factors, including the cause of mortality. It may be appropriate to carry out a risk assessment on the *disposal* options. Relevant environmental and waste management legislation should be adhered to.

~~Carcasses to be disposed of and the disposal process to be chosen should be under the supervision of the *Competent Authority*.~~ Storage, transport and *disposal* of *aquatic animal carcasses* should be carried out in adherence with all relevant local and national legislation. In the case of killing of animals for disease control purposes or unusually large mortalities of unknown origin, this may be require approval from, or supervision by, the *Competent Authority*.

The guidelines in this Annex are general in nature. The choice of one or more of the recommended methods should be in compliance with relevant local and national legislation. ~~*The guidelines should be applied in conjunction with procedures described for the killing of aquatic animals in Appendix XXXXX.*~~

Article X.X.X.2.

Definitions

For the purpose of these guidelines, the following definitions are relevant to the *disposal* of *aquatic animal carcasses* and their wastes:

- **Aquatic animal**. For the purposes of this chapter, '*aquatic animal*' refers to the following: *live fish* (including eggs and gametes), *molluscs, decapods* (lobsters, shrimps, crabs) from aquaculture or the wild. The definition does not cover water-living *amphibians*, *reptiles*, *birds* or *mammals*.

- **Aquatic animal carcass** means the entire body or parts body/trunk of an *aquatic animal* subsequent to killing or death.

- **Aquatic animal population** means a group of holding units with *aquatic animals* sharing a common defined origin.

- **Aquatic animals for slaughter/harvest/killing/culling** means *aquatic animals* that are destined to be transported or taken to *fish slaughtering premises* or other *processing plants* preparing products for human consumption or for disposal.

- **Aquatic animal offal/waste** means the whole or parts of an *aquatic animal* and *aquatic animal* products not approved for human consumption including sludge and sieve material collected during slaughtering.

- **Biogas production** means decomposition of infected material by micro-organisms in an anaerobic environment.

- **Container** means a transport appliance:

    - of a permanent type and sufficiently strong to enable repeated use;

    - specially constructed to facilitate *transportation of live aquatic animals* by one or several means of transport;

    - provided with fittings that make it easy to manipulate, particularly for trans-shipment from one kind of transport vehicle to another;

    - constructed in a water tight way, easy to load and unload and capable of being cleansed and disinfected between transport;

    - ensuring safe and optimal transport of live aquatic animals from a welfare point of view.

- **Composting** means decomposition of infected material by micro-organisms under aerobic conditions.

- **Death** means irreversible loss of brain activity in fish and crustaceans.

- **Decontamination** means all stages of cleaning and disinfection.

- **Disposal** means the inactivation of the pathogen with reduction of the *aquatic animal carcass* and parts of it to constituent components, e.g. by means of i.e. burial, chemical or thermal treatment. **Disposal** means reduction of *aquatic animal carcasses* to its constituent components and inactivation of the pathogens of concern (e.g. by means of burial, chemical or thermal treatment.)

- **Disposal plant** means a plant approved by the *Competent Authority* for the *disposal* of *aquatic animal carcasses* and waste thereof.

- **Ensiling** means the process of grinding the *aquatic animal carcasses* and reducing the pH in the mass by adding an organic acid. The pH should ~~must~~ be kept below 4.0 for the duration of the process.

- **High risk waste** means *aquatic animals* or *aquatic animal carcasses*, waste or offal that constitute, or are suspected of constituting, a serious health risk to animals or humans. Waste that is not *high risk waste* is considered of low risk.

- ~~**High risk waste material** means animal wastes that constitute or are suspected of constituting a serious health risk to animals or humans including:~~

    - ~~dead aquatic animals; including companion animals that the *Competent Authority* make special provisions for;~~

    - ~~aquatic animals that are being killed due to disease;~~

    - ~~wastes of aquatic animals containing residues of substances that may represent a serious health risk to animals or humans or products of animal origin that is deemed unsuitable for human consumption due to such residual concentrations;~~

    - ~~aquatic animals that show clinical signs or at slaughter show pathological signs of disease that is transmissible to fish as well as parts of and wastes from such fish.~~

- ~~**Low risk waste** means: *aquatic animal* wastes other than with the exception of what is defined as *high risk waste*s and that do not constitute serious risk for the spread of disease that may be transmitted to humans or animals, such as fresh wastes from aquatic animals from plants producing fish or fish products for consumption.~~

- ~~**Mass destruction** means an emergency destruction and disposal of the entire population of aquatic animals for disposal.~~

- ~~**Rendering** means a closed processing system for destruction of infective material in *aquatic animals* by means of mechanical and thermal treatment.~~

- ~~**Technology** means the process used for disposal of aquatic animals.~~

- ~~**Transport** means the *bio secure* removal of *aquatic animals*, *aquatic animal carcasses* or parts of *aquatic animals* from the infected *aquaculture establishment* to the site of disposal.~~

- ~~**Waste water** means effluent fluids from the slaughtering- and processing process including water from the cleaning process of the slaughtering- or processing plant premises.~~

Article X.X.X.3.

General provisions

All *aquatic animal carcasses* and processing wastes should ~~shall~~ be treated in such a way that the raw waste material may easily be collected and transported to a separate storing place and subjected to *disposal* in order to ensure that the risk of spreading of infection is contained. The storage place should ~~must~~ be separated from the farm site/production area and have leak proof containers and a sufficient carrying capacity to store the waste until *disposal.*

Provisional storage of wastes may take place after:

a) Chilling/freezing down to 4º C or colder, or

b) Preservation with organic acids to below pH of 4~~,~~.0 or lower, or

c) Other methods approved by the *Competent Authorities.*

Article X.X.X.4.

~~Regulations and Jurisdiction~~ Governance

~~The legislation regulating aquatic animal health and the organisation of the~~ The *Competent Authority* ~~Veterinary Administration~~ should oversee ~~give the *Veterinary Services* the authority and the legal powers to carry out the activities necessary for~~ the efficient and effective *disposal* of dead *aquatic animals* and their wastes. Cooperation among all ~~between the Veterinary Service and any other~~ relevant agencies and stakeholders ~~bodies~~ involved in *aquatic animal* health is necessary to ensure safe *disposal*. In this context the following aspects should be integrated ~~regulated~~:

1. ~~right of entry to an establishment for the veterinary services and associated personnel;~~ physical, logistical and data access by relevant personnel, in cooperation with involved stakeholders;

2. movement controls and the authority to make exemptions under certain biosecurity conditions, for example for transport of dead *aquatic animals* to another location for *disposal*;

~~3. the obligation of involved farmers/owner and aquatic animal handlers to cooperate with *Veterinary Services*;~~

4. ~~any need~~ mechanisms to transfer ownership of dead *aquatic animals* to the *C~~c~~ompetent A~~a~~uthority*;

5. the determination~~ing~~ of the method and location of *disposal*, and the necessary equipment and facilities, by the *Competent Authority* ~~*Veterinary Services*~~, in consultation with other authorities including national and local government organisations competent for the protection of the environment.

~~Should the chosen option for the *disposal* of dead aquatic animals or wastes of *aquatic animals carcasses* be applied near the border of a neighbouring country, the *competent authorityies* of that country should be consulted.~~

Article X.X.X.5.

Collection, storage and labelling of aquatic animal carcasses/ other wastes

1. On farm storage

Aquatic animal carcasses infected by an agent causing a~~n OIE-listed~~ *disease* referred to in the *Aquatic Code* or suspected of being so, should ~~must~~ not be transported (moved from the farm) to fish slaugtherhouses or to establishments for *disposal* ~~of *aquatic animal* waste~~ without permission from the *Competent Authority*.

Aquatic animal carcasses and waste should ~~must~~ be stored ~~at an appropriate temperature or pH, and~~ in a manner that prevents leakage of infectious agents to the environment. Where possible, waste should be stored frozen or undergo *ensiling.* ~~It is recomended to make silage of the carcasses/waste immediately at the aquaculture establishment where the waste arise. The ensilage production shall include grinding and adding of formic acid so that pH does not exceeding 4.0.~~

Unnecessary storage of *aquatic animal* waste should ~~must~~ not take place before being handled in an appropriate way according to these regulations. ~~Upon all storage, it must be secured that neither persons not concerned nor aquatic animals have access to aquatic animal waste.~~ All stored waste~~s~~ should be secured to prevent contact with *aquatic animals,* other animals or birds. Access should be limited to authorised personnel only.

~~Measures must be in place to prevent birds or noxious animals including aquatic animals getting in touch with aquatic animal waste under the storage period.~~

The *Competent Authority* may authorise ~~exempt from the instructions and permit~~ transport of fresh or frozen products to establishments for further handling.

2. Intermediate storage

If intermediate storage sites are planned for *aquatic animal* waste prior to transport to a *disposal plant*, such intermediate storage should ~~must~~ be in ~~pursuance~~ compliance with regulations given by the *Competent Authority*.

Equipment used for transportation should ~~must~~ be cleaned and disinfected before being returned.

Containers used for storage and transport of *aquatic animal* ~~products/~~waste~~s~~ not intended for human consumption should ~~must~~ be transported in bulk directly to a *disposal plant* for handling, and should ~~must~~ be labelled with the necessary information regarding content, origin and destination.

Article X.X.X.6.

Handling, storage and processing of risk waste ~~material~~

1. High risk waste

Waste material of *aquatic animals* considered to be *high risk waste* should be treated in a *disposal plant* or be destroyed in an incineration plant approved by the *Competent Authority* for this type of waste or according to specific regulations ~~regarding combat~~ on the control of contagious diseases. The *Competent Authority* may give exemptions from the instructions for *disposal* including permission to *disposal* by ~~embedment~~ burial or incineration outside an approved incineration plant~~,~~ ~~upon judgment as regards spread of~~ after consideration of the epidemiology of the disease, capacity of the *disposal plant*, availability of transporting vehicle, distance of transportation and the amount of waste.

2. Low risk waste

Low risk waste from *aquatic animals* may be used as raw material in feedstuffs for other ~~fur- and production~~ animals (such as pigs, poultry, ruminants), technical or pharmaceutical products (such as chitin) or it may be composted.

Alternatively, low risk waste may be treated at *disposal plants* or in other plants/sites according to the instructions given by the competent authority.

If low risk waste ~~are~~ is being handled or transported together with *high risk waste* or being mixed with *high risk waste*, such waste ~~are to~~ should be considered as *high risk waste* and ~~must~~ be treated as such.

3. Processing of high risk waste ~~material~~

a) Registration and labelling of batches

Disposal plants should ~~must~~ have a system for registration and labelling of each batch for tracing purposes ~~in order to trace each batch of products to time of production or sampling for examinations~~. ~~Exemptions may be given for products from incineration- and biogas/*composting* plants.~~

b) Notification

If testing of *high risk waste* ~~*material*~~ shows that the product is not satisfactorily produced and thus may be a risk for spreading of an infectious agent, *disposal plants* should ~~have to~~ report immediately to the *Competent Authority* which then may requir~~r~~e additional measures to solve the problem. Such ~~Unsatisfactorily processed~~ products should ~~must~~ not be transported from *disposal plants* without permission from the *Competent Authority*.

c) Reporting

Disposal plants should ~~must~~ report annually to the *Competent Authority* on their ~~its~~ operations. The report should ~~must~~ contain a short summary on quantity and type of raw material received, supplier, quantity and type of finished product, receivers, critical check points,

~~aberrations to~~ and deviations from provisions ~~in pursuance with the~~ stipulated in relevant regulations ~~and measures to correct this~~.

d) *Disposal* programme

After killing (culling) of *aquatic animals*, the process of *disposal* should take place as soon as possible to ~~prevent~~ minimise the risk of spread of any infectious agent. Procedures should also be in place to avoid spread of diseases ~~pathogens~~ by leakages, scavengers, etc. if delay in the *disposal* plan occurs.

e) Site of *disposal*

Selection of suitable sites for *disposal* should be identified on local or regional basis as part of a contingency plan established by the *Competent Authority*. Ideally, *disposal* on site should not be permitted. If *disposal* on site is necessary, a combination of different methods for treatment of the waste prior to landfill may be approved by the Competent *Authority* (i.e. *ensiling*, thermal treatment).

If the site for *disposal* is close to the border of a neighbouring country, the *Competent Authority* of that country should be notified.

f) *Disposal* methods

The methods of *disposal* include burial, *composting*, *ensiling*, incineration, pasteurisation, rendering, on-site processing and freezing. The method of choice for *disposal* should ~~must~~ depend on the pathogen in question, the number/volume of *aquatic animals* to be disposed and the site chosen for *disposal*. The choice should be based on an assessment of potential risk to public and animal health as well potential effects on the environment arising from the *disposal*

Article X.X.X.7.

Conditions for approval, inspection, and supervision of disposal plants ~~and sampling~~ for high risk waste

1. Approval of *disposal plants*

Disposal plants handling waste~~s~~ of *aquatic animals* should ~~must~~ be approved by the *Competent Authority*.

The localisation and design for building and any substantial change of a *disposal plant* should ~~must~~ be approved by the *Competent Authority*.

Disposal plants using low risk ~~material~~ waste for production of technical or pharmaceutical products may be exempted from the demand for approval but should be registered by the *Competent Authority*.

2. Conditions for approval

In order for a *disposal plant* to be approved for handling of *aquatic animal* waste~~s~~, it should ~~must~~:

a) be adequately separated from the public highway and other premises such as fishfarms, fish slaugtherhouses, fish processing plants and rivers, etc.;

b) fulfill requirements for buildings and equipment given by the *Competent Authority*;

c) have access to necessary laboratory services at approved laboratories;

d) fulfill requirements for handling of the *aquatic animal* waste~~s~~ given by the *Competent Authority*;

e) fulfill requirements for handling the products as given by the *Competent Authority*.

Approval should be withdrawn if a *disposal plant* no longer fulfils the criteria given by the *Competent Authority*.

3. General provisions for *disposal plants*

a) The plant should ~~must~~ be localised at an adequate distance from other establishments that handle *aquatic animals* ~~aquaculture enterprises such as fish slaughterhouses, processing plants and fish farms~~ to minimise the risk of spread ~~so that the risk of spread~~ of infectious agents to such establishments ~~is minimal~~.

b) Routines should ~~must~~ be established in order to prevent *aquatic animal* waste from contaminating ~~getting in touch with~~ equipment that can not be disinfected.

c) The plant should ~~must~~ be separated into a clean and an unclean sector/section.

d) The unclean section should ~~must~~ have floors from which it is easy to collect and lead away liquids. It should ~~must~~ be easy to clean and disinfect.

e) A system for the collection of waste water from the unclean section including the possibility for disinfection of the effluent water should ~~must~~ be in place.

f) Handling and treatment of *aquatic animal* waste should take place as soon as possible after being received and it should ~~must~~ be ensured that all organic materials are ~~being~~ treated.

g) Effluent waste water should be disinfected before leaving the premises in order to reduce the risk of spreading disease.

h) Measures to prevent birds, insects, rodents or other noxious animals from getting in touch with the *aquatic animal* waste prior to treatment should ~~must~~ be in place.

i) Personnel at the (unclean sector)(dirty section) should ~~must~~ use suitable working clothes and footwear that is easy to distinguish from working clothes used in clean section. Such personnel should ~~must~~ not be admitted to clean section without change of working clothes and footwear and after thorough hand washing. Separate pull on clothing and footwear for inspection personnel should ~~must~~ be at hand. Equipment should ~~must~~ not be brought from dirty to clean section.

j) The end product should ~~must~~ comply with requirements set by the *Competent Authority*.

4. Special provisions for *disposal plants*

a) Demands for treatment, refining and storing of animal waste in *disposal plants*

Aquatic animal waste, if not already ensiled, should ~~must~~ be ensiled as soon as possible after arrival.

The ensiled mass should ~~shall~~ be heated to a core temperature of minimum 85° C for at least 25 minutes and at earliest 24 hours after the admixture of formic acid.

b) Sterilisation plants

Minimum requirements for thermal treatment of the lots is a core temperature of at least 133° C for at least ~~4~~2~~0~~0 minutes at a pressure of 3 ~~bar or 136° C for 20 minutes at a pressure of 3.2 bar~~. ~~This treatment is due to glueformation and hydrolysation of proteins not suitable for fish wastes unless mixed with other waste materials.~~

c) Incineration plants

Incineration plants treating animal *high risk waste~~s~~* of *aquatic animals* should ~~must~~ fulfil the general criteria given above. *Aquatic animal* waste should ~~must~~ be incinerated as soon as possible after being received. ~~Prior~~

d) *Composting* plants

A *composting* plant should ~~must~~ fulfil the general requirements given above. A *composting* plant should not receive *high risk waste* unless pretreated to a microbiological safe standard; and *aquatic animal* waste should ~~must~~ be composted as soon as possible after being received.

Composting should ~~must~~ take place in a reactor so that the process of decimation of possible infectious agents can be controlled and supervised. *Aquatic animal* waste products may also be composted by rank *composting*. The *composting* process should ~~must~~ not be ended until decimation of possible infectious agents have been achieved.

e) Biogas plants

A biogas plant should ~~must~~ fulfil the general requirements given above. The plant should not receive *high risk waste* unless pretreated to a microbiological safe standard; and *aquatic animal* waste should ~~must~~ be processed as soon as possible after being received.

f) Internal control in *disposal plants*

A system for internal control, identifying critical points and means of control for such points, should ~~must~~ be in place at the ~~destruction~~ *disposal plants*. A general documentation

system for internal control including sampling for control of critical points should ~~must~~ be established.

Spot checks of batches should be carried out in order to check the microbiological standards. Products from incineration- and *composting* plants may be exempted from such checks. The *Competent Authority* may grant exemptions on specified conditions.

Records with the results from the different samples and checks, should ~~must~~ be kept for a given period decided upon by the *Competent Authority*. Analyses and sampling should ~~must~~ be carried out in accordance with international recognised standards.

g) Burial and burning

The following considerations are important in selecting a burial site:

- Access - both for equipment to dig and close or cover the burial pit and for the delivery of carcasses or other materials to be buried.

- Environment - including distance to watercourses, the sea, bore holes and wells; depth of the ground water level; susceptibility of the land to flooding; proximity to buildings, especially houses; proximity to neighbours or public lands including roads; slope of the land and drainage to and from the pit; permeability of soil; sufficient space for temporary storage of overburden; and direction of prevailing wind (to manage odour).

- Construction - rocky areas~~, with slow digging increase costs and~~ should be avoided. Soils with good stability, capable of withstanding the weight of equipment used to dig ~~construct~~ and fill the pits, should be selected. If required, diversion banks can be constructed to prevent surface runoff entering the pit or to prevent any liquids escaping from the burial site. Fencing may be necessary to exclude people and animals until the site is safe for use.

h) Pyre-burning

The following considerations are important in selecting a pyre-burning site:

- Location - the possible effects of the fire's heat, smoke and odour on nearby structures, underground and aerial utilities, roads and residential areas.

- Access to the site - both for equipment to construct the pyre and maintain the fire, and for the delivery of fuel and *aquatic animal carcasses* or other materials to be burnt.

- Environment - an adequate firebreak around the pyre is essential. Local bush fire brigades should be consulted for advice, for any required permits and for fire appliances to be on site during the burn.

- Fuel - pyres need considerable fuel to achieve complete incineration. The amount and types of fuel available will vary considerably. All required fuel should be on site before the burning is started.

Article X.X.X.12.

Methods for handling of waste ~~material~~ (aquatic animal carcasses, parts of aquatic animal carcasses)

Disposal may be carried out by several methods such as *composting*, ~~mounding,~~ fermentation, incineration, pyre burning, rendering and/or deep burial/landfill in order to prevent spread of pathogens causing disease in *aquatic animals*.

Waste ~~material~~ of *aquatic animal* origin, packing material etc. should be collected, handled and disposed of to ensure that contamination and spread of disease is avoided. Such material should be stored in closed, leak proof containers prior to *disposal*. Special transportation procedures should ~~must~~ be in place when transporting infectious material (*aquatic animal carcasses*/other waste ~~material~~) from infected aquaculture premises to the place of pathogen inactivation/*disposal* ~~handling~~.

Recommended methods for pathogen inactivation and *disposal* of ~~in~~ *aquatic animals* are as follows:

1. Burial

   Burial is a general practice for *disposal* of animals. Controlled burial may take place either in a landfill site or ~~in a place (pit site)~~ other locations accepted by the *Competent Authority* based on risk assessments as regards *aquatic animal* health, public health and possible environmental pollution. ~~While landfill will be large, pit burials will be rather small and relatively close to the surface.~~

   In selecting an acceptable burial site, the following considerations are important:

   - The site should be easy to access by equipment for digging and closing of the burial pit as well as for the delivery of *aquatic animal carcasses* and/or other waste ~~material~~ to be buried. It should be located at a distance from watercourses, the sea, water-supply (wells, boreholes), ~~fish farms~~ *aquaculture establishments* and proximity to areas easily accessed by the public. Fencing and restricted admittance may be necessary.

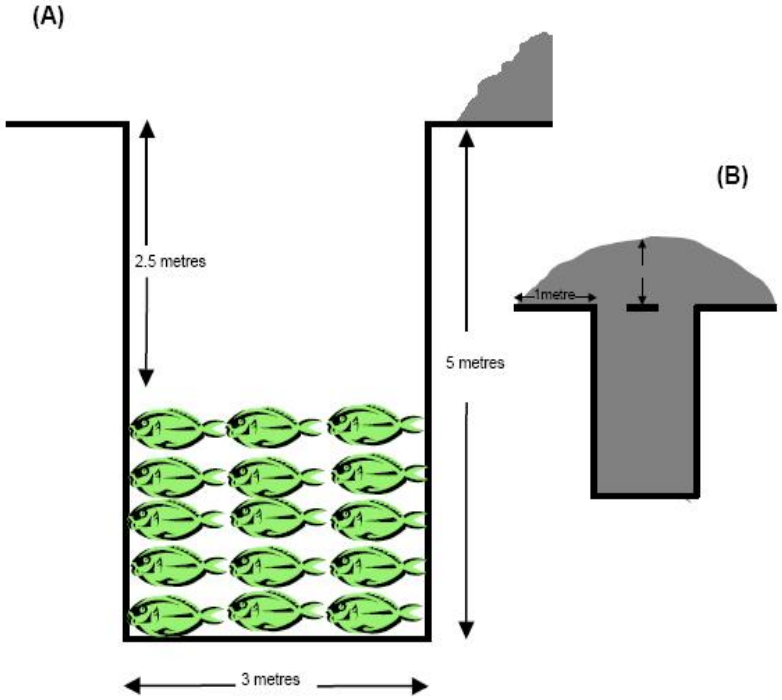
   - The pit dimension depends on the volume of the ~~fish~~ *aquatic animal carcasses* and/or material to be buried. Furthermore, they should be constructed in such away that they are easy to fill with *aquatic animal carcasses* and other material to be buried. Figure 1 shows how a pit may be constructed ~~(by courtesy of *AQUAVETPLAN*~~).

   - The pit filling content should be covered with unslake~~n~~d lime (CaO~~H~~) at a rate of 85 kg per 1000 kg ~~fish~~ of waste ~~material~~ to hasten decomposition and to prevent scavenging of ~~that~~ contaminated material ~~to be surfaced by scavengers, etc~~. ~~If necessary, s~~Such pits should be inspected ~~in order~~ to confirm ~~ensure~~ that no leakages of infected material have occurred.

   Whenever possible, the ~~material~~ waste should be subjected to a ~~pathogen reducing~~ treatment that ensures inactivation of the disease agent, such as *ensiling* or pasteurisation, prior to burial or landfill.

Figure 1 (Source: Aquavetplan 2002, Disposal)

Model of pit for disposal of *carcasses* by burial: (A) open pit; (B) freshly closed pit.



2. Maceration

Maceration by using a mechanical device ~~outfit~~ with rotating blades or projections causes immediate fragmentation and death in newly hatched *aquatic animals* and embryonated eggs (as well as fertilised/unfertilised eggs of fish) and is a suitable method for processing of such material.

~~Maceration requires specialised equipment which should be kept in excellent working order. The disadvantage of maceration is the need for specialised equipment. The rate of introducing the material should be such that the equipment is not jammed.~~

After maceration, the ~~material~~ waste should be subjected to a ~~pathogen reducing~~ treatment that ensures inactivation of the disease agent, such as *ensiling* or pasteurisation.

~~For bio-security reason, macerated material from infected *aquatic animals* has to be treated by one of the processing methods given in this chapter, i.e. *ensiling*, etc.~~

3. Chemical and biological treatment of waste~~s~~

Chemical and biological treatment of *aquatic animal carcasses*/ other waste~~s~~ ~~of *aquatic animals*~~ may be carried out aerobically or an-aerobically. The processes normally lead to end products that

are microbiologically stable and that may be used as fertilisers (or for production of technical products).

4. Ensiling

Ensiling of *aquatic animal carcasses* and other waste ~~material~~ from *aquatic animals* in an organic acid such as formic acid is an effective method to kill most infectious agents in *aquatic animals* within 48 hours. The pH in the *ensiling* process should be maintained at, ~~3.5 –~~ or below, ~~4.0~~ or above ~~pH~~ 12 throughout the process. ~~Thus, it is necessary to monitor pH throughout the entire process. Infectious pancreas necrosis virus (IPNv) is, however, resistant to such *ensiling*. In order to kill IPNv, additional processing or *disposal* should be carried out.~~ After ensilation, the waste should be subjected to a ~~pathogen reducing~~ treatment that ensures inactivation of the disease agent, such as pasteurisation.

~~Ensiling of *aquatic animal carcasses*/wastes for disease control purposes should always be followed by heat treatment or further processing.~~

5. Biogas/fermentation

Biogas production is a process where organic matter in biological waste products is fermented under anaerobic conditions. Fish waste is usually processed in co-digestion with a liquid substrate such as slurry. The main gases produced are methane (50-75 %) and carbon dioxide. The energy in the methane may be used for heating purposes.

The two main types of *biogas production* are mesophilic anaerobe digestion and thermophilic anaerobe digestion. The mesophilic process takes place at 33-35 °C where the liquid fraction remains for 20 – 25 days. The thermophilic process takes place at 52-55 °C and the liquid fraction remains at that temperature for15-20 days.

Both processes are normally continuous, and a portion of the end material is removed every 2-12 hours. There is a risk that new material which has been in the reactor for only 2-12 hours is removed with the finished products.

To get a biological stable end product, this is often pasteurised in specially constructed tanks or heaters by heating to 70 °C for one hour.

6. *Composting*

Depending on the type of *composting* (e.g. windrows, closed vessel) and the raw material used, as well as the climatic conditions, the temperature parameters of the process and the heat distribution in the material may be different. An example is given in the German Bio waste Ordinance (1998) which specifies that *composting* plants should operate with a material having a moisture content of 45-50% at a pH of approximately 7.

When held in windrows, the entire material needs an exposure time of at least two weeks at 55°C, while in closed vessels exposure to 65°C for one week is required. In theory, many types of fish pathogens can be inactivated in a validated *composting* process. Even though systematic investigations with fish pathogens have not yet been performed, it may be possible to extrapolate from the behaviour of other similar pathogens of warm-blooded animals, as well as of relevant indicator organisms, that a validated process will be safe from the hygienic point of view. However, data presented has highlighted the robustness of IPN virus and its ability to

survive this process. Consequently it is necessary to consider the capacity of individual fish pathogens to survive various treatment processes.

High risk waste should be heated at 85 °C for at least 25 minutes prior to the *composting* process. ~~It's a normal procedure to heat high risk material prior to the biogas process. For fish material keeping at 85 °C for at least 25 minutes has been used.~~

To get a biological stable end product, the compost ~~is often~~ may be pasteurised in specially constructed tanks or heaters by heating to 70 °C for one hour.

Inactivation data for fish pathogens in validated thermophilic anaerobic batch processes are not available, but it may be concluded from Table I, page 18 that under comparable circumstances similar fish pathogens will also be inactivated. In Table I the longest survival times are given without taking the exposed matrix (virus suspension or virus adsorbed to a membrane) into account.

7. Thermal treatments

Thermal treatment of *aquatic animal carcasses* or other organic material may be carried out by different methods, such as burning, incineration, heating (pasteurisation) and sterilisation.

8. Incineration

Incineration is a controlled burning process carried out in fixed incinerators, air curtain incinerators or municipal incinerators tested and authorised by the *Competent Authority*. Mobile ~~A~~air curtain incinerators ~~are a mobile incineration system that~~ may be brought on site. *Aquatic animal carcasses*/other waste~~s~~ may thus be burned to ashes on spot and transportation of infected material is not required.

Leak-proof transportation of ~~input~~ waste ~~material~~ for *disposal* to incinerators ~~on~~ at fixed locations ~~is~~ may be necessary, as well as requirements for subsequent disinfection of vehicles transporting *aquatic animal carcasses*/other waste ~~material~~.

Incinerators for biological material are very effective for a complete *disposal* of *aquatic animal carcasses*/other waste ~~material~~ of *aquatic animals*/*disease* agents~~pathogens~~ and with little or no pollution to the environment. However, such ~~I~~incinerators~~,~~ ~~however,~~ may only be capable of handling limited volumes of biological material.

9. Pyre burning

Pyre burning may not be suitable for ~~is not so convenient to handle~~ large numbers ~~amounts~~ of *aquatic animal carcasses*~~/~~ or large volumes of waste~~s~~ of *aquatic animals*. ~~However, when constructing a pyre, the material to be destroyed, should be placed on top of inflammable material.~~

In selecting an acceptable pyre burning site, the following considerations are important:

- Site location should be away from residential areas, etc to avoid unpleasant conditions caused by smoke and odour from the burning. Pyre burning sites should be placed in such a way that they are easy to access. ~~A fire bed of 2,5 x 2,75 m is needed per tonne of fish.~~

- Fuel/other combustable material for pyre-burning are needed in considerable amounts to complete degradation of the *aquatic animal carcasses*/other ~~material~~ waste to be disposed.

- Fire management should ~~must~~ be administered in an appropriate manner using sufficient fuel supply in the initial phase and throughout the entire burning process. If the pyre-burning is carried out correctly, ~~fish~~ *aquatic animal carcasses* will be destroyed within 48 hours. The ashes should then be brought to a place of *disposal* approved by the *Competent Authority*.

10. Heating

a) Pasteurisation

Heat treatment at temperatures below 100°C can be considered as pasteurisation. Pasteurisation may ~~and will~~ only have limited inactivating effects on micro-organisms. Heat resistant spores of mesophilic or thermophilic sporeformers will generally survive this procedure or will only be inactivated after extremely long exposure times or multiple heating steps with cooling steps in between.

The advantage of a moderate heat treatment such as pasteurisation is that product quality is maintained, especially with regard to easily hydrolysed proteins that are found in raw materials originating from fish.

The construction of the heating devices can vary, in that it may either be constructed as a pipe heater or as a pasteurisation tank. In the latter, stirring improves the heat transfer and heat distribution. Any time/ temperature relationship that has been validated with the relevant organisms may be used for pasteurisation.

For materials likely to contain high numbers of pathogens, pasteurisation at 90°C for 1 hr should be used. For materials with a low pathogen load, 70°C for one hour may be applied. Thermal inactivation of pathogens also depends on the size of exposed particles if the material to be pasteurised contains solid material, such as animal tissues. Thus, a maximum particle size of 50 mm is recommended for heating at 90°C/ 1 hr, and a particle size below 30 mm for heating at 70°C/1 hr. Batch treatment should be used to safeguard the microbiological safety of the process and end-product.

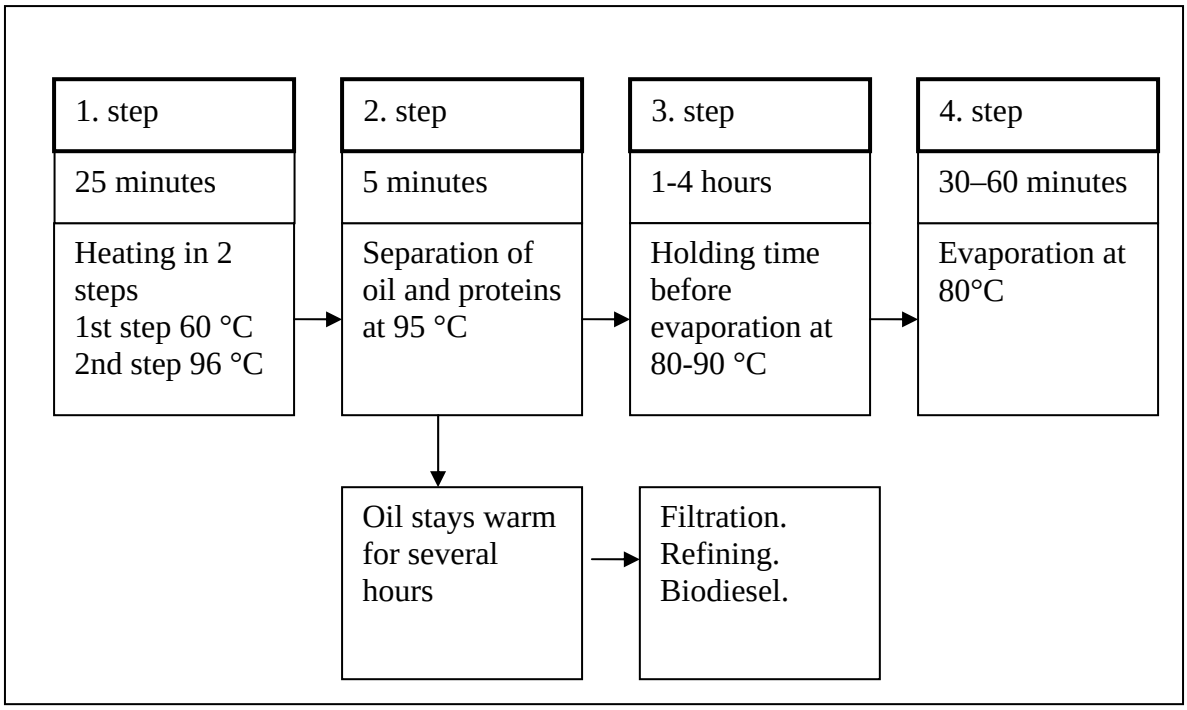
b) Sterilisation

Sterilisation of ~~fish material~~ *aquatic animal carcasses* and/or waste based on the process described for terrestrial animals (133ºC, at 3 bars for 20 minutes) may lead to problems due to technological difficulties; ~~and~~ or to a product that might ~~can~~not be used as feed or fertiliser due to glue formation and/or hydrolysis of proteins ~~((EU – Use of by products in aquaculture).~~

11. Rendering

a) ~~This is~~ Rendering is generally achieved through a closed system for the mechanical and thermal treatment of *aquatic animal* tissues leading to stable, sterilised products, e.g. animal fat and dried animal protein.

b) The process is used for the production of fish meal and fish oil, and can also be used as a method for *disposal* of dead *aquatic animals*. This ~~kind of heat~~ treatment will eradicate all of the known *aquatic animal* pathogens, and the end products can, depending on the quality of the starting material, be used for the production of technical products or even as feed for pet and fur animals.



c) Description of the process

The raw material for this process can be either fresh or ensiled materials. The quality of the end product depends on the quality of the raw material.

Step 1: the raw materials are heated slowly to a temperature of 95°C

Step 2: the oil and the proteins are separated by pressing and centrifuging

Step 3 and 4: the drying process should not be so hot that it denatures the fish proteins, but hot enough to remove all fish pathogens.

The oil fraction stays warm for several hours, and is typically ~~will be~~ decanted and purified before further processing.

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