

Aquatic Animal Health Standards Commission Report

New

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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 *Competent Authority* should be notified so that necessary steps can be taken to dispose of the dead aquatic animals when feasible, in order to minimize the risk for possible spread of disease.

Comment/rationale: there are thousands of wild fish kills which occur across the globe annually. Many of these kills are not logistically possible to respond to in a timely manner before they otherwise decompose on their own.

The method for disposal should be based on judgments depending on the cause of mortality of aquatic animals (disease, ~~intoxication~~ toxicosis, environmental changes, etc.) and the possible risk of introducing a listed disease if no precautionary steps are taken.

Comment/rationale: ‘toxicosis’ or ‘exposure to toxins’ have a more precise application in this context

Carcasses to be disposed of and the disposal process to be chosen should be under the supervision of the *Competent Authority*.

The guidelines in this appendix 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 AppendixXXXXX.

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*, and *decapods* (lobsters, shrimps, crabs) from aquaculture or the wild. The definition does not cover water-living *amphibians*, *reptiles*, *birds* or *mammals*.

Comment/rationale: syntax

- **Aquatic animal carcass** means the 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 a slaughtering premises or other *processing plants* preparing products for human consumption, or for disposal.

Comment/rationale: ‘fish slaughtering premises’ is too restrictive for ‘aquatic animals’ in this context.

- **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; or discarded for other reasons.

Comment/rationale: some types of offal/wastes may in fact be approved for human consumption, but may be discarded by choice.

- **Biogas production** means decomposition of infected material by micro-organisms in an anaerobic environment.
- **Container** means a transport ~~appliance~~; receptacle:

Comment/rationale: ‘receptacle’ is more descriptive than ‘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~~ watertight way, easy to load and unload and capable of being cleansed and disinfected between transport;

Comment/rationale: typo

- 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.

Comment/rationale: syntax

- **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 carcasses and reducing the pH in the mass by adding an organic acid. The pH must be kept below 4.0 for the duration of the process.

Comment/rationale: ensiling usually takes days to weeks to complete, and the pH should be below 4 for that time period.

- **High risk 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~~ and which is deemed unsuitable for human consumption due to such residual concentrations;

Rationale: syntax

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

Rationale: 'fish' is overly restrictive in context of these guidelines

- **Low risk waste** means: animal wastes with the exception of what is defined as high risk wastes 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~~ an entire population of aquatic animals ~~for disposal~~.

Rationale: syntax

- **Rendering** means a closed processing system for destruction of infective material in aquatic animals by means of mechanical and thermal treatment.
- **Technology** means the physical or chemical process used for disposal of aquatic animals.

Rationale: additional wording added for clarity

- **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 facilities, including water from the cleaning process of ~~the slaughtering~~ slaughtering or processing plant premises.

Rationale: syntax (no hyphen needed after 'slaughtering')

Article X.X.X.3.

General provisions

General Comment/note: throughout the remainder of the document, wherever the words “shall” or “must” appear, they are replaced by the word ‘should’. The words “shall” and “must” are too proscriptive for the purposes of these guidelines.

All carcasses and processing wastes ~~shall~~ should 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 ~~must~~ should 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:

- Chilling/freezing down to 4° C or colder, or
- Preservation with organic acids to below pH of ~~4,0~~ 4.0 or lower, or

Rationale: typo

- Other methods approved by the *Competent Authorities*.

Article X.X.X.4.

~~Regulations and Jurisdiction~~ Oversight

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

Rationale: Improved syntax

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

Rationale: less proscriptive as revised; in many countries such involvement is not necessarily authorized by legislation.

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;

Rationale: Combined Point 3) with Point 1) above; except under certain circumstances there is no such blanket obligation in many countries.

4. ~~any need~~ Mechanisms to transfer ownership of dead aquatic animals to the ~~competent~~ authority Competent Authority (as applicable);

Rationale: improved clarity

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

Should the ~~chosen option~~ location for the disposal of dead aquatic animals or their wastes ~~of aquatic animals~~ be applied near the border of a neighbouring country, the competent authorities of that country should be consulted. Disposed aquatic animals or their wastes, including any potential effluents arising from the disposal, should not make contact with open or shared watersheds.

Rationale: the suggested changes (added wording and deleted text) improves biosecurity and provides clarity

Article X.X.X.5.

Collection, storage and labelling of aquatic animal carcasses/ wastes

1. On-farm storage

Rationale: typo

Aquatic animal carcasses infected by an agent causing or suspected of causing an OIE listed disease ~~or suspected being so~~, must not be transported (~~moved from the farm~~) to a fish slaughterhouse or to establishments for disposal of aquatic animal waste that are not located on the same premises as the affected animals without permission from the *Competent Authority*.

Rationale: re-worded for clarity, and 'fish' is too restrictive in a context of all types of aquatic animals

Aquatic animal carcasses and waste ~~must~~ should be stored at an appropriate temperature or pH, and in a manner that prevents leakage of infectious agents to the environment. It is recommended to make silage of the carcasses/waste immediately at the aquaculture establishment where the waste arises. The ~~ensilage production~~ ensiling process ~~shall~~ includes grinding and adding of formic acid so that ~~the~~ pH ~~does not exceed~~ is less than or equal to 4.0 for the entire ensiling process.

Rationale: consistency; syntax

Unnecessarily lengthy storage of aquatic animal waste ~~must~~ should 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 wastes should be secured to prevent contact with any aquatic animals. Access should be limited to authorized personnel only.

Rationale: clarity; less proscriptive

Measures ~~must~~ should be in place to prevent birds or ~~noxious~~ other animals, including aquatic animals, ~~getting in touch with aquatic animal waste under the storage period~~ from contacting stored aquatic animal wastes.

Rationale: syntax; less proscriptive

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

Rationale: syntax

2. Intermediate Longer-term storage

If intermediate or longer-term storage sites are planned for aquatic animal waste prior to transport to a disposal plant facility, such ~~intermediate storage~~ must be in pursuance with regulations given by should be under the supervision of the *Competent Authority*.

Rationale: syntax

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

Containers used for storage and transport of aquatic animals s (or their products/wastes) ~~not intended for human consumption,~~ must sent for disposal due to disease considerations should be transported in bulk directly to a disposal plant facility for handling, and ~~must~~ should be labelled with the necessary information regarding content, origin and destination.

Rationale: less proscriptive; clarity

Article X.X.X.6.

Handling, storage and processing of risk material

1. High risk waste

Waste material of aquatic animals considered to be high risk waste (e.g. zoonoses, toxified, or capable of spreading pathogens causing notifiable diseases) should be treated in a disposal plant or be destroyed in an incineration plant approved by the *Competent Authority* or according to specific regulations regarding combat of contagious diseases. The *Competent Authority* may give exemptions from the instructions for disposal ~~including permission to disposal by embedment or incineration outside an approved incineration plant upon judgment as regards~~ based on variables including spread of disease, capacity of the disposal plant, availability of transporting vehicle, distance of transportation and the amount of waste.

Rationale: clarity

2. Low risk waste

Low risk waste from aquatic animals may be used as raw material in feedstuffs for fur- and production animals (pigs, poultry, ruminants), technical or pharmaceutical products; 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.

Rationale: syntax; less proscriptive

3. Processing of high risk material

a) Registration and labelling of batches

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

Rationale: clarity

b) Notification

If testing of high risk material shows that the product is not satisfactorily produced and thus may be a risk for spreading of an infectious agent, disposal ~~plants have to report~~ facilities should immediately report to the *Competent Authority* which then may ~~require~~ require additional measures to solve the problem.

~~Unsatisfactorily processed~~ products that have not been treated to effectively neutralize infectious agents should ~~must~~ not be transported from disposal ~~plants~~ facilities without permission from the *Competent Authority*.

Rationale: clarity

c) Reporting

Disposal ~~plants must~~ facilities should report annually to the *Competent Authority* on ~~its~~ their operations. The report ~~must~~ should 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~~.

Rationale: clarity

d) Disposal programme

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

Rationale: 'prevention' in itself may not be possible by the time an event is reported and/or responded to.

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 must depend on the pathogen in question, the number/volume of aquatic animals to be disposed and the site chosen for disposal.

Article X.X.X.7.

Conditions for approval, inspection, supervision of disposal plants and sampling

1. Approval of disposal plants

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

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

Disposal plants using low risk material 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 wastes, it ~~must~~ should:

- a) be adequately separated from the public highway and other premises such as fishfarms, fish slaughterhouses, 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 wastes 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 ~~must~~ should be localised at an adequate distance from other aquaculture enterprises such as fish slaughterhouses, processing plants and fish farms so that the risk of spread of infectious agents to such establishments is minimal.

- b) Routines ~~must~~ should be established in order to prevent aquatic animal waste from getting in touch with equipment that can not be disinfected.
- c) The plant ~~must~~ should be separated into a clean and an unclean sector/section.
- d) The unclean section ~~must~~ should have floors from which it is easy to collect and lead away liquids. It ~~must~~ should 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 ~~must~~ should be in place.
- f) Handling and treatment of aquatic animal waste should take place as soon as possible after being received, and it ~~must~~ should 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 ~~must~~ should be in place.
- i) Personnel at the (unclean sector)(dirty section) ~~must~~ should use suitable working clothes and footwear that is easy to distinguish from working clothes used in clean section. Such personnel ~~must~~ should 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 ~~must~~ should be at hand. Equipment ~~must~~ should not be brought from dirty to clean section.
- j) The end product ~~must~~ should 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, ~~must~~ should be ensiled as soon as possible after arrival.

The ensiled mass ~~must~~ should 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 40 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 hydrolysisation of proteins not suitable for fish wastes unless mixed with other waste materials.~~

Rationale: this explanation is not necessary

- c) Incineration plants

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

d) Composting plants

A composting plant ~~must~~ should 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 ~~must~~ be composted as soon as possible after being received.

Composting ~~must~~ should 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 ~~must~~ should not be ended until decimation of possible infectious agents have been achieved.

e) Biogas plants

A biogas plant ~~must~~ should 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 ~~must~~ should 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 ~~must~~ should be in place at the destruction plants. A general documentation system for internal control including sampling for control of critical points ~~must~~ should 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, ~~must~~ should be kept for a given period decided upon by the *Competent Authority*. Analyses and sampling ~~must~~ should 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 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 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 (carcasses, parts of 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.

Rationale: 'Mounding' is not defined

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 ~~must~~ **should** be in place when transporting infectious material (carcasses/other waste material) from infected aquaculture premises to the place of pathogen inactivation/disposal handling.

Recommended methods for pathogen inactivation and disposal 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 location** accepted by the *Competent Authority* based on risk assessments as regards aquatic animal health and possible environmental pollution. ~~While landfill will be large, pit burials will be rather small and relatively close to the surface.~~

Rationale: clarity; last sentence not necessary to point out

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 carcasses and/or other material to be buried. It should be located at a distance from watercourses, the sea, water-supply (wells, boreholes), fish farms 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 carcasses and/or material to be buried. Furthermore, they should be constructed in such way that they are easy to fill with carcasses and other material to be buried. Fig 1 shows how a pit may be constructed (~~by courtesy of AQUAVETPLAN~~).

Rationale: the source on the diagram should be cited. No extra citation needed here.

- The pit filling content should be covered with ~~unslaken~~ unslaked lime (CaOH) at a rate of 85 kg per 1000 kg fish material to hasten decomposition and to prevent that contaminated material to be surfaced by scavengers, etc. ~~If necessary,~~ Such pits should **periodically** be inspected in order to ensure that no leakages of infected material occur.

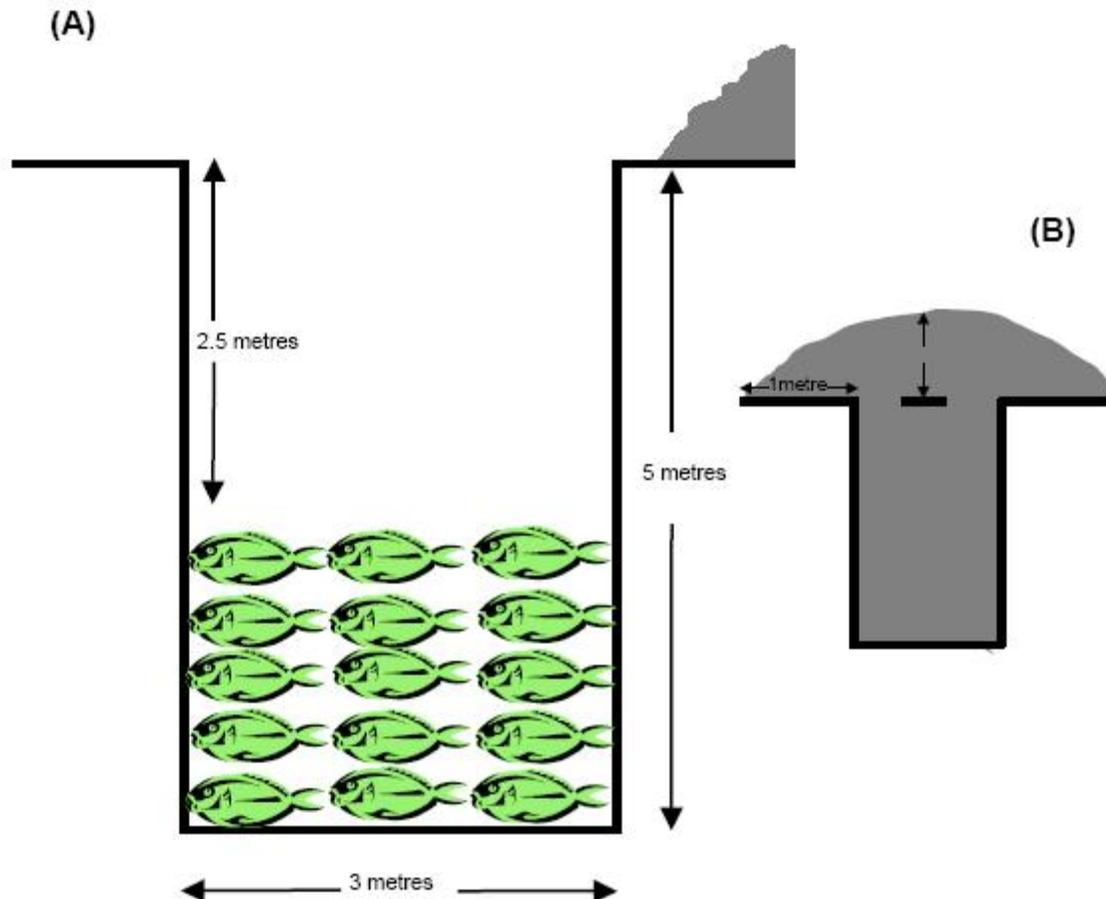
Rationale: clarity

Whenever possible, the material should be subjected to a pathogen ~~reducing~~ neutralizing treatment such as ensiling or pasteurisation, prior to burial or landfill.

Rationale: the word 'reduction' is not necessarily precise or effective enough

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 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 [for maceration](#) should be such that the equipment is not jammed.

Rationale: clarity

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

3. Chemical and biological treatment of wastes

Chemical and biological treatment of carcasses/wastes 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 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~~ at or below 4 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. Ensiling of 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 for 15-20 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.

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

Rationale: improved clarity

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.

Rationale: improved clarity

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 carcasses or other organic material may be carried out by different methods, such as burning, incineration, heating (pasteurization) and sterilisation.

8. Incineration

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

Rationale: clarity

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

Rationale: clarity

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

Rationale: clarity

9. Pyre burning

Pyre burning is not ~~so necessarily~~ convenient a convenient method to handle for handling large amounts of carcasses/wastes of aquatic animals. ~~However, when constructing a pyre, the material to be destroyed, should be placed on top of inflammable material.~~

Rationale: clarity

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 combustible material* for pyre-burning are needed in considerable amounts to complete degradation of the carcasses/other material to be disposed. When constructing a pyre, the material to be destroyed should be placed on top of inflammable material.

Rationale: the specific guidance fits better here

- *Fire management* 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 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. ~~and will~~ Pasteurisation may 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.

Rationale: the first sentence cannot be supported as originally written (incomplete). Many, if not most, pathogens of aquatic animals are easily neutralized at temperatures less than 100°C, depending on exposure time.

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.

Rationale: clarity

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 based on the process described for terrestrial animals (133°C, ~~at 3 bars atmospheric pressures~~ for 20 minutes) may lead to problems due to technological difficulties; ~~and or to~~ a product that ~~can might~~ not be used as feed or fertiliser due to glue formation and ~~/or~~ hydrolysis of proteins (~~EU Use of by products in aquaculture~~).

Rationale: clarity; relevance

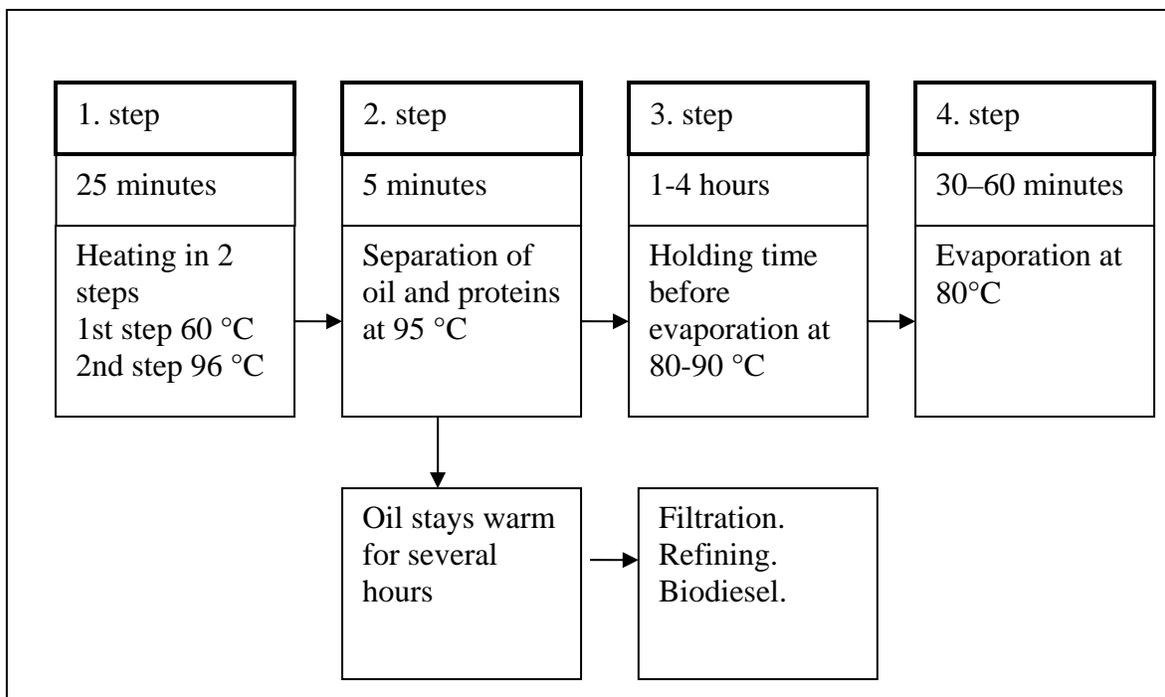
11. Rendering

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

Rationale: clarity

- 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.

Rationale: clarity



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 ~~will be~~ is typically decanted and purified before further processing.

Rationale: clarity

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