SEAFISH

Seafish Non-Standard Design Purification Systems: Generalised Operating Manual for Purification Systems of Non-Standard Design

March 2018

Seafish Report (SR) No.: 723
ISBN No.: 978-1-911073-29-1

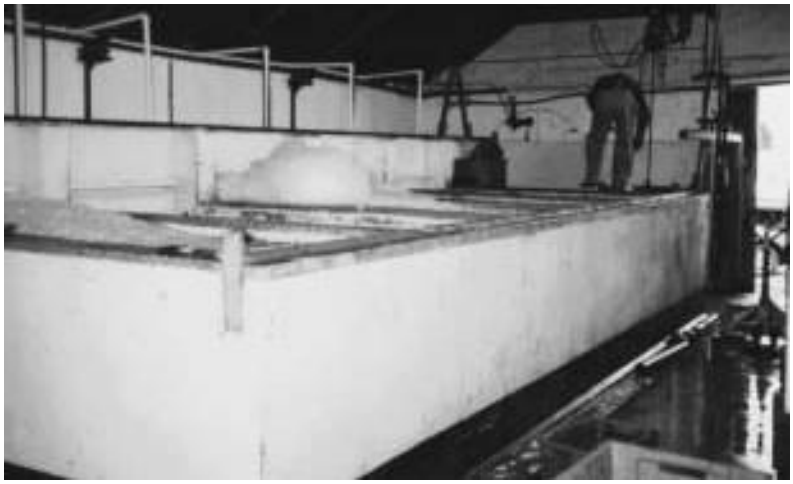
Seafish

Origin Way
Europarc
Grimsby DN37 9TZ

T: +44 (0)1472 252 300
F: +44 (0)1472 268 792
E: seafish@seafish.co.uk

www.seafish.org

Non-Standard Design Purification Systems



Generalised Operating Manual for Purification Systems of Non-Standard Design

Seafish Report (SR) No.: 723
ISBN No.: 978-1-911073-29-1

Updated March 2018 by Pyke and Deane Aquaculture Consultants
Email: consultmandy@hushmail.com

Non-Standard Design Purification Systems:
Generalised Operating Manual for Purification Systems of Non Standard Design

Contents

1. Purification Technology in the UK

The purification of bivalve molluscs in the UK began in the 1920s with the development of mussel purification at the then Ministry of Agriculture and Fisheries Research Station at Conwy. This used a large outdoor tank, over the floor of which was spread a shallow layer of mussels on top of wooden grids. Seawater was not re-circulated but instead the tank contained a large volume of water, which was replaced half-way through the purification cycle to replenish the dissolved oxygen. The seawater was sterilised by chlorination in a separate tank.

During the 1960s there was some development including the introduction of seawater re-circulation to replenish the oxygen combined with ultra-violet light (UV) treatment of the water. However, mussels continued to be purified in a single layer because of concern over their high oxygen demand and the possibility of faecal material being re-ingested by the mussels at the bottom, however, oysters were purified on grids stacked three high. Such shallow tank systems continue to be used, however, the grids have been replaced by plastic mesh containers.

A further development was the stacking of containers of molluscs in a vertical column, over a sump tank, with seawater cascaded down from one container to another. In this system the containers are individually supported in a frame, enabling separate access to each container. Such vertical stack systems require much less floor space but are expensive compared with shallow tanks and their current use is limited to small-scale installations for high value species.

Seafish has been investigating the handling and purification of bivalve molluscs since 1986 with the objectives of increasing the quality and safety of the products and the efficiency of the industry. The shallow tank approach to mussel purification required a lot of land, which for large systems resulted in outdoor installations that were exposed to the elements and over which there was little temperature control. In addition, their operation is labour intensive. Seafish investigated the stacking of containers of mussels in a purification tank and, following extensive trials, successfully demonstrated that under controlled conditions of higher water flow rate they could be stacked six high. This is now an accepted practice in the UK and the tanks are indoors. Outdoor tanks are no longer recommended by Seafish.

Seafish was also concerned about the apparent poor seawater flow characteristics and methods of draining down of many vertical stack systems. Extensive development work and trials then resulted in a much-improved design of system.

The new multi-layer purification system for mussels still required the filling and emptying of each of the shallow plastic mesh containers, which remained a labour-intensive operation. More recent Seafish investigations demonstrated that under controlled conditions of down welling flow, mussels can be purified in a single deep layer. From this Seafish developed the bulk bin approach whereby modified pallet boxes, that can be filled and emptied mechanically, are used as mussel purification containers which are connected to seawater supply and return lines from a common sump.

In all of these systems the common factors are that the molluscs are immersed in suitable conditions of oxygenated clean seawater in which they function naturally and purge themselves of contamination. Detritus settles under the molluscs and is not re-ingested.

Bulk bin system for mussels

2. The Approval of Purification Systems

For England, Wales and Northern Ireland approval will be decided by a Local Authority (LA) Authorised Officer (AO). AOs will follow the guidance provided by the Food Standards Authority (FSA)[1]. The Food Business Operator (FBO) should prepare for the approval process and have a Food Safety Management Plan (FSMP) in place based on Hazard Analysis and Critical Control Point (HACCP)[2]. Conditional Approval (CA) can be granted by an AO, however, this must not last more than six months. If the 'establishment' is not fully compliant within this time, approval must be withdrawn. The FBO must provide evidence to the AO to demonstrate compliance. Bacteriological tests are the responsibility of the operator of the purification system and can prove time consuming and costly, particularly if repeat testing is required. Approval in Scotland is overseen by Food Standards Scotland (FSS)[3].

The AO will approve a system only if satisfied that it is designed and operated in accordance with basic rules and that there is sufficient evidence to demonstrate that the system will purify bivalve molluscs satisfactorily. This may require them to make a site visit before approval, to carry out a technical inspection, and for a bacteriological test to be carried out. The bacteriological tests are the responsibility of the operator of the purification system and can prove time consuming and costly, particularly if repeat testing is required.

3. Seafish Standard Design Systems

A range of standard design purification systems have been developed by Seafish. They are built to specified designs that meet the technical requirements and which have been tested extensively in a wide range of conditions. Being proven designs, bacteriological testing can be less stringent and consequently they have a more predictable, simplified, less time consuming and less expensive approval procedure.

4. Non Seafish Standard Design Systems

There is no obligation on a purification centre operator to install standard design systems. The operator may wish instead to install a system to her or his own specification. Such a purification system must still meet the technical requirements of The AO, who will approve a system only if satisfied that it is designed and operated in accordance with basic rules and that there is sufficient evidence to demonstrate that the system will purify bivalve molluscs satisfactorily. This requires them to make a site visit before approval, to carry out a technical inspection, and for a bacteriological test to be carried out.

Although the initial capital cost of such a system using components already available to the operator may be less than that of a manufactured standard design, additional costs may accrue from consultancy fees and extensive bacteriological testing. There may also be risks, delays and costs associated with remedial work following inspection and testing.

Non-standard designs currently in use in the UK are mostly built as variations on the shallow tank, multi-layer or vertical stack themes. However, there is no legislation at the time of writing that proscribes a specific design.

5. Seafish Operating Manuals for Purification Systems

It is essential that a purification system is operated correctly if it is to produce a safe product.
In the past the LA issued operating instructions (Conditions of Approval) to purification system operators giving specific details of use. Such instructions are no longer issued, the FSMP should now outline all procedures and operations. The Seafish manuals offer guidance only and cannot take account of all the variable factors facing a FBO. Seafish do not take part in the approval process.
The following manuals have been produced:

[1] https://www.food.gov.uk/enforcement/monitoring/shellfish/shellfish-purification
[2] https://www.food.gov.uk/business-industry/food-hygiene/haccp
[3] http://www.foodstandards.gov.scot/business-and-industry/industry-specific-advice/fish-and-shellfish

Title	Seafish Report No.	ISBN No.
Operating Manual for the Bulk Bin System for Mussels	718	978-1-911073-24-6
Operating Manual for the Large Scale Multi-Layer System	719	978-1-911073-25-3
Operating Manual for the Medium Scale Multi-Layer System	720	978-1-911073-26-0
Operating Manual for the Small Scale Shallow Tank System	721	978-1-911073-27-7
Operating Manual for the Vertical Stack System	722	978-1-911073-28-4
Generalised Operating Manual for Purification Systems of Non-standard Design	723	978-1-911073-29-1

6. The Scope of this Manual

All the manuals are concerned primarily with the operation and not the design of purification systems, and although some details regarding good practice on installation are given, it is assumed that the manuals are to be used with systems that satisfy the required technical and bacteriological test requirements.

Non-standard designs are diverse in their details of design and construction but because they are normally built as variations of the shallow tank, multi-layer or vertical stack themes, much of their operating practice is similar to that given in the operating manuals for the comparable types of standard design systems.

This manual makes use of this by cross-referencing to the other relevant manuals in the series which must be used where referred to.

Should a system be designed that uses a different principle of operation then advice should be sought from the LA.

7. Seawater Supply

The FBO is responsible for the quality of natural seawater used. The seawater must be free from contamination in quantities that may adversely affect the molluscs or be subsequently harmful to the consumer. Either natural or artificial seawater can be used. The FBO is responsible for the quality of natural seawater used. Guidance on this subject has been produced by Seafish and Cefas It should be 'clean' and not contain any contaminants that could become a threat to human health[4].

Factors affecting the suitability of seawater are:

Turbidity: Turbidity is the measure of particles or opacity in seawater that obstructs light. It can be measured in Nephelometric Turbidity Units (NTU). An advisory limit for depuration plants has been set at less than 15 NTUs. Any obstruction to the transparency of seawater will inhibit the ability of UV light to disable bacteria. Turbidity meters can be obtained should there be a problem with turbidity for a plant.

Salinity: This must suit the particular species of bivalve mollusc being held and should ideally be similar to the area from which they were harvested. Seawater salinity should be checked ideally before the tank is being filled. The seawater salinity must be within the range required for the species and can be measured using a hydrometer. If the reading shows the salinity to be too low or high it should be re-checked and if still incorrect the water must not be used.
Salinity can be too high if an incorrect mix of artificial seawater has been used or evaporation has occurred over a period of re-use.

Salinity that is too low can result from an incorrect artificial seawater mix or, in the case of natural seawater, too much dilution from a natural freshwater source. For natural seawater supply it may be possible to wait for a change in tidal conditions.

[4] https://www.cefas.co.uk/media/52850/2012-water-quality-in-purification-leaflet.pdf

The salinity of artificial seawater can be adjusted by dilution with tap water or adding extra salt. Care must be taken to maintain the correct mixture of salts.

Some of the most common minimum levels of salinity are given in the table below.

Minimum Seawater Salinity

Species	Min salinity ($^0/_{00}$)
Pacific oysters (*C. gigas*)	20.5
Native oysters (*O edulis*)	25
Mussels (*Mytilus* spp.)	19
Cockles (*C. edule*)	20
Hard clam (*M. mercenaria*)	20.5
Native clam (*T. decussatus*)	20.5
Manila clam (*T. philippinarium*)	20.5
Razor clam (*Ensis* spp.)	30
Scallops (*P. maximus*)	35
Thick trough shell (*S. solida*)	30
Peppery furrow shell (*S. plana*)	20.5
Sand gaper (*M. arenaria*)	25

Microbiological Treatment: Initial low levels of microbiological contamination are reduced by UV treatment of the water before it enters the tank[5]. Repeated cycling of water through a low wattage UV bank over time can reduce bacterial contamination if high wattage lamps are not available[6]. The use of ozone to supplement but not replace UV treatments is permitted and should be included in the FSMP if used[7,8].

Position of Seawater Intake: This must not draw in waste from other discharges, it should be sufficiently below the water surface to avoid poor quality surface water and be above the seabed where mud or fine sand are present. The times when suitable seawater may be drawn may be limited by tide and this may require the provision of water storage tanks ashore.

Artificial Seawater: Artificial Seawater has higher initial cost but can offer considerable advantages where systems are to be operated inland or local supplies of natural seawater are considered unsuitable. Advice on the production and use of artificial seawater is given in a Seafish technical advisory document on the Reuse of seawater for purification systems[9].

8. General Advice on System Installation

Most purification systems in the UK currently operate with a seawater re-circulation system or single pass system. They must be designed to ensure that all molluscs in the system receive an adequate supply of oxygenated clean sea water.

[5] WHO http://www.who.int/water_sanitation_health/emerging/depuration.pdf
[6] Cefas 'Ultraviolet disinfection in depuration systems in England & Wales'
[7] https://www.food.gov.uk/sites/default/files/multimedia/pdfs/enforcement/enfni10039annb.pdf
[8] https://www.cefas.co.uk/media/52849/20100827-ozone-discussion-document-uk-final.pdf
[9] http://www.seafish.org/media/Publications/FS32_07_09_ReuseofseawaterforpurificationsystemS.pdf

Basic equipment to achieve this consists of suction pipe, pump, UV sterilisation unit, water outlet pipe and interconnecting pipe-work, with water jets or cascades to provide aeration. Control valves for tank filling and emptying and a flow control valve and flowmeter are usually required. If treatment of the incoming seawater supply is required, it must pass through the UV unit before immersing the molluscs.

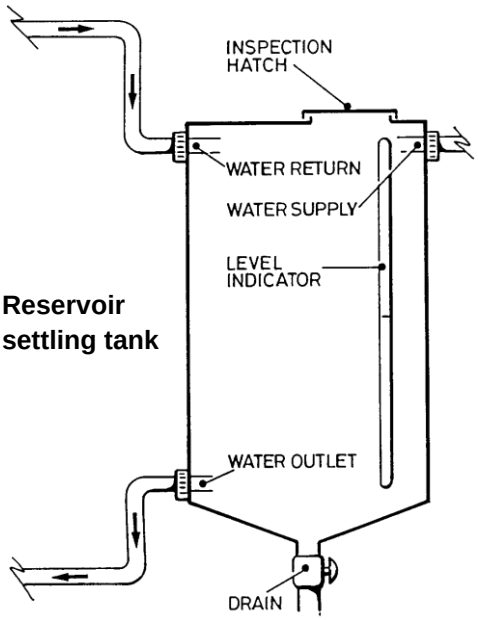
If the seawater re-circulation equipment is installed on site, equipment manufacturer's instructions must be followed. Care should be taken to keep the pump clear of the floor and to install it and the UV in a dry area away from any splashing from the tank and from washing down, and clear of the handling of containers. All valves must be accessible and the flowmeter, if fitted, and at least one end cap of each UV lamp (or similar indicator) must be clearly visible. Pipe-work and equipment should be installed such that they drain when the system is emptied to avoid leaving areas of stagnant water when not in use. If this is not practical then means of draining specific pipe-work or equipment should be included. Access for maintenance is important, particularly to the UV sterilisation unit which will require periodic cleaning and tube replacement.

With shallow tank and multi-layer systems, if artificial seawater is to be used, or if the seawater is to be re-used, a separate reservoir will have to be installed. This must be suitable for seawater use, have a drain at its lowest point for flushing out waste, and an operating outlet pipe clear of the base. This must be accessible for inspection and cleaning and if outdoors must be covered. The reservoir capacity must be sufficient to contain the total volume of seawater required in the purification tank.
A single reservoir can serve several purification tanks used in sequence.

Vertical stack systems have a sump which acts as a reservoir, separate from the containers of molluscs, as an integral part of their design.

Connection to a single-phase power supply is normally required for the UV sterilisation unit. The pump may require single or three phase supply. All connections and switches used within the working area where the system is installed must be hose-proof. IP66 classification is recommended. Cables must not be left trailing on the floor.

9. Initial Testing



Reservoir settling tank

A new system must be run firstly with seawater only, to check that the water circulation system will operate correctly and that there are no leaking joints, and then be left to run overnight. Leaks will probably be a result of joints being inadequately tightened. The system must be able to operate at the required water flow and this is best monitored by installation of a flowmeter (which for a multi-layer system is essential). Check the operation of the water spray bar, cascade, or jets which must be uniform. Water must not jet or fall directly onto the places where molluscs are held. The UV lamps must operate correctly. After draining down, the tank should be cleaned as described in Section 16.3. For systems that are filled via the circulation pump an approximation to the flow can be made from the time taken to fill a known volume of the tank.

A new system must be run firstly with seawater only, to check that the water circulation system will operate correctly and that there are no leaking joints, and then be left to run overnight. Leaks will probably be a result of joints being inadequately tightened. The system must be able to operate at the required water flow and this is best monitored by installation of a flowmeter (which for a multi-layer system is essential). Check the operation of the water spray bar, cascade, or jets which must be uniform. Water must not jet or fall directly onto the places where molluscs are held. The UV lamps must operate correctly. After draining down, the tank should be cleaned as described in Section 16.3. For systems that are filled via the circulation pump an approximation to the flow can be made from the time taken to fill a known volume of the tank.

10. Mollusc Supply

Non-uniform spray bar flow

It is often forgotten when handling live bivalve molluscs that they are a live animal and even though encased in a hard shell they are easily damaged and physically or thermally shocked. Molluscs must be in good intrinsic condition if they are to be active when re-immersed and it is advisable, therefore, that the handling history between harvesting and arrival at the purification or dispatch centre is known and acceptable.

Depending upon species and harvesting techniques, damage to a few molluscs may be inevitable. However, if more than a few molluscs are dead, gaping or showing signs of excessive shell damage then the batch should be rejected. The time from harvesting should be known as molluscs should not be out of seawater for more than a few days before re-immersion. For some species, such as those grown in sub-littoral areas and not used to being out of water, this time period must be short. For cockles a maximum of 12 hours[10] is recommended. When out of seawater a raw material storage temperature of between 2°C and 10°C is generally recommended, however, native oysters should not be held at less than 4°C and mussels can be iced.

When approaching their spawning season bivalve molluscs are more susceptible to shock, and great care needs to be taken if spawning in the tank is to be avoided. Molluscs are weakened by spawning, and often they are not harvested until they have sufficiently recovered.

11. System Operation

When used for purification, the operating requirements specified in the FSMP must be followed. Although the instructions given in this manual are in line with established practices, the FSMP apply to each individual system and may incorporate special environmental parameters depending on the particular circumstances of operation.

Purification is a batch process. Firstly, the system is loaded with molluscs, then filled with seawater and water circulation commences. After the requisite period the seawater is drained away from the molluscs and then the purified molluscs can be removed. The system must not be disturbed (i.e. molluscs added or removed) during the period of immersion. When loaded mechanically, it is feasible to fill multi-layer systems with seawater prior to loading the molluscs.

Batches of molluscs from different sources must be kept separate for documentation purposes, enabling the tracing of molluscs back to source, but different batches from the same category of harvesting area can be held in the same tank. The Regulations prohibit the mixing of species in a tank. The mixing of species would be harmful if the tank conditions did not suit all the species concerned. In multiple tank installations the re-circulating seawater must not be shared during purification by tanks at different stages of the purification cycle.

The operation of the different types of purification systems is discussed in more detail in Sections 12-15. These sections must be read with reference to the specified standard design manual.

12. Shallow Tank Systems

This section makes reference to relevant sections of the Operating Manual for Small Scale Shallow Tank Systems (Seafish Report No.: 721)

[10] Minutes of Meeting to discuss depuration issues – Cefas/FSA/Seafish 1-December 2008 Aviation House, London

Rectangular shallow tank system

12.1 Design Variations

The molluscs are held in suitable mesh type containers placed on the bottom of a shallow, rectangular tank. The preferred design is to use a spray-bar above the longest side of the tank, from which seawater flows to a suction pipe mounted clear of the tank floor on the opposite side. At relatively low recirculation rates this simple approach can create a uniform flow of sufficiently oxygenated seawater across the tank.

Some older systems use long narrow tanks with water flowing along the length of the tanks between the shorter sides, or fit spray-bars along two adjacent sides and draw water from a single point at the opposite corner. The effectiveness of such variations in design must have been demonstrated prior to the issue of FSMP.

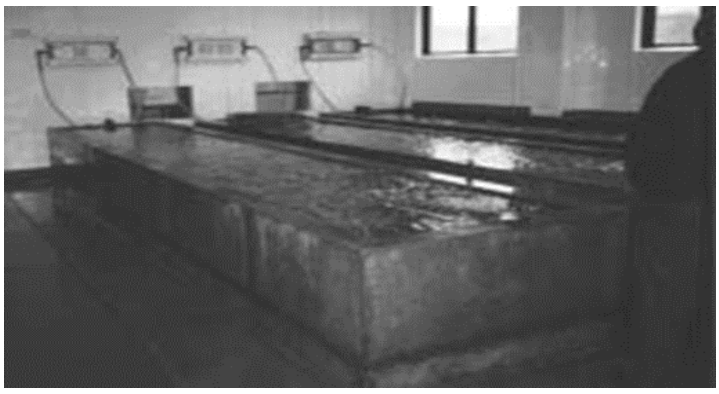
12.2 Mollusc Containers

Suitable mesh containers must be used with mesh sides and bottom. Two such containers in common use are described in Manual 721, Section 9.2, but containers should make a reasonably good fit acro than around them, but with clearance left at spray- container used is to be changed or there is doubt a

Unsuitable containers with part solid sides

12.3 Loading the Containers with Molluscs

Molluscs must be washed and any that are dead or damaged should be removed before loading into the containers. The molluscs in each container must be loaded to a depth no greater than that specified in Manual 721, Section 9.3. If the containers used are different from those in the Manual 721, the nominal loading may be given in the FSMP. If not, Seafish will be able to advise. Only those species specified in the FSMP may be purified.



Long narrow tanks

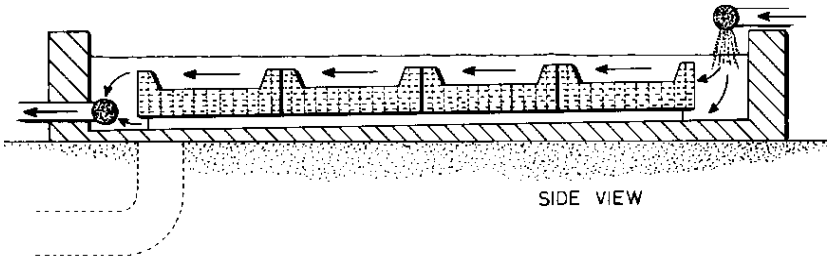
12.4 Loading the Tank with Containers

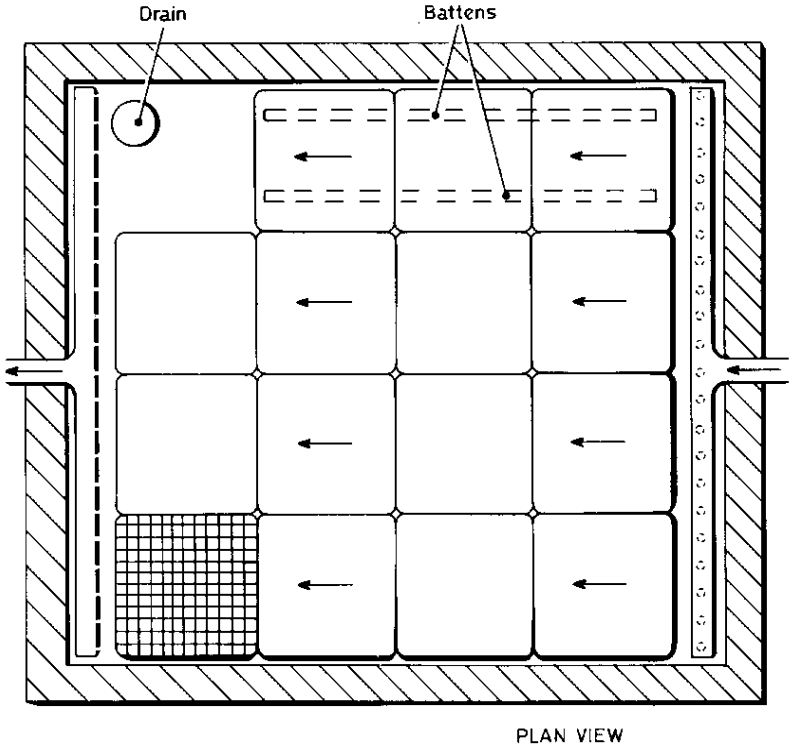
The containers must be positioned clear of the tank floor, usually on plastic battens, and positioned such that they are not directly against the suction pipe nor beneath the spray-bar. The containers must also be kept clear of any drain that is used for emptying the tank whilst the molluscs are still in position. Battens must be aligned with the direction of water flow.

Containers stacked on plastic battens

Stacked containers in tank

Container stacking up to three high is normal practice for oysters and clams with mussels in a single layer. However, the stacking of containers of mussels may be permitted in some systems (usually as a result of a satisfactory dissolved oxygen test). Care must be taken to stack containers such that they interlock correctly, and the load is not taken by the molluscs.





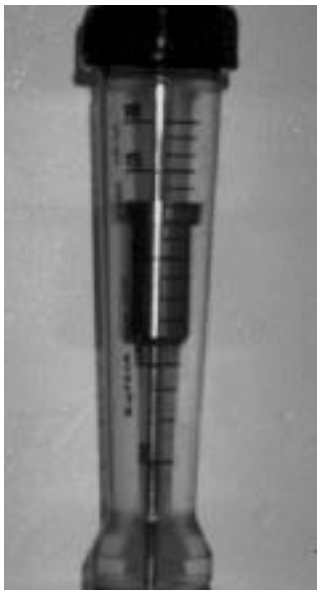
If the tank is to be only part loaded the containers should be loaded across the full width of the tank so that the water flows through them.

12.5 Filling the Tank with Seawater

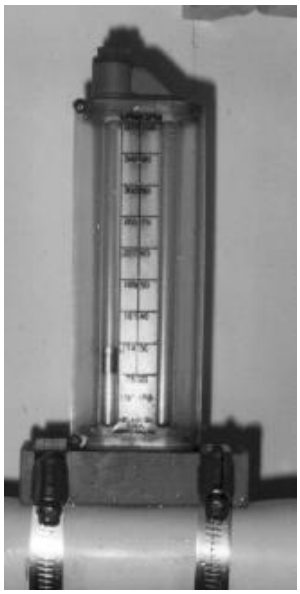
The seawater salinity must suit the particular species of mollusc undergoing purification (Section 7) and should be checked whilst the tank is being filled. Manual 721, Sections 9.5 and 13.2 give further details, including salinity measurement.

Before filling, the UV treatment unit must first be switched on and checked to see if it is functioning correctly. This is usually indicated by an annular ring of green/blue light being visible at the end caps of each lamp (or similar indicator).

The method of filling the tank with seawater may vary with individual system design but should normally be via the system UV unit and the tank spray bar. The seawater circulation and valve control position diagram and instructions given in Manual 721, Section 9.5 can be used where a similar pipe-work system is installed, or reservoir used. If the seawater is treated in a separate settlement/treatment system or is treated by a separate UV as part of the seawater supply system to the purification centre, it may enter the tank directly.



In-line flowmeter



Saddleback flowmeter

Filling must continue until the containers have been covered, at which time the seawater supply is turned off and seawater re-circulation commenced. The seawater flow must be at least that required in the FSMP and should be checked and set if a flowmeter and control valve are installed. If the flowmeter is of the in-line flow-through type and fitted as an integral part of the pipe-work system, the flow is usually read from the widest part of the indicator. If the flowmeter is of the “saddleback” type and attached to the flow pipe surface the indicator gives a direct reading. With the latter type it is necessary to ensure any entrapped air is bled out of the meter before a reading is taken. This is done by unscrewing the bleed screw on top.

Spray-bars must be checked to ensure that water jetting is uniform and is directed correctly as occasionally holes can become partially blocked by weed or debris during filling.

It is essential that at the start of the purification cycle the molluscs are covered with seawater by at least 80 mm for mussels and 30 mm for other species. During immersion molluscs should open their shells slightly to permit respiratory/filter feeding activity and will tend to move up within the container, effectively reducing the depth of water above them. Also, the molluscs may have lost inter-valvular fluid during storage and replenish it as their shells open. The molluscs must remain covered during purification.

12.6 Operating Requirements During Purification

Seawater Temperature: To ensure that molluscs remain sufficiently active, seawater temperature must be maintained at or above that required in the FSMP for each species. Recommended maximum temperatures may also be given. Further detail is given in Manual 721, Section 9.

Immersion Time: This is specified in the FSMP and is usually 42 hours. It is possible in certain circumstances to reduce the depuration time. However, this can only be done with the approval of the AO[11,12].

Mollusc Activity: When the molluscs are immersed they should show some signs of activity by slightly opening their shell halves. Dissolved waste excreted by the molluscs may also result in some foaming of the water. Further detail is given in Manual 721, Section 9.6.

Monitoring the System Operation: For a purification centre, details of molluscs received, start and finish times of purification and details of subsequent consignment must be recorded and checks of seawater salinity, temperature, turbidity, flow rate and UV lamp life recorded. This is best recorded using a log sheet as detailed in Manual 721, Section 9.9.

Seawater Re-use: The FSMP will usually permit re-use of seawater over a specified period of time. However, this is prescribed as the maximum limit and the operator must be satisfied at each re-use that the seawater quality is adequate. Further detail is given in Manual 721, Section 9.10.

Microbiological Sampling: Operators of purification systems are required to carry out microbiological testing on samples of molluscs. This is discussed in Manual 721, Section 9.11.

12.7 Draining the Tank and Unloading Molluscs

At no time whilst they are immersed should molluscs be disturbed or removed as this can cause re-suspension and ingestion of settled out material in the system. The tank must be drained before removing the molluscs.

The method of draining the tank will vary with individual system design. More recently built systems adopt the preferred method of initial draining of the seawater to waste or reservoir via the circulation system suction pipe, which continues the same direction and rate of flow in the tank. This is shown in the seawater circulation diagram in Manual 721, Section 9.5. The mollusc containers can then be removed and the remaining water and detritus below the level of the containers can be flushed to waste via a separate drain. Older systems may simply have a valve or plug or screw cap opening in the tank floor or wall to direct seawater directly to waste. This should be positioned at the suction end of the tank to maintain the same seawater flow direction and must be sized such that the discharge flow rate is not excessive and does not disturb detritus whilst the molluscs are immersed.

After unloading the molluscs must be washed and packed and the containers and tank cleaned as described in Manual 721, Section 9.8. If molluscs are to be returned to the system for storage they and the tank must first be hosed down.

13. Multi-Layer Systems

This section makes reference to relevant sections of the Operating Manual for the Medium Scale Multi-Layer Systems (Seafish Report No.: 720)

13.1 Design Variations

A description of how a multi-layer system works is given in Manual 720, Section 2.

Although multi-layer systems have been developed by Seafish as a standard design, the principle has been adapted by some operators who have constructed their own systems. Because of the need to retain control over water flow to maintain adequate levels of dissolved oxygen throughout the stacked containers in these systems, they have used the same design features and their method of operation is basically similar to the standard design.

[11] http://www.seafish.org/media/publications/Red_Dep_Time_V3IB_RF.pdf
[12] https://www.food.gov.uk/sites/default/files/reduced-purification-times-shellfish.pdf

Series of concrete multi-layer systems

Series of concrete multi-layer systems multi-layer systems that are not of the standard design should have undergone a dissolved oxygen test in fully loaded condition as part of the technical inspection prior to approval.

13.2 Mollusc Containers

These must have open mesh sides and bottom. The mollusc containers must be a good fit into the cross-section of the tank so that the water flows through them rather than around them. Suitable containers currently in use are described in Manual 720 Section 9.2. Alternative containers can be used, as long as the flow of water through the tank is maintained and dissolved oxygen levels are maintained at an optimum.

13.3 System Operation

Instructions for container loading and unloading, filling and draining seawater and operating requirements are described in Manual 720 Sections 9.3 to 9.13. Any differences in pipe-work should not affect the basic method of operation.

14. Vertical Stack Systems

This section makes reference to relevant sections of the Operating Manual for Vertical Stack Systems (Seafish Report No.: 722)

14.1 Variations in System Design

The molluscs are held in purpose designed, solid-sided containers which are supported above one another over a sump tank. Seawater is drawn from the sump to the top container in the stack from where it cascades down to the container below, and so on, until it returns to the sump. Such systems have been in widespread use for many years and common variations in design are detailed below:

Seafish Standard Design: this has two stacks of eight purpose designed containers stacked in a frame supported over a plastic sump tank. It is a self-contained unit with its own seawater circulation system and the facility for drainage of individual containers direct to the sump. Further details are given in Manual 722.

Other Containers in Frame Designs: the number of containers in a stack may be as many as ten and the number of stacks over the sump as many as ten. The containers used in such systems are usually the same as used in the Seafish Standard Design, however, other types of container may be in use. Non-standard containers usually drain down through one another and not separately.

Interlocking Containers: containers are stacked directly on top of one another without a support frame. This has a number of disadvantages including a reduced cascade height, and lack of visibility of and access to the molluscs within the stack. Containers may or may not drain separately to the sump.

Stacked Tanks: a number of shallow tanks are stacked one above the other over a sump with molluscs held in mesh containers within each tank. The water cascades down from tank to tank and the system is effectively a series of shallow tank systems operating from a common sump.

Vertical stack system using Seafish containers

14.2 Mollusc Containers

The solid-sided containers in stacked container systems must facilitate a uniform flow of seawater through the molluscs and incorporate a cascade system, which provides aeration but does not direct seawater onto the molluscs in the container below. The Seafish modified container described in Manual 722, Section 2, has been designed to achieve this and has a removable mesh mat to keep the molluscs clear of the container bottom. It is fitted also with a drain tap to enable separate drainage of each container to the sump.

Stacked tank, rather than stacked container, systems must use suitable mesh sided containers within the tanks as described in Section 12.2.

14.3 Loading the Containers with Molluscs

For stacked container systems the mesh floor matting should first be placed in the bottom of the containers. Molluscs must be washed and any that are dead or damaged should be removed before loading into the containers. The molluscs in each container must be loaded to a depth no greater than that specified in Manual 722, Section 8.2. If the container is not the type used in the Standard Design the nominal loading may be given in the FSMP. For stacked tank systems the guidance given in Section 12.3 may be followed.

14.4 Loading the System with Containers

For stacked container systems each container must be orientated correctly, either when slid onto the frame supports (as discussed in Manual 722, Section 8.3) or when stacked directly on top of one another. The top container must be orientated to receive the seawater supply correctly and the lower containers must be orientated to receive the cascade from the container above. Drain taps, if fitted, must be closed. If the system is to be only part-loaded, all containers may still have to be installed to reduce splashing.

For stacked tank systems the guidance given in Section 12.4 should be followed.

14.5 Filling with Seawater

The seawater salinity must suit the particular species of mollusc undergoing purification (Section 7) and should be checked whilst the sump is being filled. Manual 722, Sections 8.4, 8.5 and 12.2, give further details, including salinity measurement.

The seawater sump tank acts as a reservoir and can be used for the mixing of artificial seawater but it must not be used as a settlement tank for turbid seawater. The sump should contain sufficient seawater to fill the containers or tanks and maintain sufficient water depth to maintain pump suction without drawing in air.

Before commencing circulation and immersing the molluscs the UV unit must be switched on and care taken to ensure that the lamp is functioning correctly. This is usually indicated by an annular ring of green/blue light being visible at the end caps.

The circulation pump can then be switched on to fill the containers or tanks with seawater. Check to see that the containers in stacked container systems are correctly orientated and level and that all molluscs become immersed by about 30 mm of seawater. The levelling of the containers may be crucial to water

flow, as described in Manual 722, Section 7.

If a flowmeter is fitted the correct water flow should be set. Either an ‘in line’ or ‘saddleback’ type flowmeter may be fitted. These are described and shown in Section 12.5.

14.6 Operating Requirements During Purification

It is essential that the purification system functions correctly throughout the purification period and that adequate records are kept and checks on operation made. The mollusc containers must not be moved or otherwise disturbed whilst the molluscs are immersed as this can cause the re-suspension and ingestion of detritus. Details on seawater temperature, immersion time, mollusc activity, system monitoring, seawater re-use and microbiological sampling are given in Manual 722, Sections 8.6 to 8.8 and 8.10 to 8.12.

14.7 Draining the System and Unloading Molluscs

The containers or tanks must be drained to below the level of the molluscs before the containers are moved.

To drain the containers or tanks first turn off the pump and UV. The means of draining individual containers or tanks will depend upon their design. The Seafish Standard Design containers are fitted with drain taps connected to a drain pipe. Some early designs relied on a small hole fitted in the bottom of each container with drainage into the box below, but this is no longer recommended as it is slow and can carry over detritus.

Once the seawater has drained sufficiently, the containers can be removed from the frame, stack or tank. The molluscs must then be washed and packed and the containers cleaned as discussed in Manual 722, Section 8.9. The sump should be drained and cleaned out whenever the seawater is replaced.

Guidance on the subsequent use of the systems for immersed storage is given in Manual 722, Section 8.9.

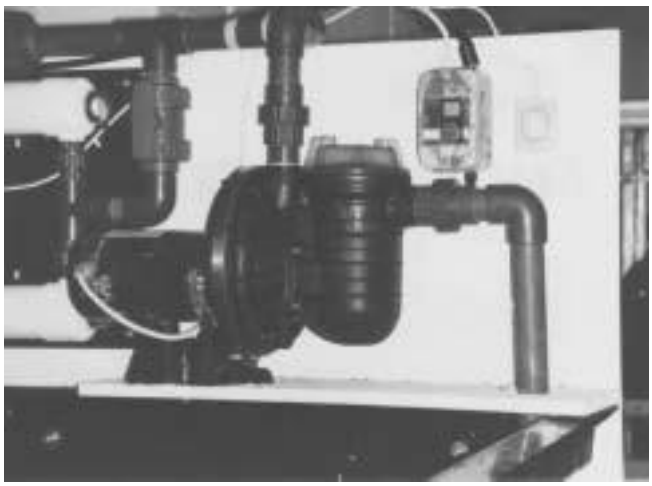
15. Cleaning and Maintenance

15.1 Pump Filter

A course screen filter may be fitted to the pump or to the pipe-work on the suction side to prevent any larger shell pieces from entering the pump and causing damage. This requires occasional cleaning by lifting out and rinsing with clean tap water.

15.2 Ultra Violet Light (UV) Sterilisation Unit

These systems are fitted with either single or multiple UV units, with 15, 25 or 30-watt lamps or other suitable system. The instructions for cleaning and lamp replacement are given in the appropriate standard design system manual.



Pump with filter unit

4 x 30-watt UV lamp unit

15.3 Purification System Cleaning

After each purification cycle the purification tanks and containers should be thoroughly flushed out with clean water to remove silt and shell debris. With vertical stack systems the sump tank should be cleaned out when seawater is replaced.

To prevent accumulation of slime and dirt the system should periodically be cleaned with a suitable cleaning agent. Hypochlorite solution (as found in household bleach) is recommended. The empty containers should be loaded into the system tank or sump, filled with tap water and the hypochlorite added (with care, following manufacturer's instructions). The circulating pump should then be switched on and left for a few hours. After cleaning, the system must be thoroughly flushed through with clean water to remove any traces of residual chlorine which will harm molluscs.

Cleaning agents must be stored in a safe place way from the mollusc handling and purification areas.

15.4 Sand Filter

If a sand filter is used for seawater supply (it must not be fitted such that it forms part of seawater re-circulation) care must be taken to follow the manufacturers operating instructions. In particular, the pressure gauge should be checked as excess pressure indicates the filter is becoming clogged and requires back flushing.

16. Possible Problems and Answers

Occasionally things can go wrong due to equipment failure, poor handling, poor seawater quality or poor intrinsic quality of the molluscs, or simply incorrect operating procedure. Some of the more likely problems and answers, but by no means every possibility, are given in the relevant Standard Design Manuals.

17. Modifications to Purification System

Modifications to the system or its method of operation should not be made without first contacting the AO. The design flow conditions in the system must be maintained if it is to operate effectively and modification may disrupt this. The LA must approve of any changes made.

18. Further Information

18.1 Industry Guidelines

Seafish have produced a Good Manufacturing Practice Guidance (GMPG)[13] document on bivalves. Recommendations are based upon good practice but include legal requirements. The document deals with facilities and equipment and includes purification and the use of purification facilities for conditioning and immersed storage.

18.2 Seafish and Seafish Advice

At Seafish[14], our mission is to support a profitable, sustainable and socially responsible future for the seafood industry. Our remit includes everything - and everyone - from fishermen and processors through

[13] http://www.seafish.org/media/publications/gmpg_bivalves_downloadable.pdf
[14] http://seafish.org/

to importers, retailers and food service providers. We offer an advisory role to industry, local food authorities and government departments. Where resources permit, Seafish will provide general advice when possible and appropriate, and/or signpost enquirers to other sources of information and service providers.

18.3 Artificial Seawater

Artificial Seawater has higher initial cost but can offer considerable advantages where systems are to be operated inland or local supplies of natural seawater are considered unsuitable. Advice on the production and use of artificial seawater is given in a Seafish technical advisory document[15] on the re-use of seawater for purification systems.

18.4 Seafish Technical Reports

Technical Reports describing much of the work carried out by Seafish on Mollusc Purification can be obtained from Seafish.

Further information on the operation of Purification Systems or any of the above-mentioned publications can be obtained from:

Lee Cocker, Aquaculture Manager and/or Lee Cooper, National Learning and Standards Manager
Seafish, Origin Way, Europarc, Grimsby, NE Lincolnshire DN37 9TZ
Tel: +44 (0)1472 252 300
Fax: +44 (0)1472 268 792
Email: seafish@seafish.co.uk

[15] http://www.seafish.org/media/Publications/FS32_07_09_Reuseofseawaterforpurificationsystems.pdf