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Seafish Standard Design Purification Systems: Operating Manual for the Small Scale Shallow Tank Purification System

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Contents

1. The Development of the Small Scale Shallow Tank System

Historically in the U.K. the purification of oysters and clams was permitted in tanks with mollusc trays stacked three high. The stacking of trays of mussels was not permitted and this resulted in large shallow outdoor purification tanks that were exposed to the elements and over which there was no real control of seawater temperature.

To improve upon this Seafish developed more sophisticated high-density, multi-layer purification tank systems for high throughput operations, and an improved vertical stack cascade system for smaller-scale operations with high value species. These physically smaller units can be housed in the controlled environment within a building.

To assist in this development work, Seafish constructed a number of small shallow tank purification systems, each capable of holding two mollusc trays and using a standard plastic pallet box as the tank. Each operated independently with its own seawater circulation system and ultra violet light (UV) steriliser. These were used during trials at a number of commercial purification centres around the UK and several operators expressed commercial interest in them as being suitable for purifying and holding molluscs on a small scale. A simple shallow tank system, based upon the original test design, was therefore developed and tested by Seafish working with an equipment manufacturer. A larger capacity pallet box than the original test system was used at little additional cost and resulted in a simple and inexpensive purification system for small scale use.

2. How Does a Shallow Tank System Work?

The molluscs are held in plastic trays through which water easily flows. These are placed on battens on the bottom of the shallow tank. Seawater enters via water jets above one end of the tank and flows through the trays of molluscs to a suction pipe or weir across the other end. The tanks are normally constructed of plastic, however, some can be constructed of concrete. The water flow rate in this simple design is relatively low and hence the capacity to supply sufficient dissolved oxygen to the molluscs is also low and the permissible loading (i.e. the stacking) of the system is limited.

The seawater is re-circulated via a pump and the flow rate controlled by a valve and flowmeter. The seawater receives microbiological treatment by passing through an enclosed ultra-violet light (UV) sterilisation unit.

The molluscs function naturally in the clean seawater and purge themselves of bacterial contamination. Detritus settles out on the base of the tank.

3. 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 and Critical Control Points (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

[1] https://www.food.gov.uk/enforcement/monitoring/shellfish/shellfish-purification
[2] https://www.food.gov.uk/business-industry/food-hygiene/haccp

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 issue “approval” for 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 test is the responsibility of the operator of the purification system and can prove time consuming and costly, particularly if repeat testing is required.

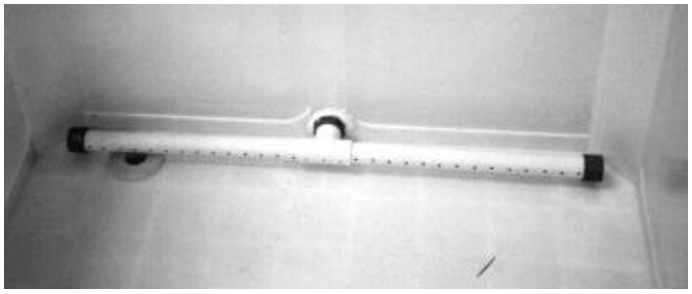
4. The Standard Design Concept

The range of standard design purification systems developed by Seafish were built to specified designs that met the technical requirements of the time and which had been tested extensively in a wide range of conditions. Being proven designs, they have a more predictable, simplified, less time consuming and less expensive approval procedure than applying for approval of an unknown system.

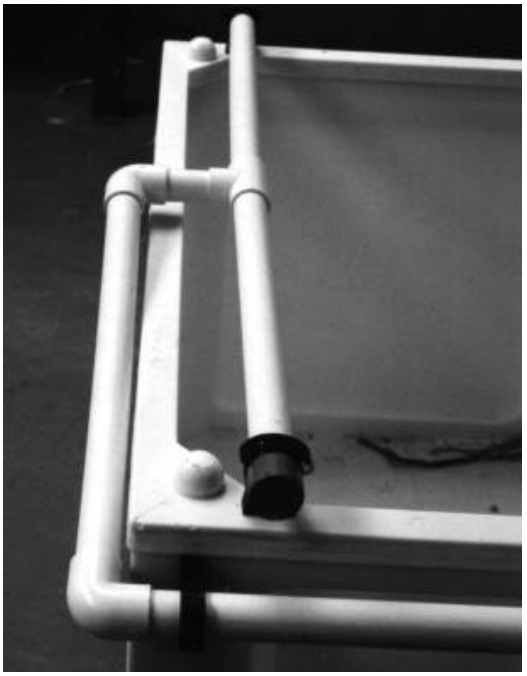
5. The Seafish Standard Design Small Scale Purification System

This normally uses a 650 litre Allibert Type 21626 or similar plastic pallet box as the tank, into which six mesh type plastic trays are placed. Trays may be stacked in two columns, three high.

The trays are stacked on top of lengths of plastic pipe battens, which keep them clear of the tank floor. Seawater re-circulation equipment consists of a suction pipe, waterproof pump, flow control valve, 25-watt UV water steriliser, flowmeter, perforated spray bar and interconnecting pipework. ‘T’ pieces either side of the pump provide for seawater filling and emptying. The suction pipe is clear of the tank base, and a drain is fitted in the tank floor for final drainage and cleaning. When fully loaded, the system has a nominal capacity of 90 kg of mussels and requires 550 litres of seawater.

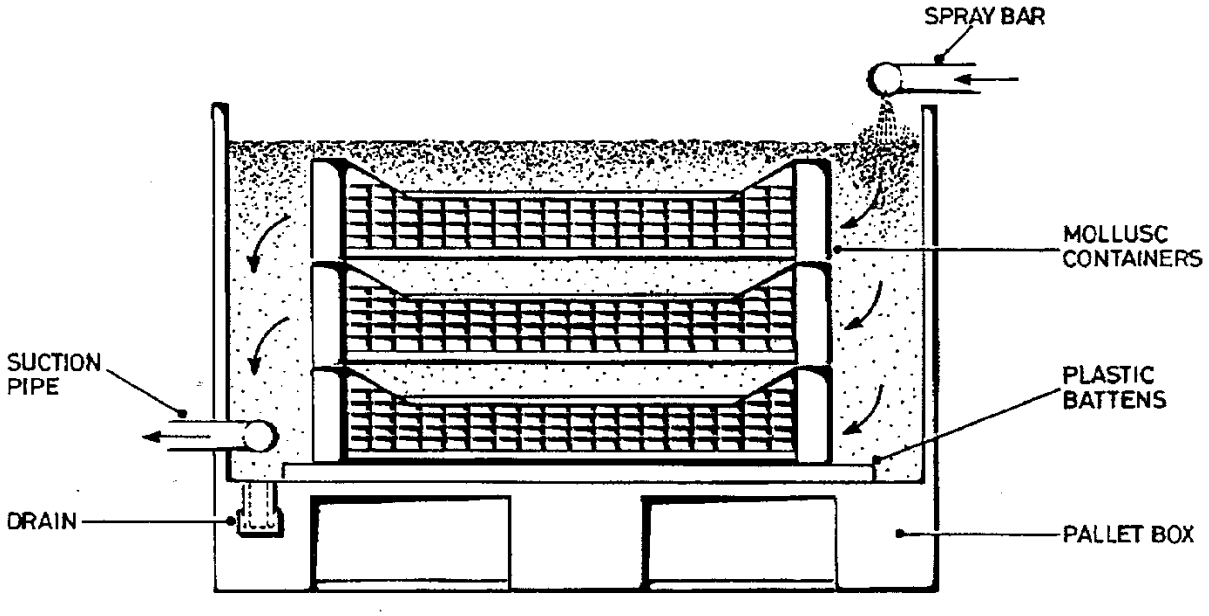


Suction pipe



Spray bar

[3] http://www.foodstandards.gov.scot/business-and-industry/industry-specific-advice/fish-and-shellfish



Side view of shallow tank system

6. 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. Turbidity can be removed by the use of a sand filter or a seawater settling tank. If a sand filter should be used for new incoming water, it should not be installed as part of the seawater re-circulation system.

Temperature: The table below gives a guide to those most common temperatures used by species. Mollusc activity is dependent upon seawater temperature and adequate dissolved oxygen levels. Minimum seawater temperatures are stipulated for the purification of each species to ensure adequate mollusc filtration activity. A maximum seawater temperature is sometimes stipulated for mussels which have a high oxygen demand. In addition, if seawater temperature is too high all molluscs can weaken, spawn or die and so maximum temperatures are recommended for some species by Seafish. These depend upon species, growing conditions and season. The temperatures normally required for purification are shown below.

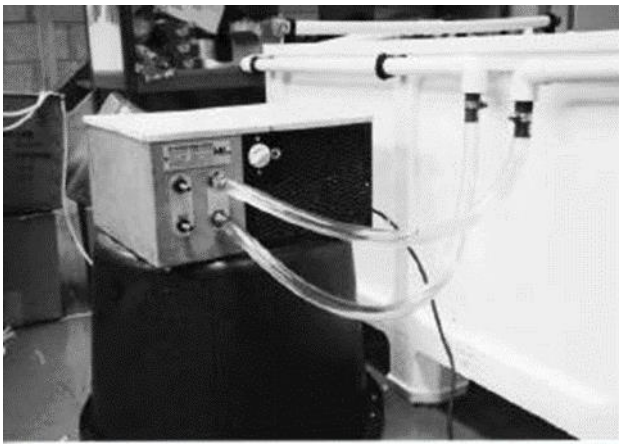
Large temperature differentials between molluscs and seawater when filling the purification system should be avoided as they may reduce mollusc activity, induce spawning or even cause mortality. To avoid this, molluscs should be allowed to reach the required temperature slowly.

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

Seawater Temperatures

Species	Minimum	Maximum
Mussels	5^{O}C	15^{O}C
Native Oysters	5^{O}C	15^{O}C
Pacific Oysters	8^{O}C	18^{O}C
Clams	12^{O}C	20^{O}C
Cockles	7^{O}C	16^{O}C

If suitable minimum seawater temperatures cannot be maintained the system must not be used for purification. Seawater chillers and heaters can be obtained to operate with these systems. These must be installed and operated such that the water flow is not disrupted or local hot or cold spots created in the part of the tank where the molluscs are held. Further information should be obtained from the tank manufacturer, and approval sought from the AO before use.



In-line seawater chiller

Oxygen: Dissolved Oxygen (DO) in the water is affected by temperature and water flow rate, especially under the spray bar. The points below are taken from the FSA guidance (FSA, 2016)[5] to AOs and should be followed. Probes for measuring dissolved oxygen should be calibrated as per the management plan.

- The minimum DO at any point in the purification tank must be capable of sustaining normal physiological activity of the shellfish
- It is recommended that DO levels are measured at the spray bar, middle of the system and at the suction bar
- The minimum DO currently used in assessing the oxygenation capabilities of purification systems is 5mg/l

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.

[5] https://www.food.gov.uk/enforcement/monitoring/shellfish/shellfish-purification

- 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
- 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*)	25.0
Mussels (*Mytilus* spp.)	19.0
Cockles (*C. edule*)	20.0
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

Position of Seawater Intake: This must not draw in waste from sewage 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 re-use of seawater for purification systems[6].

Microbiological Treatment: Initial low levels of microbiological contamination are reduced by UV treatment of the water before it enters the tank. Repeated cycling of water through a low wattage UV bank over time can reduce bacterial contamination if high wattage lamps are not available[7,8]. The use of ozone to supplement but not replace UV treatments is permitted and should be included in the FSMP if used[9,10].

[6] http://www.seafish.org/media/Publications/FS32_07_09_Rpdf
[7] WHO http://www.who.int/water_sanitation_health/emerging/depuration.pdf
[8] Cefas 'Ultraviolet disinfection in depuration systems in England & Wales'
[9] https://www.food.gov.uk/sites/default/files/multimedia/pdfs/enforcement/enfni10039annb.pdf
[10] https://www.cefas.co.uk/media/52849/20100827-ozone-discussion-document-uk-final.pdf

7. System Installation

Panel mounted seawater recirculation equipment

Tank location should avoid direct sunlight. The tank may be levelled such that the tank floor slopes to its drain valve. Alternatively, after use these tanks are often tipped on their side for effective cleaning.

The seawater re-circulation system was disassembled to reduce the chance of damage during transport and requires re-assembly onto the panel attached to one end of the tank in accordance with the manufacturer's instructions. The system valve control diagram is shown on a separate page below.

The standard layout of pipework and equipment is such that it can all be drained when the system is emptied, to avoid leaving areas of stagnant water. If there is a need to change this layout care should be taken to maintain this total drainage. It may be necessary to install means of draining specific pipework and equipment.

The flowmeter and UV end caps must remain visible and valves be accessible. Access for maintenance is important, particularly to the UV sterilisation unit, which will require periodic cleaning and tube replacement. Some UV systems do not have illuminated end caps. In some cases, a simple alternative illumination may indicate the lamp is illuminated. Specialist equipment for measuring the irradiated light may be incorporated into large systems. The 'dose' delivered to a cross-section of water will depend on the flow rate and transparency (turbidity) of the water.

The tank is usually filled and emptied via the circulation pump, which has double valves on its suction and delivery sides to re-direct input from tank re-circulation to seawater supply, for filling and to re-direct output from re-circulation to emptying. Flow rate is controlled by the valve on the delivery side.

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. A capacity of at least 600 liters will be needed. A single reservoir can serve several purification tanks used in sequence.

Connection to a single-phase power supply may be required for the UV sterilisation unit and pump.
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.

8. Initial Testing

A new system must be run, firstly filled 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 of 20 litres/minute. Check the operation of the water spray bar. Water must jet vertically down into the area between the tank wall and trays. The UV lamp must operate correctly. After draining down, the tank should be cleaned as described in Section 10.3.

9. 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 "approval" applied to each individual system may take account of unique circumstances depending on the particular circumstances of operation.
Purification is a batch process. Firstly, the tank is loaded with molluscs, then the tank is filled with seawater and water circulation commences. After the requisite period the seawater is emptied from the tank 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.

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 should not be shared during purification by tanks at different stages of the purification cycle unless proof of sterility of the returning water from treatment is demonstrated

9.1 Mollusc Supply

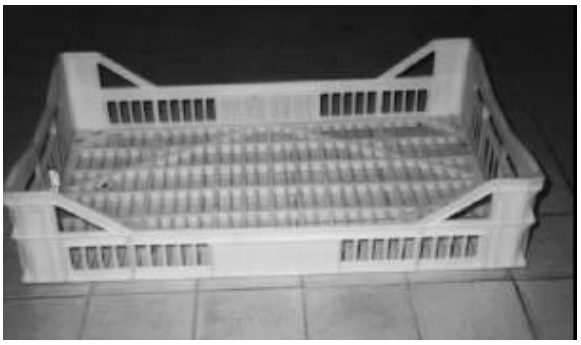
It is often forgotten when handling live bivalve molluscs that they are a live animal and even though encased in a hard shell they are easily damaged and physically or thermally shocked. Molluscs must be in good intrinsic condition if they are to be active when re-immersed and it is advisable, therefore, 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 is recommended[11]. When out of seawater a raw material storage temperature of between 2°C and 10°C is general 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.

9.2 Mollusc Trays

The trays used for stacking inside the purification tank must have suitable open mesh sides to allow water flow, and open mesh bottom to permit faeces, silt, sand, etc. to settle out. The original two tray types in use for the small-scale system at the time of this advice being originally written were the GPG C1479 and the Allibert 41042. Alternative trays of similar design may be used.



GPG C1479

Allibert 41042

Manufacturer Type	External Size (mm)	No. for Tank
Allibert 41042	760 x 450 x 165	6
GPG C1479	762 x 457 x 140	6

Tray types or similar

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

Only one type can normally be used at any time as they are not normally inter-stackable. Other suitable trays should be used as long as the flow of water is not impeded or DO levels to the animals reduced.

9.3 Loading the Trays with Molluscs
The molluscs must have been thoroughly washed with clean water to remove silt, sand and weed before being put into the purification tank, and care taken not to roughly handle them. Any dead or damaged molluscs should be removed. Molluscs can be washed in the trays.

Tray Loading

Species	Allibert 41042/GPG C1479 or similar	
	Depth	Nom. Amount
Mussels	80 mm	15 kg
Pacific Oysters	Double Layer	125 Oysters
Native Oysters	Single over-lapping layer	125 Oysters
Clams	80 mm	21 kg
Cockles	80 mm	15 kg

The molluscs must be placed in the trays at depths no greater than those specified in the 'Tray Loading' table. The nominal weight (or number in the case of oysters) is only a guide and will vary with season, harvesting area and size.

9.4 Loading the Tank with Trays
The plastic pipe battens provided (two to each side) must first be positioned on the tank floor, aligned with the direction of water flow. The trays of molluscs must then be placed on top of these, taking care that the trays stack correctly on top of one another and are centrally positioned so that they are not directly against the suction pipe nor beneath the spray bar.

Although the trays will fit either along or across the tank, they should be positioned along the tank with their narrow ends to the spray bar and suction pipe. This minimizes the gap between the trays and the tank sides so that the water flows through the molluscs.

9.5 Filling the Tank with Seawater
Before filling, the UV treatment unit must be switched on and care taken to ensure that the tube is functioning correctly. This is usually indicated by an annular ring of green/blue light at the end caps or alternative means.

For systems operating with a seawater reservoir the system is filled from the reservoir via the circulation pump, and with the valves open or shut as indicated in the sea water circulation diagram. Valves must be correctly set to ensure seawater enters the tank via the UV steriliser and not the suction pipework.

When the seawater level is at the top surface of the trays the valves are operated as shown in the diagram for circulation.

When a single reservoir is used to serve more than one purification tank, particular care must be taken with valve settings to ensure that seawater is not directed into the wrong tank.

In-line flowmeter

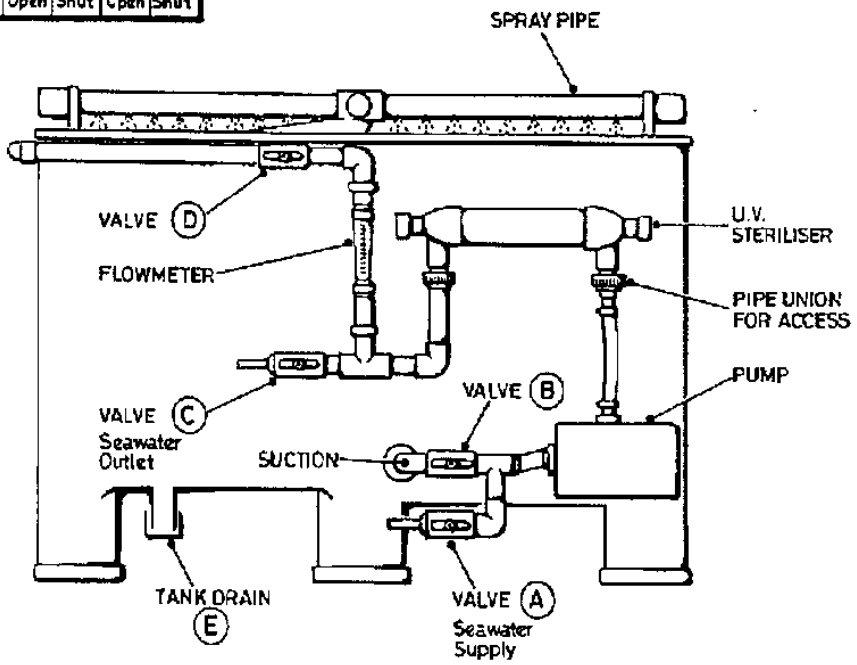
The flow control valve D should now be set to maintain the required water flow of 20 litres/minute. The flowmeter is of the in-line flow-through type and fitted as an integral part of the pipework system.

In-line flowmeter

The flow is read from the widest part of the indicator. If no reservoir is used and seawater is supplied directly it should still enter the tank via the UV unit. However, the circulation pump originally fitted is not of a self-priming type and cannot be used to draw water from a level below it. In this case a separate pump will have to be used. This pump should deliver water at about the specified system flow rate to maintain effective UV treatment. The seals on the UV unit may burst if pressure in the pipework is excessive. 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.

WATER FLOW		A	B	C	D
Purification Tank	Fill	Open	Shut	Shut	Open
	Empty	Shut	Open	Open	Shut
	Circulate	Shut	Open	Shut	Open
Reservoir	Circulate	Open	Shut	Open	Shut

Seawater circulation system and valve control positions



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 intervalvular fluid during storage and replenish it as their shells open. This may introduce detritus into the tank. If this happens then delay starting the timed cycle whilst continuing to run the system, until the water in the tank is clear. The molluscs must remain covered with water during purification.

9.6 Mollusc Activity

When the molluscs are immersed in seawater they should exhibit signs of activity by slightly opening their shell halves. Often air bubbles will be seen rising to the water surface as entrapped air is released. After a few hours the shell halves should be more open and, depending upon species, mantles or syphons should be visible. Some species are more active than others. Mussels are often active within minutes whereas hard shell clams exhibit intermittent activity. After the first overnight period the molluscs should be active and the seawater clear (tank bottom visible).

Surface foaming

If not, the system should be drained down and the reason sought. Inactive molluscs will not purify satisfactorily.

Foaming on the water surface is created as a result of the build-up of dissolved waste excreted by molluscs. The amount of foam will depend upon species, level of activity and the extent of re-use of seawater. It is not normally a problem but if foaming is excessive it will flow over the tank sides and will reduce the seawater level such that the molluscs are not adequately covered. In this case, action must be taken to reduce foaming.

9.7 Immersion Time

For purification, the minimum immersion time required will usually be 42 hours. It is possible in certain circumstances to reduce the depuration time[12]. However, this can only be done with the approval of the AO[13]. The immersion period can be extended prior to draining down if it is desired to store the full load of molluscs in the system. Extended storage of cockles is not recommended as they become exhausted and die.

If during a purification cycle the system should stop operating, the time lost must be made up to ensure the required purification time has been achieved. If the system has been stopped or operating at a reduced flow for more than a few hours the molluscs may have been weakened. If they show signs of weakness such as gaping, or even mortality, the molluscs must not be consigned for human consumption.

9.8 Draining the Tank and Unloading Molluscs

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

To drain the tank the seawater is diverted away from the spray bar to waste or a reservoir by operating the valves as shown in the seawater circulation diagram. This continues the same direction and rate of water flow in the tank, thereby reducing the chance of any re-suspension of material. Once pump suction is lost the water flow will stop and pump and UV can be switched off. Some water will be left in the bottom of the tank but it will be below the trays and is run to waste with the detritus by opening the final main tank drain valve (E).

Unloading of trays is carried out manually after the water has been drained. Once unloaded the molluscs must be washed with clean water and the required sorting and packing operations carried out. As the finished product must be alive, this should be done with care to minimize shock and damage. Packaging must be clean and labels attached as instructed by the local AO. A product storage temperature of 2°C to 5°C is generally recommended, however, native oysters should not be held at less than 4°C and mussels can be iced.

The trays and tank should be washed whilst wet before silt, etc. dries on. With the drain valve (E) open the sediment in the bottom of the tank can be flushed out to waste.

If only some of the molluscs are to be packed after purification and the system is to be used for immersed storage of the remainder, the system should still be emptied and washed out. Trays of molluscs that are to be put back into the system must first be hosed down.

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

9.9 Monitoring the System Operation

For a purification center details of molluscs received, start and finish times of purification and details of subsequent consignment, must be recorded and checks of seawater salinity, temperature and UV lamp life made. These details are best recorded in tabular form using a log sheet such as that shown at the end of the manual or indicated by the FSMP. The source column could include movement document number. It is recommended that seawater temperature is measured at the start, middle and end of purification. If a time recorder is not fitted to the UV sterilisation unit then hours switched on should be recorded cumulatively to give an indication as to when the lamps need replacement. The comment column can be used to note anything that occurred during purification such as a power cut or pump failure and subsequent action taken. The dates also allow a check on seawater re-usage.

If more than one purification system is used each should have its own log sheet to avoid confusion.

Log sheets must be filled in legibly and be kept somewhere dry, such as an office, and not be left lying around in the purification or dispatch centre. It is a good idea to keep basic system details of start and finish time, salinity and temperature, on a chalk or pen board mounted on a wall. This serves as a daily reminder of status and can be transferred to the log book on a weekly basis.

9.10 Seawater Re-use

The FSMP should prescribe conditions under which seawater can be re-used for each purification system, and generally permit re-use over a specified period of time. However, this period is prescribed as the maximum limit of water usage and the operator of a purification system must satisfy themselves at each successive re-use within the period that the water quality is adequate. If molluscs appear inactive when immersed and water quality is suspected, new seawater should be used. If seawater quality was the cause, molluscs will usually become active when re-immersed in the new seawater.

The re-use of seawater for successive purification cycles can result in dissolved waste from the molluscs accumulating in the seawater to a level which may inhibit purification. This depends upon the species of molluscs, their intrinsic condition, the loading of the purification system and the seawater temperature. When repeatedly re-using seawater, the salinity may increase as a result of evaporation, particularly when temperatures are high, and care must be taken to ensure it does not go beyond the prescribed level.

9.11 Microbiological Sampling

Operators of purification systems are required to carry out microbiological testing on samples of molluscs post-depuration. This is called End Product Testing (EPT). Guidance on the frequency of sampling and on competent laboratories to which samples can be taken should be sought from the AO. Sampling frequency will be based upon the standards of operation at the purification center, including the degree of supervision and control and adherence to industry good practice guidelines.

A sample of molluscs must contain sufficient shellfish flesh for a test to be carried out; 10-15 molluscs would normally be taken as a sample. With large molluscs it may be possible to use less (although never less than 6). Dead or gaping molluscs should not be used. The laboratory will advise if sample size is inadequate and sometimes will not accept samples below a certain number, so it is advisable to check.

The sample molluscs should be put into a clean plastic bag and be kept in cool conditions, ideally at 4°C (an insulated box containing freezer packs is the method normally used) and be delivered to the laboratory within 24 hours. Molluscs must not be frozen. The samples must be labelled to enable identification.

The microbiological results must show that the purified molluscs comply with any relevant legislative or FSMP requirements. If these standards are not met then the AO must be contacted for further advice.

10. Cleaning and Maintenance

10.1 Pump

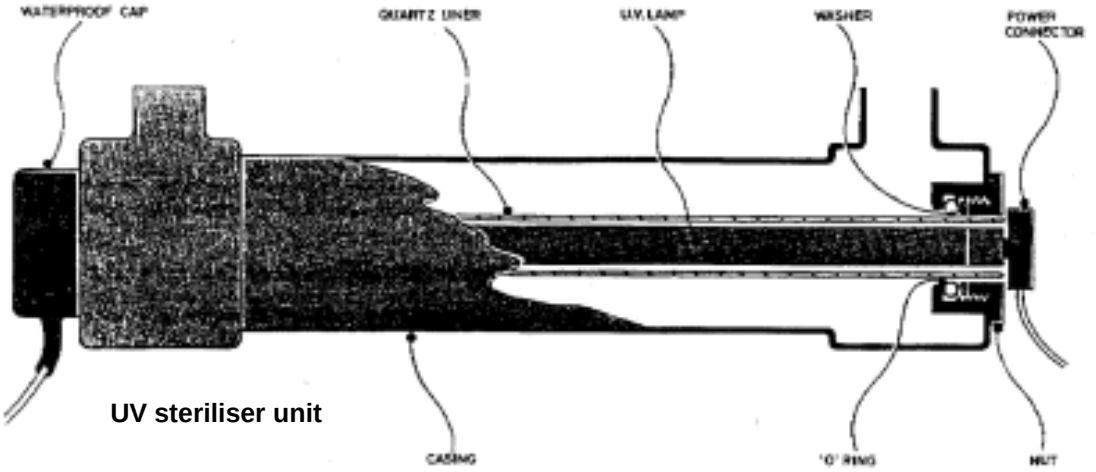
With the pump switched off the pump suction end cap is easily uncoupled by turning it a ¼ turn. Any byssus or pieces of shell can then be removed from inside the pump. If the tank is full of water valve B will have to be closed. The suction pipe cover can be replaced after first ensuring that the sealing ring and housing face are clear of any shell or debris. The cap should be tightened firmly.

10.2 UV Sterilisation Unit

Safety: UV light is dangerous to the eyes and skin and the lamp must never be operated outside its housing. A green/blue glow can be seen at the ends of the unit to indicate that it is on in normal use. Before any cleaning or maintenance is carried out the electrical power must be switched off.

Lamp Replacement: The lamps gradually deteriorate in use and must be changed as specified in the FSMP. This may be based upon the intervals specified by the lamp manufacturer in terms of hours of use, however, a calendar time interval may be given instead.

25-watt UV lamp unit



UV steriliser unit

To replace a lamp:

- Switch-off the power
- Carefully pull-off the lamp connectors and covers from either end, supporting the tube if mounted vertically
- Gently slide the lamp out of the quartz sleeve
- Fit the new lamp in the reverse procedure

Cleaning: The quartz sleeve may need cleaning occasionally as a result of sediment building up on its outer surface. The accumulation of sediment will depend upon the clarity of the water supply and it is recommended that the sleeve is checked after a few weeks to give a guide to the frequency of cleaning required.

To remove the quartz sleeve:

- Switch off the power and remove the UV lamp as described above
- Make sure the water has been drained out of the unit
- Unscrew the end nuts and remove the “O” ring seals and washers (this is sometimes difficult). The tube will need support at the bottom of the unit if mounted vertically to prevent it falling out
- Withdraw the quartz sleeve, taking care to handle it at the ends only, and inspect it carefully. If cracked the sleeve must be replaced. The sleeve should be cleaned with soapy water and gentle brushing if necessary. The sleeves discolour after many years of use and if badly stained should be replaced
- Rinse and dry the sleeve and replace it in the unit Inserting a clean wooden dowel into the sleeve can assist in this and reduce the chance of breakage
- Replace “O” rings and washers and tighten the nuts with hand pressure only and, if necessary, re-connect to the plumbing system
- Turn on the water and check for leaks
- Replace the lamp

10.3 Purification System Cleaning

After each purification cycle the purification tank should be thoroughly flushed out with clean water to remove silt and shell debris. Trays should be hosed down.

To prevent accumulation of slime and dirt the tank and pipework should periodically be cleaned with a suitable cleaning agent. Hypochlorite solution (as found in household bleach) is recommended. The empty trays should be loaded into the tank, the system filled with tap water and the hypochlorite added (with care, following manufacturer's instructions). It 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 away from the mollusc handling and purification areas.

10.4 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 manufacturer's operating instructions. In particular the pressure gauge should be checked as excess pressure indicates the filter is becoming clogged and requires back flushing.

11. 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. The following gives some of the more likely problems and answers but by no means covers every possibility. If the cause of a problem cannot be found, further advice should be sought by contacting Seafish.

11.1 Difficulty in Filling the Tank with Seawater

- Water level in reservoir too low (below pump)
- Air lock in supply pipework
- Valves incorrectly set
- Pump filter partly blocked

11.2 Water Flow Stopped

- Power supply off (if circuit trip in control box will not re-set, contact electrician)
- Pump failure
- Control valve turned off
- Pump filter blocked
- Water level in tank below suction pipe

11.3 Water Will Not Flow at Required Rate

- Pump filter partly blocked
- Pipework fouled with marine growth (in particular spray or suction bar)
- Air leak on pump suction. When this occurs, air can be seen passing through the sight tube of in line flowmeters, or air accumulates in the saddle type
- Valves partly blocked or incorrectly set
- Worn pump

11.4 UV Lamp Unit Not On or Flickering

If the green/blue light does not appear at the ends of the unit when switched on, or the lamp flickers, the unit is not operating correctly.

- UV lamp faulty and requires replacement
- Starter unit in control box faulty
- Corrosion on terminal ends

11.5 Excessive Foaming

- Water flow greater than that prescribed
- Water re-use. With seawater re-use there can be a gradual build-up of the dissolved waste that causes foaming, particularly with mussels and at higher seawater temperatures. More frequent water replacement may be necessary

11.6 Molluscs Appear Inactive Whilst Immersed

- Incorrect salinity
- Seawater temperatures too low or too high
- Seawater quality poor (re-used too often)
- Inadequate water flow
- Molluscs in weakened condition as a result of poor handling and/or delays between harvesting and re-immersion
- Molluscs in seasonally weak condition (post spawning)
- Thermal shock. Molluscs subjected to too great a temperature change when re-immersed

11.7 Seawater Becomes Cloudy

If during purification or immersed storage the seawater becomes clouded (usually a milky colour) the molluscs have probably spawned and if held in the system will die. Spawning does occur naturally but can be precipitated by shock and high-water temperatures. The clouding of the water should not be confused with the slight turbidity that can sometimes occur when molluscs are initially immersed. This can be caused by mud and silt not removed completely by washing and should disappear within a few hours.

11.8 Molluscs Die or Appear Weak

Molluscs generally gape when dead or are in a weakened condition, and will not close their shell halves at all or only close them slowly when disturbed.

- Molluscs have spawned
- Molluscs in a weakened condition (see 11.6)
- Water temperature too high
- Too long a period of immersion
- Molluscs stressed following a period with no water flow

12. Modifications to Purification System

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

13. Measurement of Seawater Salinity and Temperature

13.1 Temperature

A hand-held, digital electronic probe thermometer is recommended. A robust and water-resistant type should be used and its calibration checked at intervals (for example in a container of clean, iced, fresh water). Glass thermometers are prone to breakage and if used to measure seawater temperature this should not be directly in the purification system but in a suitable container (as used for salinity measurement) filled from the tank.

The continuous monitoring of seawater temperature is possible using special, sealed electronic units that can be positioned in the purification system.

13.2 Salinity

Seawater salinity should be checked using a hydrometer. These are usually made of glass so care must be taken and measurement made in a suitable container filled from the tank. The container must be clean and be deep and wide enough to allow the hydrometer to float without touching the sides or bottom (a soft drinks bottle with the top cut off can be used).

The hydrometer will usually give a reading of specific gravity (SG). From this and seawater temperature, a conversion chart can used to obtain a salinity reading.

Some hydrometers can give a direct reading of salinity with built-in temperature compensation. For this type the salinity conversion chart is not required.

Using the traditional type hydrometer:

1. Fill the container with seawater, place on a bench at eye level and let any air settle out

2. Insert the hydrometer (ensuring it is clean) and let it settle making sure it is afloat and not touching the container sides
3. Read the hydrometer scale level with the water surface ignoring the surface tension meniscus around the hydrometer stem. The scale is usually between 1.000 and 1.050 and is a reading of SG
4. After use, wash the hydrometer and container with tap water

14. Further Information

14.1 Industry Guidelines

Seafish, in collaboration with the trade, local food authorities and relevant government departments are publishing comprehensive guidelines covering the harvesting, handling and distribution of bivalve molluscs. Recommendations are based upon good practice but include legal requirements. The current document deals with facilities and equipment and includes purification and the use of purification facilities for conditioning and immersed storage.

14.2 Other Operating Manuals

Seafish have produced a series of these operating manuals for the range of standard design purification systems available. These include multi-layer, vertical stack and bulk bin systems. There is also a manual for those who wish to operate a system constructed of a 'Non-Standard Design'.

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

14.3 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 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.

14.4 Seafish Technical Reports

A range of Technical Reports describing much of the work upon which the Standard Design Systems have been developed can be obtained from Seafish.

Further information on the operation of the Small Scale Shallow Tank Purification System 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

[14] http://seafish.org/

Purification System Log Sheet

Species	Amount	Source	Start		Finish		Seawater				UV Hours	Consignment	Comment
			Date	*Time*	*Date*	*Time*	*Sal*	*Temp*	*Temp*	*Temp*			