

# SEAFISH

## Seafish Standard Design Purification Systems: Operating Manual for the Bulk Bin System for Mussels

March 2018

**Seafish Report (SR) No.: 718**  
**ISBN No.: 978-1-911073-24-6**

Seafish

Origin Way  
Europarc  
Grimsby DN37 9TZ

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

[www.seafish.org](http://www.seafish.org)

# Seafish Standard Design Purification Systems



## Operating Manual for the Bulk Bin System for Mussels

Seafish Report (SR) No.: 718  
ISBN No.: 978-1-911073-24-6

Updated March 2018 by Pyke and Deane Aquaculture Consultants  
Email: [consultmandy@hushmail.com](mailto:consultmandy@hushmail.com)

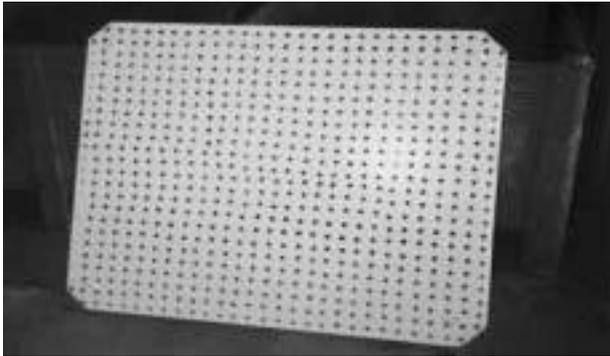
# Seafish Standard Design Purification Systems: Operating Manual for the Bulk Bin System for Mussels

## Contents

1. The Development of Bulk Bin Purification for Mussels.....	1
2. How Does the Seafish Bulk Bin Purification System Work?.....	1
3. The Approval of Purification Systems.....	2
4. The Standard Design Concept.....	2
5. Use of the Bulk Bin System for Other Species .....	3
6. Seawater Supply.....	3
7. System Installation .....	4
8. Initial Testing.....	5
9. System Operation .....	5
9.1 Mollusc Supply .....	6
9.3 Positioning the Bins.....	6
9.4 Filling and Re-circulating the Seawater .....	7
9.5 Seawater Salinity.....	7
9.6 Seawater Temperature.....	8
9.7 Mollusc Activity .....	8
9.8 Immersion Time.....	8
9.9 Draining the System and Unloading Molluscs .....	8
9.10 Monitoring the System Operation .....	9
9.11 Seawater Re-use .....	9
9.12 Microbiological Sampling.....	9
10. Cleaning and Maintenance .....	10
10.1 Pump Filter .....	10
10.2 Ultra Violet Light (UV) Sterilisation Unit .....	10
10.3 Purification System Cleaning .....	11
10.4 Sand Filter .....	11
11. Possible Problems and Answers.....	12
11.1 Difficulty in Filling Bins with Seawater and Maintaining Water Level .....	12
11.2 Water Flow Stopped.....	12
11.3 Water Flow Out of Main Bin Outlet Reduced Whilst Maintaining Overflow .....	12
11.4 Mussels Not Covered by Seawater .....	12
11.5 UV Lamp Unit Not On or Flickering.....	12
11.6 Excessive Foaming .....	12
11.7 Molluscs Appear Inactive Whilst Immersed .....	12
11.8 Seawater Becomes Cloudy .....	12
11.9 Molluscs Die or Appear Weak .....	12
12. Modifications to Purification System .....	13
13. Measurement of Seawater Salinity and Temperature .....	13
13.1 Temperature .....	13
13.2 Salinity .....	13
14. Further Information .....	13
14.1 Other Operating Manuals .....	13
14.2 Seafish and Seafish Advice .....	14
14.3 Artificial Seawater.....	14
14.4 Seafish Technical Reports .....	14

## 1. The Development of Bulk Bin Purification for Mussels

Historically, in the UK, mussels had to be purified in a single layer no more than 80 mm deep. This resulted in large shallow outdoor purification tanks that were exposed to the elements and over which there was no real control over seawater temperature. Following extensive trials, Seafish demonstrated that under controlled conditions, trays of mussels could be purified when stacked up to six high. This resulted in the development of standard design multi-layer purification systems. Although these systems enabled mollusc purification to be housed indoors, and reduced some of the labour required to load and unload the tanks, it was still necessary to manually fill, empty and wash the individual mollusc containers.



**Mesh false floor**

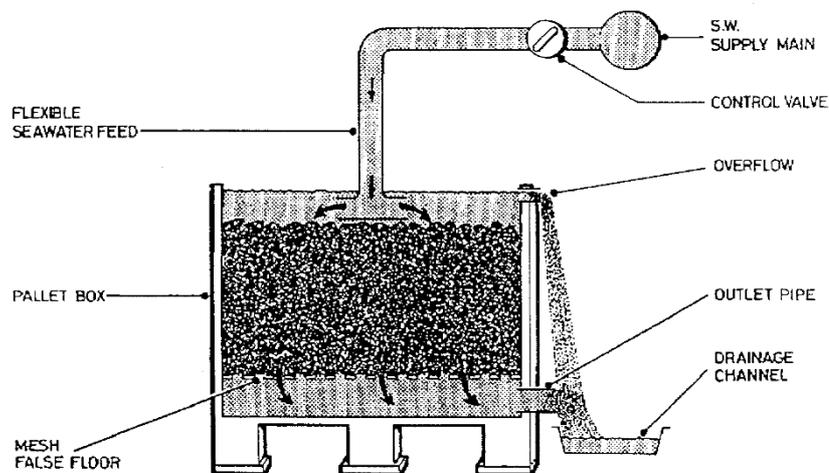
For many years the Dutch had been de-gritting in bulk, rather than in trays, in large tanks up to 1.2 m deep. Seafish investigated this approach and found that although mussel activity could be maintained at such a depth, the limiting factors for purification were providing sufficient water flow to maintain adequate levels of dissolved oxygen and the need for a down-welling water flow to carry away detritus and to avoid its re-ingestion by the molluscs. It was necessary then to develop these principles into a working mussel purification system.

Plastic pallet bins are readily available and inexpensive and are designed for use with hand pallet and fork lift trucks and a variety of other mechanical handling aids. A series of trials were undertaken by Seafish which resulted in the standard modification of a standard plastic pallet bin to create a bulk bin for mussel purification. This was shown to successfully purify mussels when operated under controlled conditions. Further trials with a multiple bin installation were successful and established the bulk bin system for mussel purification in the UK.

For large capacities the system has potential advantages over other systems in terms of both low capital cost and low labour cost through mechanized handling. It also has the flexibility to be part-used for smaller quantities without operating the complete system.

The system is not suitable for the bulk purification of species that do not naturally function in deep layers, and is at present approved for the purification of mussels only.

## 2. How Does the Seafish Bulk Bin Purification System Work?



**Side view through bulk bin**

The mussels are held in a deep layer in a number of specially modified plastic pallet bins. Each bin is transportable and can be connected to a common seawater supply and return system. This consists of a sump from which seawater is pumped to an ultra violet light (UV) steriliser unit, where it receives microbiological treatment, and then to a main supply line. From this, each bin receives a controlled seawater supply which ultimately returns to the sump via a common drainage channel. The pallet bin is a GPG Dolav Type D12105 or similar with a capacity of 650 litres and external dimensions of 1200 mm x 1000 mm x 740 mm. It is fitted with a plastic false floor, fabricated from plastic sheet and drilled with holes to permit the flow of water and detritus. The false floor is a good fit to the sides of the box, and is supported 80 mm clear of the box floor by side supports and plastic pillars. It is removable for cleaning. Mussels are loaded to a depth of 380 mm above the false floor, which corresponds to approximately 300 kg of mussels per bin. Water is supplied from the main via a control valve and a flexible feed pipe such that it enters each bin above the mussels but below the water surface, and this creates little disturbance. Two water outlet pipes are fitted, one below the false floor but clear of the base of the bin, and the other near the top rim of the box. The lower water outlet pipe is sized to permit a water flow of 6,500 litres/hour down through the mussels with the water level at the upper outlet pipe, which acts as an overflow. This ensures the provision of an adequate supply of dissolved oxygen to the mussels without requiring a flowmeter. The bin drains automatically when the water supply is turned off.

Aeration takes place as the water cascades out into the drainage channel and again as it cascades from the drainage channel into the sump.

The down-welling flow carries detritus to the base of the bin where most of it settles out. Some is inevitably drawn to the sump which is designed to enable further settlement. By use of a baffle plate the water returning to the sump is directed down to its base, whereas the suction pipe to the pump draws water from closer to the surface. The molluscs function naturally in the clean seawater and purge themselves of bacteriological contamination.



**Seawater outlet pipe**

### **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)<sup>1</sup>. 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 Points (HACCP)<sup>2</sup>. 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.

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.

### **4. The Standard Design Concept**

The range of standard design purification systems developed by Seafish 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 is less stringent and consequently they have a more

<sup>1</sup> <https://www.food.gov.uk/enforcement/monitoring/shellfish/shellfish-purification>

<sup>2</sup> <https://www.food.gov.uk/business-industry/food-hygiene/haccp>

predictable, simplified, less time consuming and less expensive approval procedure.

'Stacked' bulk bin systems are now commonly used. Seafish has not provided any technical written guidance on these systems.

## 5. Use of the Bulk Bin System for Other Species

The system has been developed for mussels and is not suitable for species that do not naturally function in deep layers. However, as the bin is similar to that used for the shallow tank system (see Manual 721, referred to in Section 14.2) it may be possible to purify other species using the common seawater circulation system, provided they are stacked in mesh containers within the bin.

## 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<sup>3</sup>.

Factors affecting the suitability of seawater are:

**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 become 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. 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. The minimum salinity for mussels is 19.0‰ (parts per thousand). They may require higher levels dependent on harvesting area condition.

**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.

**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<sup>4</sup>. The use of ozone to supplement but not replace UV treatments is permitted and should be included in the FSMP if used<sup>5,6</sup>.

**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

<sup>3</sup> <https://www.cefas.co.uk/media/52850/2012-water-quality-in-purification-leaflet.pdf>

<sup>4</sup> Cefas 'Ultraviolet disinfection in depuration systems in England & Wales'

<sup>5</sup> <https://www.food.gov.uk/sites/default/files/multimedia/pdfs/enforcement/enfni10039annb.pdf>

<sup>6</sup> <https://www.cefas.co.uk/media/52849/20100827-ozone-discussion-document-uk-final.pdf>

of seawater for purification systems<sup>7</sup>.

## 7. System Installation

Unlike other Seafish standard design purification systems that can be supplied as a complete package, the bulk bin system consists of standardised bins plus a custom design of sump, pump, UV and plumbing, etc., to suit the number of bins and the layout of the premises. The bins should be ideally installed indoors and avoid direct sunlight, and are best installed in a double row with the seawater supply main and drainage channel installed between them. Sufficient access must be allowed on either side to manoeuvre bins into and out of position.

The circulation pump must provide a flow rate of more than 6,500 litres/hour per bin, and sufficient back-pressure in the main supply line when all bins are operating, to maintain flow control to each bin via its control valve.

The UV installation originally comprised two 30-watt UV lamps per bin when enclosed in enclosed 6 tube multiple units, with sufficient numbers of these multiple units connected in parallel. More efficient high intensity UV units are now being used by many FBOs.

The seawater supply main is normally at high (but accessible) levels with flexible plastic downpipes from the flow control valves down to the bins and ending in plastic 'T' pieces to distribute the flow into the bins rather than directing it onto the mussels.



**Double row of bins**

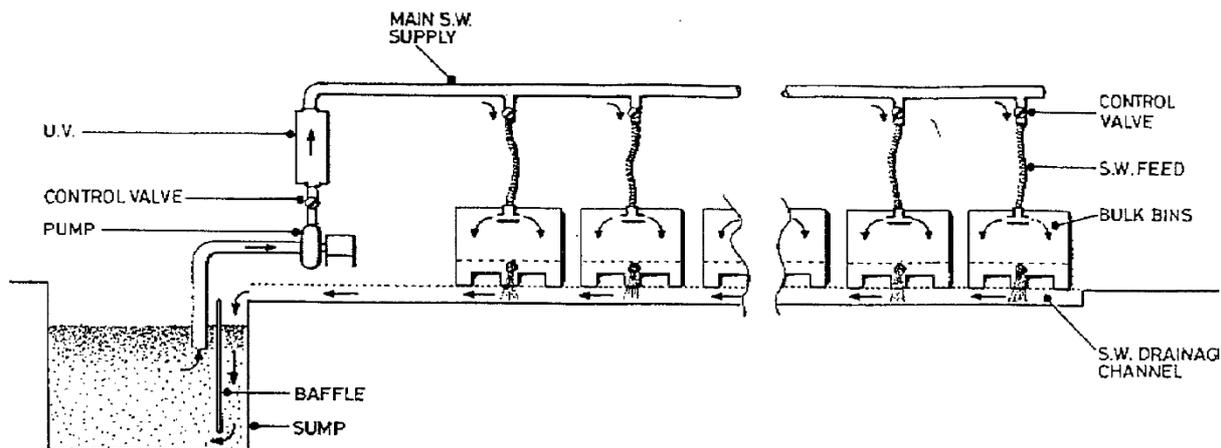
The main water outlet pipe near the base of the bin is quite low down and assuming that the bins are located at floor level, the drainage channel to the sump will probably have to be inset into the floor (with a gradual slope down toward the sump). A floor channel must have a raised lip on either side to prevent any wash water and debris from within the building being inadvertently washed into the channel and hence into the seawater re-circulation system.

The sump tank should have a seawater capacity of at least 1 m<sup>3</sup> per bin and be designed to enable settlement of any detritus from the bins. The sump must be suitable for seawater use, have a drain at its lowest point for flushing waste out when cleaning and a suction pipe well clear of the sump bottom. It must be accessible for inspection and cleaning and if outdoors must be covered.

If the seawater is to be re-used a separate reservoir will have to be installed, as the sump tank must be cleaned out after each purification cycle. The reservoir must also be suitable for seawater use, have a drain at its lowest point for flushing out when cleaning and an operating outlet pipe clear of the base. It must be accessible for inspection and cleaning and if outdoors must be covered. In large installations a single reservoir can serve several sumps used in sequence.

---

<sup>7</sup> [http://www.seafish.org/media/Publications/FS32\\_07\\_09\\_Reuseofseawaterforpurificationsystems.pdf](http://www.seafish.org/media/Publications/FS32_07_09_Reuseofseawaterforpurificationsystems.pdf)



### Bulk bin installation

The pump and the UV units must be installed off the floor and away from any splashing from washing down. Access to valves for operation and to the pump and UV for maintenance is important. The UV units will require periodic cleaning and tube replacement and at least one end cap of each UV lamp should be clearly visible. Pipework and equipment should be installed such that they drain naturally to avoid areas of stagnant water when not in use. If this is not practical then means of draining specific pipework or equipment must be provided.

Connection to a single-phase power supply is required for the UV sterilization 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.

### 8. Initial Testing

A new system must first be run 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 empty bins should be positioned beneath their feed pipes and the sump filled as described in Section 9.4. The main valve between the pump and UV and individual control valves to each bin should be opened and the pump and UV switched on. After allowing time for the seawater flow to settle some bins may fill and overflow excessively whilst others may fill only partially. It is necessary to adjust the bin control valves such that all bins are full and just overflowing at a constant rate. This may take some time as alteration of flow to one valve will affect flow rate from the others. Once a reasonable balance has been achieved it should not be necessary to adjust the control valves further. If a balanced flow cannot be achieved refer to Section 11.1.

The UV lamps must operate correctly and if lamps do not work or flicker refer to Section 11.5. After draining down, the system 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 FSMP apply to each individual system and may incorporate special conditions depending on the particular circumstances of operation.

Purification is a batch process. Firstly, the bins are loaded with molluscs and moved into position, then circulation is commenced and the bins fill with seawater from the sump. After the requisite period of immersion, the circulation is halted and the bins drain. The bins are then taken away and unloaded. The system must not be disturbed (i.e. bins moved or 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 system. Bins sharing the same water supply from a common sump operate together as a single purification system.

### **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 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 mussels should not be out of seawater for more than a few days before re-immersion. For molluscs grown in sub-littoral areas and not used to being out of water, this time period should be short. When out of seawater a raw material storage temperature of between 2°C and 10°C is generally recommended for most molluscs, however, mussels can be iced.

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

### **9.2 Loading the Bins with Mussels**

The molluscs must have been thoroughly washed with clean water to remove silt, sand and weed before being put into the bins, and care taken not to roughly handle them. Any visibly dead or damaged molluscs should be removed.

Before loading the bins, the false floors must have been washed and all molluscs and sediment from previous use removed. Ensure that the lower outlet pipe is unobstructed and that the false floors are placed in the bins.

Mussels can be loaded into the bins up to the maximum depth of 380 mm leaving 120 mm of free space between them and the top lip of the bin. The mussels must not be loaded any deeper as they tend to expand with shell opening when immersed and must remain immersed whilst undergoing purification. Weights or any objects must not be placed on the molluscs during the depuration cycle.

### **9.3 Positioning the Bins**

Once loaded the bins can be manoeuvred into position at the seawater feed pipes and drainage channel. Care must be taken to position them correctly such that the outlet pipes run into the drainage channel. Once in position the flexible feed pipes and 'T's can be lifted over the top lip of the bins and placed on top of the mussel layer. A gap should be left between each pair of bins to allow access to the flow control valves if necessary.

If the system is to be only part loaded the remaining empty bins should be put in place as it will be necessary to have all water outlets operating in order to maintain the pre-set water flow, as discussed in Section 8.



**Bin and feed pipes in position**



**Flexible feed pipes and control valves**

#### **9.4 Filling and Re-circulating the Seawater**

The sump must be filled with a sufficient quantity of seawater such that pump suction will still be maintained when water is transferred to the bins during circulation. This seawater must be of suitable quality as discussed in Section 6. Whether supplied from a separate reservoir, from a settling tank or direct from the sea (possibly via a sand filter), or using artificial seawater, the provision of this supply will probably necessitate a separate plumbing system.

Prior to commencing circulation, the UV unit must be switched on and care must be taken to ensure all tubes are functioning correctly. This is usually indicated by an annular ring of green/blue light at the end caps of each unit or by some other means. If the light flickers, is dull or is not on refer to Section 11.5.

The circulation pump can then be turned on and seawater will start to fill the bins having already passed through the UV Bin filling takes approximately 10 minutes. Once full it is essential that all the mussels are well covered with about 80 mm of seawater and that seawater is flowing from all the bottom outlet and top overflow pipes as discussed in Section 8. If any adjustment is necessary this can be to the flow control valve on each feed pipe. It should be noted that these systems can be operated as a 'single pass' system. If this is the case a significantly greater UV dose should be applied to the water.

#### **9.5 Seawater Salinity**

Seawater salinity should be checked whilst the sump is being filled. The seawater salinity for mussels must be as given in Section 6, and can be measured using a hydrometer as described in Section 13.2. 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 condition.

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. Premixed commercially available salt is available.

## 9.6 Seawater Temperature

Mollusc activity is dependent upon seawater temperature and adequate dissolved oxygen levels. A minimum seawater temperature of 5°C for mussels is stipulated for purification to ensure adequate mollusc filtration activity. If seawater temperature is too high molluscs will weaken, spawn or die. This can depend upon growing conditions and season. In addition, mussels have a high oxygen demand and so a maximum seawater temperature of 15°C is usually stipulated.

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.

If the minimum seawater temperature cannot be maintained the system must not be used for purification. Seawater chillers or heaters can be provided<sup>8</sup>. These must be installed and operated such that the water flow is not disrupted and an even temperature is maintained. This can be achieved by heating or chilling the water in the sump. Approval should be sought from the AO before use.

## 9.7 Mollusc Activity

When mussels 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 mantles visible. Mussels are often active within minutes of being re-immersed. After the first two to three hours they should be active and the seawater clear (sump bottom visible). If not, the system should be drained down and the reason sought. Inactive molluscs will not purify satisfactorily.

Foaming on the water surface in purification systems is created as a result of the build-up of dissolved waste excreted by molluscs and water turbulence; the amount of foam depending upon the level of molluscs' activity, water disturbance and the extent of re-use of seawater. It is not normally a problem and with the bulk bin system there may be foaming in the drainage channel and sump, where water turbulence occurs, but it should not be present in substantial quantities on the surface of the bins. If excessive, action must be taken to reduce foaming (Section 11.6).

## 9.8 Immersion Time

For purification the FSMP will specify the minimum immersion time required which will usually be 42 hours. The immersion period can be extended prior to draining down if it is desired to store the full load of molluscs in the system. It is possible in certain circumstances to reduce the depuration time. However, this can only be done with the approval of the AO<sup>9,10,11</sup>.

If during a purification cycle the system should stop operating, the seawater will automatically drain out of the bins, leaving the molluscs in dry/damp conditions, which should not be detrimental to them. However, when purification is restarted the time lost must be made up to ensure that the required purification time has been achieved. If the seawater flow has reduced such that the water level in one or more bins has fallen, leaving some mussels out of water, the purification cycle must be considered to have been disrupted and time lost made up for the entire batch, after the fault has been corrected.

## 9.9 Draining the System and Unloading Molluscs

The bins must not be moved before they are drained as this can cause re-suspension and ingestion of settled out material in the system. To drain the bins back to the sump simply turn off the pump and UV. The bins then drain over a period of about 10 minutes. Drainage is not total as water continues to run off from the mussels for some hours and some water and most of the sediment remains in the base of the bin but the molluscs are held clear of the bin floor.

Once the bins have drained they should be moved to the post purification washing/packing area and be washed and debyssed. Mussels should be tipped out using mechanical handling equipment and not shovelled out as this can cause unnecessary damage. When tipped out of the bin some of the sediment

<sup>8</sup> Pg 31 of the FAO Fisheries Technical Paper <http://www.fao.org/3/a-i0201e.pdf> Bivalve Depuration: Fundamental and Practical Application.

<sup>9</sup> [http://www.seafish.org/media/publications/Red\\_Dep\\_Time\\_V3IB\\_RF.pdf](http://www.seafish.org/media/publications/Red_Dep_Time_V3IB_RF.pdf)

<sup>10</sup> <http://www.sarf.org.uk/cms-assets/documents/29383-342050.sarf066.pdf>

<sup>11</sup> <https://www.food.gov.uk/sites/default/files/reduced-purification-times-shellfish.pdf>

in the bin may fall away but generally it is contained by falling onto the underside of the false floor. Once out of water the mollusc shells close and hence this constitutes little risk provided that they are not re-immersed in static tanks during subsequent washing.

The molluscs must be debysed, 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 minimise shock and damage. Packaging must be clean and labels attached as instructed by the LA. A product storage temperature of 2°C to 5°C is generally recommended for most molluscs although mussels can be iced.

The bins and false floors should be washed whilst wet before silt, etc. dries on. The sump should be drained and any sediment flushed out.

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 full system should still be emptied and washed out and the molluscs washed prior to reloading. Instructions on part loading the system given in Section 9.3 should be followed.

If the seawater is to be re-used, that lost to waste will have to be replenished with new seawater as necessary. Also, in warm weather there may be a need to make up evaporative losses.

### **9.10 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 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. 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 sterilization 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 left lying around in the purification or dispatch centre. It is a good idea to keep basic 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.

### **9.11 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 FBO of a purification system must be satisfied at each successive 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. The important seawater/mollusc ratio in the system and the percentage of the water replenished after each purification cycle depend upon the design and size of the sump used, and the permissible extent of water re-use will depend on this. When re-using seawater, the salinity will 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.

### **9.12 Microbiological Sampling**

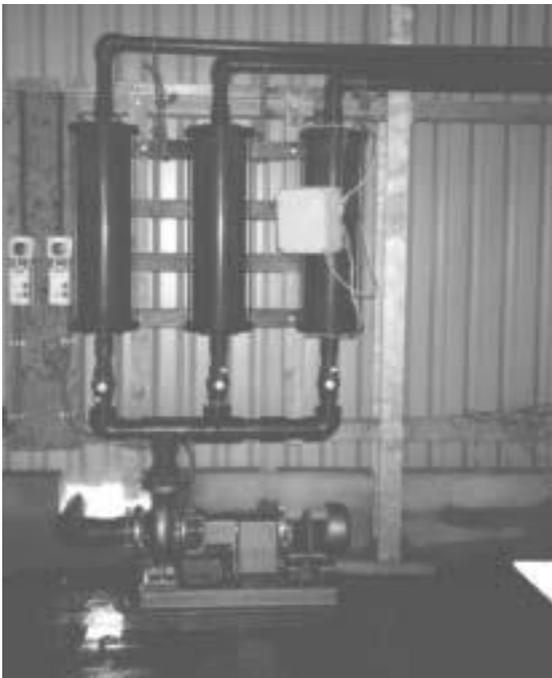
Operators of purification systems are required to carry out microbiological testing on samples of molluscs. Microbiological sampling for end product testing and or system efficacy can only be determined by the FBO as they will understand the risks associated with the batch and processes under their control.

Sampling frequency will be based upon the assumed level of microbial contamination on harvesting, standards of operation at the purification centre and adherence to industry good practice guidelines. The laboratory should carry out a prescribed microbiological or viral analysis procedure.

A sample of mussels must contain sufficient shellfish flesh for a test to be carried out.; 10-15 mussels would normally be taken as a sample. Dead or gaping molluscs should not be used. The laboratory will advise if sample size is inadequate and sometimes will not accept samples containing less than a certain number, so it is advisable to check.

The sample molluscs should be put into a clean plastic bag and 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.



**Pump and 3 x 6 lamp UV sterilisers**

## 10. Cleaning and Maintenance

### 10.1 Pump Filter

If a coarse screen filter is fitted to the pump on the suction side or in the suction pipe to prevent any shell pieces from entering the pump and causing damage, this will require occasional disassembly and cleaning.

### 10.2 Ultra Violet Light (UV) Sterilisation Unit

Instructions for cleaning and replacement for the lamps are given below. For large capacity systems with high intensity lamps the manufacturer's instructions must be followed.

**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 each tube or other indicator, 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 although a calendar time interval may be given instead.

To replace a lamp:

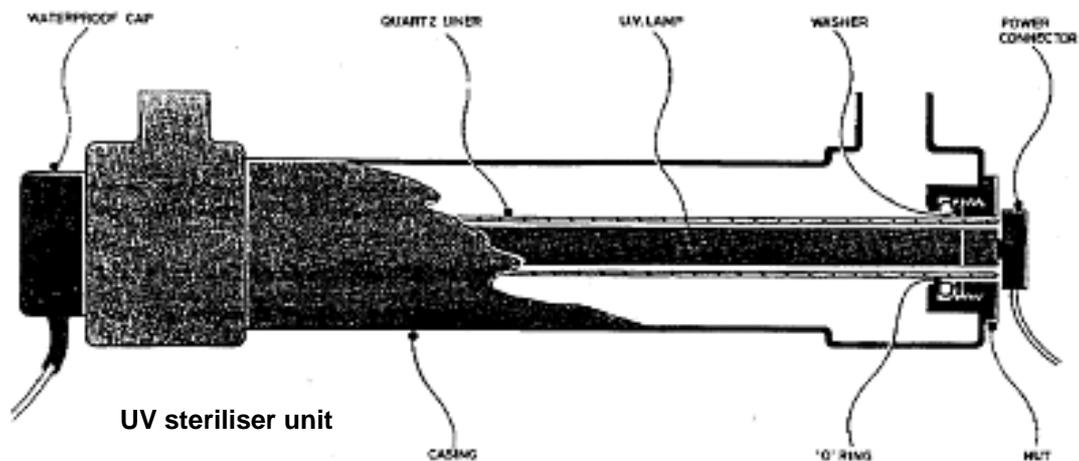
- Switch off the power
- Carefully pull off the lamp connectors and covers from either end, supporting the tube if mounted vertically
- Gently slide the lamp out of the quartz sleeve
- Fit the new lamp in the reverse procedure

**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 a 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

If access to the UV unit for servicing is difficult it may be easier to first remove it from the tank.



### 10.3 Purification System Cleaning

After each purification cycle the purification bins and sump should be thoroughly flushed out with clean water to remove silt and shell debris.

To prevent accumulation of slime and dirt the system should periodically be cleaned with a suitable cleaning agent. Soaking in hypochlorite solution (as found in household bleach) is generally recommended. The sump should be filled with clean water and the hypochlorite added (with care, following the manufacturer's instructions). Clean seawater, if available, can be used for this purpose. With the empty bins in position the circulation pump should then be switched on and left on for a few hours, preferably overnight. After this the system must be thoroughly flushed through with clean water to remove any traces of residual chlorine which will harm the molluscs. A high-pressure washer can be used to clean the sump, bins and drainage channel, again taking care to rinse thoroughly to remove any traces of the cleaning agent used, although an arrangement to clean inside the pipework and associated equipment is still required.

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 Bins with Seawater and Maintaining Water Level

- Water level in sump too low
- Air lock in pipework
- Valve or valves partly blocked or incorrectly set
- Pump filter partly blocked
- Worn pump
- Pump size inadequate

### 11.2 Water Flow Stopped

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

### 11.3 Water Flow Out of Main Bin Outlet Reduced Whilst Maintaining Overflow

- Lower outlet pipe partly blocked with shell (this should not happen if bins cleaned properly after use)

### 11.4 Mussels Not Covered by Seawater

- Water flow to bin too low (no water coming out of overflow pipe)
- Bin overfilled with mussels

### 11.5 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

### 11.6 Excessive Foaming

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.

### 11.7 Molluscs Appear Inactive Whilst Immersed

- Incorrect salinity
- Seawater temperatures too low or too high
- Seawater quality poor (re-used too often)
- 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. Mussels subjected to too great a temperature change when re-immersed

### 11.8 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.

### 11.9 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 11.7)
- Water temperature too high
- Too long a period of immersion

## **12. 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 L.A. 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 a bin outlet pipe.

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

### **13.2 Salinity**

Seawater salinity should be checked using an hydrometer. These are usually made of glass so care must be taken and measurement made in a suitable container filled from the sump. The container must be clean and deep and wide enough to allow the hydrometer to float without touching the sides or bottom (a soft drink 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 the conversion chart is 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 specific gravity (SG)
4. After use, wash the hydrometer and container with tap water

## **14. Further Information**

### **14.1 Other Operating Manuals**

Seafish have produced a series of these operating manuals for the range of standard design purification systems available. These include shallow tank, multi-layer and vertical stack systems. There is also a manual for those who wish to operate a system constructed to their own 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

#### 14.2 Seafish and Seafish Advice

At Seafish<sup>12</sup>, 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.

#### 14.3 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 on the re-use of seawater for purification systems<sup>13</sup>.

#### 14.4 Seafish Technical Reports

A Technical Report describing much of the work upon which the Bulk Bin System has been developed can be obtained from Seafish.

Title	Seafish Report No.
Development of a Bulk Bin, Deep Layer, Down Welling Mussel Purification System	456

Further information on the operation of the Bulk Bin 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](mailto:seafish@seafish.co.uk)

<sup>12</sup> <http://seafish.org/>

<sup>13</sup> [http://www.seafish.org/media/Publications/FS32\\_07\\_09\\_Reuseofseawaterforpurificationsystems.pdf](http://www.seafish.org/media/Publications/FS32_07_09_Reuseofseawaterforpurificationsystems.pdf)

