

Reuse of seawater for purification systems

Seawater is used in purification systems to keep live bivalve molluscs in good condition. The animals will cleanse themselves of low level bacterial contamination.

The seawater that is used can be either raw natural seawater or artificial seawater. Whatever type is used it should not have any microbial contamination in it prior to it entering the purification tanks. For artificial seawater made from salts this is not a problem. For raw seawater some treatment must take place prior to use.

There are different rules on the reuse of seawater in purification systems which are explained in this fact sheet.

Why use artificial seawater?

For many operators of purification and dispatch centres a local supply of good quality seawater may not be available.

Purification plants require a supply of clean seawater for their operation and this can often restrict its location and operation. Delay and exposure to extremes of temperature whilst awaiting transport to a remote site may impair the purification of molluscs.

The use of artificial seawater has the benefit of allowing more choice in plant location where:

- there is no readily available source of natural seawater
- the available seawater is polluted
- the seawater is of inadequate salinity
- the available supply is limited by tide.

Composition of artificial seawater

Natural seawater contains many different salts. A formulation of five simple salts produces an artificial seawater which will allow effective purification of bivalve molluscs. Expensive formulations containing many more salts are available, usually for use in aquaria, but offer no advantage. Some mixtures sold as 'sea salts' may not contain the correct mix of salts and thereby impair purification and subsequent keeping quality.

The five basic salts used are:

Common name	Chemical Name
Sodium chloride (pure vacuum dried salt)	NaCl
Magnesium sulphate (Epsom salt)	MgSO ₄ 7H ₂ O
Magnesium chloride	MgCl ₂ 6H ₂ O
Flake calcium chloride	CaCl ₂ 2H ₂ O
Potassium chloride	KCl

Salinity requirements for live bivalve molluscs

Salinity is way of describing the salt content of seawater. It is essential when using artificial seawater that the salinity is at or above the minimum requirement for the specific species being purified.

SALTS	Weight of salt (kg) for water volumes	
	600 litres (0.6 m)	1000 litres (1m)
Sodium chloride	12.6	21.1
Magnesium sulphate	3.1	5.2
Magnesium chloride	2.5	4.1
Calcium chloride	0.64	1.1
Potassium chloride	0.30	0.5

The reuse of seawater

Artificial seawater can be expensive if used only once. Also transporting raw seawater is expensive in fuel and man hours. Operators can minimise these costs by reusing the water under strict management controls and as long as there is good record keeping for each batch.

Water that is either artificial or raw (taken from the sea) that has been through a complete purification cycle can be reused. This normally involves disposing of the water left at the bottom of the tank or system which will have a high quantity of faeces and pseudo faeces in it.

Rules on reuse

Different rules apply to the reuse of raw natural seawater and artificial seawater. The water to be reused is normally treated in just the same way prior to the next cycle as if it has come straight from the sea or made up from salts. This can include settling out, UV treatment etc

Raw seawater - A batch of raw seawater can be reused for two weeks that is for six cycles. (Each purification cycle is a minimum of 42 hours.) It can be reused for a further two weeks in exceptional circumstances if there are good operational reasons. An example may be excessive winter rain rendering the salinity at the abstraction point to be lower than an acceptable standard.

Artificial seawater – This can be reused for four weeks providing at least 10% is replaced after each cycle and that the shellfish to water ratio is not excessive. This equates to 12 cycles.

Both the above cases for raw and natural seawater assume that the operator accepts a loss of 10% of the water from the last batch. This is made up from a central tank of unused seawater. A tank for holding freshly made up artificial or raw seawater is normally required, and a temporary holding tank for the water that has just been drained down.

Some restrictions may apply affecting how often an operator may reuse seawater based on the system design (those with a very low water to high shellfish ratio), or for specific species where the regulator does not have the confidence to allow reuse at all.

Restrictions on reuse

- The regulators scientific advisor has advised that all seawater to be used for purification must have less than 1 colony forming unit of E.coli. This really means it should be aseptically clean from a microbiological point of view. All seawater should pass through a UV bank or other acceptable water sterilisation system prior to coming into contact with the animals.
- Advice has also been received that the level of turbidity in the water should be no greater than 15 **Nephelometric Turbidity Units (NTU)**. This is a measure of the level of turbidity in a sample of water. Turbidity can reduce the efficiency of UV water sterilisation units. Any excess suspended solids should be removed from the water prior to it being used for purification purposes. This can be done by using settling tanks or filters.
- Some operators have difficulties in operating a reuse set up dependant on the physical constraints of the building or site they are working from. In this instance small companies are advised to use the purification tanks as storage and holding tanks.
- Tanks holding seawater held outside a facility can cause very high and unacceptable water temperature due to direct exposure to the sun. This can lead to the death of batches of animals or spawning. Direct exposure of

the water to sunlight can lead to the growth of large quantities of phytoplankton. Chilling the water can be expensive. It is far better to design the location to ensure seawater storage tanks do not get exposed to direct sunlight or extremes of temperature.

- Raw seawater if stored in a static condition can go off. That is a product of the natural die-off of the natural phytoplankton and other biological entities in the water.
- Abstracting raw seawater for purification purposes must not take place if there is, or there is suspected to be, a harmful algal bloom in the locality or one has just dispersed. The only way to be sure that you are not contaminating animals with biotoxins is to test each batch of water at the time of abstraction with a representative sample.
- There is an implication in the legislation that bivalve molluscs can be re-immersed in a dispatch centre. This is a positive step post purification. It allows the animals to take on board good clean highly oxygenated seawater that should ensure their vitality for the journey to the consumer.

Seafish publications:

- **HACCP** document for purification and dispatch centres operators. It includes a document for recording the reuse of seawater (QC8). See: <http://www.seafish.org/upload/file/inshore/HACCP%20Breifing%20for%20industry.pdf>

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