# Sewage systems

## Regulations.

Legislation preventing the discharge of untreated waste overboard has been in place for some time with a requirement that it should be retrofitted where not already in use. American legislation defines three types of sewage treatment units.

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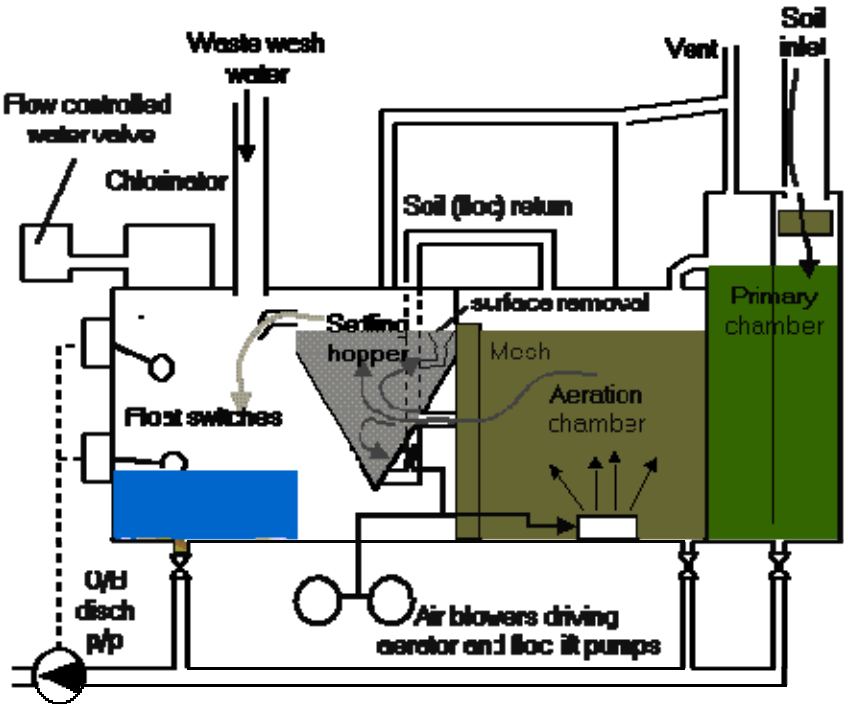
|---|---|
| **Type 1** | A device capable of discharging effluent having no floating solids and a coliform count of less than 1000 per 100ml of effluent. |
| **Type II** | A device capable of discharging effluent with suspended solids not in excess of 150mg/litre and a coliform count of less than 200 per 100ml |
| **Type III** | A device to prevent the discharge overboard of treated or untreated waste. |

Ventilation systems are to be kept independent of other vents A log is to be kept of any discharge overboard from a holding tank

## Aerobic (Biological) Treatment plant (Flow through system)




## Principle

Biological system require a steady and relatively constant flow of solid sewage so the bacteria can exist in sufficient quantity to maintain effluent discharge at the correct quality. sludge build up is a possible problem although extended residence in the aeration chamber greatly reduces the amount. For example, sewage with 80% solid waste is reduced to 20% of its original weight after 12 hours in the aeration tank.

The process of aerobicity strips oxygen from the water and creates more water, carbon dioxide and bacteria.

## Operation

The Trident sewage treatment unit shown above consists of three chambers.
Sewage enters the **aeration chamber** via a coarse mesh filter where large solids are broken down. The aeration chamber is where the main biological action takes place. Here air blowers mounted on the outside of the unit oxygenate and stir the effluent and bacteria mix via a series of pipes and nozzles. The sewage remains in this aeration tank for some time.

Incoming sewage displaces some effluent of the **settling tank (or hopper)** where under inactive conditions biological floc, activated sludge and bacteria, settle out and is returned to the aeration chamber via air lift pumps also driven by the blowers. A second transfer pipe scum's the surface of the settling tank and returns it back to the aeration chamber. This returned sludge contains the bacteria to digest the incoming sewage. Thus the importance of this floc return can be seen

*Authors note:*
*This is a common question in orals*

Effluent passing over from this chamber should be clean and ready for disinfecting in the **chlorinating chamber**. The level in this chamber is controlled by a pump and float switch arrangement. typical chlorine levels at discharge is 5ppm.

Valves are fitted to the aeration and primary chambers to allow them to be pumped out and back flushed as necessary.

The bacteria are susceptible to water conditions including temperature and the presence of toilet cleaning agents. In this way the system is fitted with by-pass valves so passing contaminated water overboard. Should the bacteria be killed it takes some time before a new colony forms. There are special 'feeds' which promote the reestablishment of these colonies.

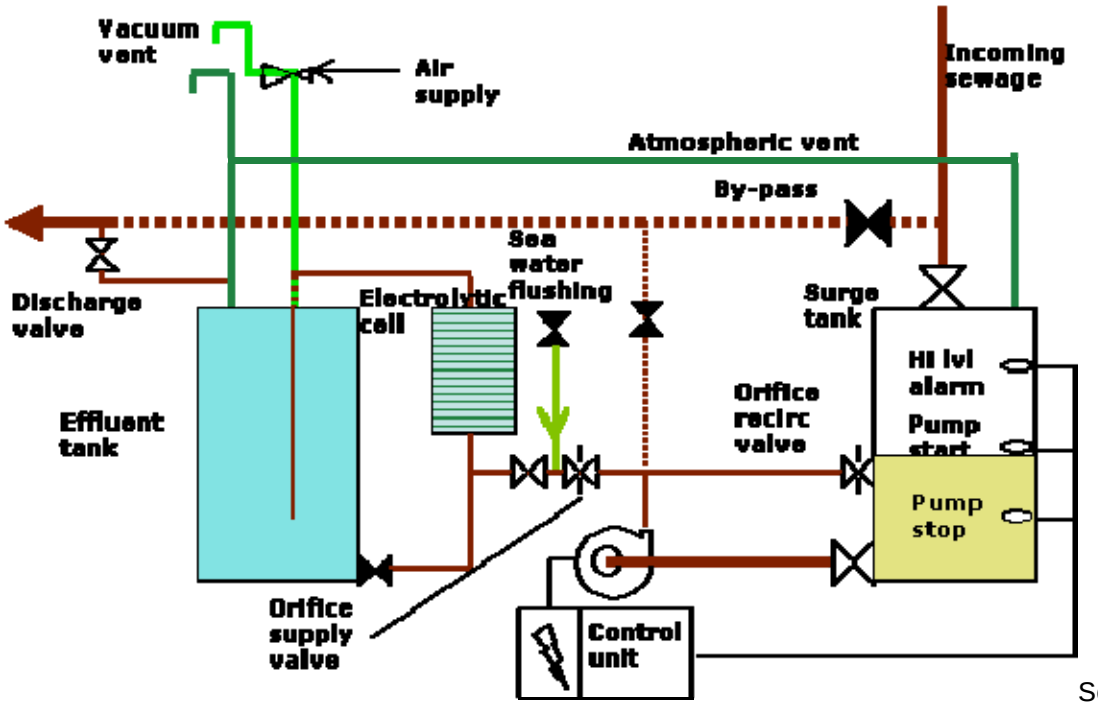
## Physical-Chemical Sewage system

This is based on the separation of the liquid element from the sewage flow. This is disinfected in a 5% chlorine for 30 minutes to kill off coliform bacteria and then discharged overboard in full MARPOL compliance.

One problem with this system is the required space, Only a finite amount of space can be set aside for the storage of the solid part of the waste which can only be discharged in port or outside territorial waters when allowed. If these facilities are unavailable the system become inoperative.

There is also the need to carry quantities of Calcium Hypochlorite for conversion to Sodium HypoChlorite for the disinfection of sewage flow. Calcium Hypochlorite requires very careful handling.

## Electrocatalytic Oxidation



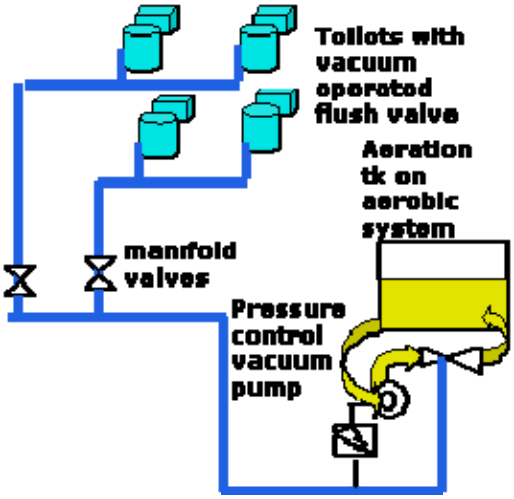

Sewage is collected, macerated and passed through a electrolytic cell.

Electrolysis produces Sodium Hypochlorite which is used to oxidise organic material before discharge. Alternately dosing by chlorine may be used. The effluent passes on through to a settling tank were the oxidation process is completed

These type of plants can be 50% smaller than biological types, this and the fact that pass through times are extremely short-typically 30 minutes compared to the several hours of the biological unit- are the main advantages of this system.The discharge contains no solids and is totally free of coliform bacteria.

A disadvantage of this system is due to the short exposure time in the oxidiser relatively high levels of chlorine are required to ensure destruction of the coliform bacteria. It is possible that this chlorine level can be present to some degree in the discharge. Dechlorination plant may be fitted

# Vacuum sewage systems




Shown is a simple layout for a vacuum sewage system.

## Operation

Liquid flows from the aeration tank of an aerobic sewage tank to a coarse impeller centrifugal pump. This delivers the liquid under pressure via an eductor and back to the tank. The eductor reduces the pressure in the sewage system pipework to a set point after which the pump is stopped. When the pressure in the pipework rises above a set value it is restarted.

The pipework consists of a network of mainly pvc pipes connected into separate zones- typically by deck- and brought down to a common manifold via isolating valves. These valves allow work on sections of the system whilst still maintaining others in use.

The toilets are connect to the system via a vacuum operated foot valve. Vacuum timers are also fitted which allow measured quantities of flushing water to be applied.

Where toilets are connected in the same zone but exist at different heights non-returning valves may be fitted. In addition filter boxes may be fitted along with additional isolating valves to improve operation.

## Advantages and disadvantages

Very little flushing water is required and the volume of sewage dealt with can be much reduced with the downsizing of relevant equipment and cost saving.This has made them very popular for passenger vessels.Lloyds regulations state that the capacity of a sewage system for flushing water with conventional plant is 115 litres/ person/ day and 15 litres for vacuum systems.

The main disadvantage is blockage due to drying and crystalisation of urea. Over a period of time this can be so severe as to completely close the pipes. Chemicals are on the market which can be added in very small doses which help remove and prevent this deposits but there success is not guarenteed.

In the event of vacuum failure a method must be in place to prevent dangerous gasses passing back into the accommodation.