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Choosing the right filter for a wellboat

Pressureised vs. Pressureless filter

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Salmon transport today

All transport of salmon is currently subject to the regulation of 17.06.2008 no. 820 on the transport of aquaculture animals. The purpose of this regulation is to promote good fish health, ensure good fish welfare during transport, and safeguard environmental considerations. All transport units utilised for transport of live aquaculture animals must be approved by the Norwegian Food Safety Authority (NFSA). Particular emphasis is given to conditions that are likely to promote infection prevention hygiene and well-being, including cleaning and disinfection procedures, dead fish management, monitoring of water quality, water sampling and logging. Further details are described in section 8.

"Construction Requirements" entails that all areas of the transport unit must be accessible in order for inspection to be carried out in a satisfactory manner. The ability to implement internal controls in concealed circulation systems and filters on board a wellboat is crucial to maintaining good infection prevention hygiene operations. Existing technological solutions used on board wellboats today are often poorly designed for the purpose of inspection and post inspection after cleaning. Therefore, the risk exists of not detecting failure of own procedures due to an absence of inspection options.

Spread of infection

Transporting fish in a wellboat can pose a considerable risk to animal welfare and of infection. Exposing fish to infectious disease, in addition to having significant financial consequences for the producer, causes the fish intense suffering. The aim is to reduce the risk of salmon becoming infected on board, and to prevent the spread of infection to the environment by filtering transport water that is taken in and discharged. Effective filtration and purification of water on board wellboats is becoming increasingly important, as transport by wellboat of edible fish, brood fish and smolt is rapidly increasing and continues to pose a risk for spreading infection. We are moving towards a trend of fewer and larger smolt production facilities, which means that the distance from the smolt production facility to the fish farms will be greater. This lengthens the transport stage and subsequently increases the risk of spreading infection. Additionally, the wellboat plays an important role in fish farming, as it is used for several operations such as de-lousing, sorting, counting and transport of live fish between farm cages and locations. Thus, there should be a greater focus on (preventing) the spread of infection in wellboats, and on employing the best solutions and technologies available for hygiene on board.

Salmon lice and fish scales

The mechanical stress inflicted on salmon in overcrowded conditions and pumping in connection with wellboat transport cause the fish to lose both mucus and scales. Lice also accompany the loss of mucus and scales. Sea lice and fish scales have a comparatively resilient structure. The adult salmon lice individuals have a relatively hard chitin shell that prevents them from being pressed through a 100-150 µm filter. The larval stages, on the other hand, are smaller and have a softer shell that

makes them easier to squeeze through the same size filter. The Norwegian Institute of Marine Research (NIMR) uses a filter of 120 µm to filter (without pressure) the nauplius 1st stage, which is considered the smallest, even though single eggs are smaller. The reason for this is that the eggs hang on an egg string and the size of the egg string is greater than the smallest larval stage. Today, most wellboats are delivered with filters of 100 or 150 µm. It is therefore vital that you use the right filter oxygen technology to ensure that all stages of salmon lice are filtered out to prevent avoid spreading a population of lice from one location to another.

Water quality on board

Section 17 "In particular, regarding water quality and water volume in closed container", in the Regulations for the transport of aquaculture animals, points out that transport units that recycle the water during transport must have suitable equipment and adaptations to the transport system in order to maintain the required water quality. It is vital to maintain water quality on board during transport as a means to preserve good fish welfare so that the salmon is able to maintain normal, healthy metabolism and not die due to toxic environmental conditions. When a salmon is exposed to stress, the fish releases mucus (glycoproteins). This can be seen by foaming in the water where large numbers of salmon are kept in closed systems, such as in a wellboat. This release of protein results in a high content of total organic carbon (TOC) in the wells' water. Fish on board a wellboat are also constantly excreting faeces. These are perishable particles that are easily dissolved by turbulence and pressure, and also dissolve in organic carbon. Such organic matter is nourishment for bacteria that can harm fish, especially with regard to gill health. Any pollution of transport water should therefore always be kept to an absolute minimum. It is thus important to use the correct filter technology to ensure that you are able to extract as much as possible of the organic carbon in the water to maintain satisfactory water quality throughout the transport stage.

Filtration of the water on board is essential in a wellboat. But how should the water be filtered and what filters can you use?

There are several conditions to consider when selecting filters::

- Quality of the filtering
- Capacity
- Energy consumption
- Available pressure for the operation
- Installation area
- Operational safety
- Volume of sludge water
- Product's life span

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Pressurised filter

Today, it is for the most part pressurised filters that are supplied to wellboats for various reasons. The filters are easy to position as they are relatively small and connect directly to water pipes. In this way it is also easy to clean pipes and run an ozonation of the filter. These filters are usually delivered with an aperture of 100-150 µm, and are pressurised during filtration. This pressurization causes soft particles, such as faeces, mucus and salmon lice larvae, to be either pressed through the aperture or dissolve into smaller pieces and thus still pass through the filter. This results in a higher concentration of dissolved organic matter in the water, and also increasing the risk of release of the smallest larval stages into the sea again.

Pressureless filter

In recent years it has become more common to use pressureless filters on wellboats. By using a pressureless filter, you can achieve filtering of even higher quality with the same aperture compared to pressurised filters. Pressureless filters, especially drum filters, were developed by the timber industry over a century ago when they needed large quantities of water that were finely filtered (100 µm). These filters are made up of a rotating drum clad with a filter cloth, where the water is filtered from the inside through the taut fabric. The canvas is designed to have small cells that catch small particles so that they lie still as much as possible, unaffected by turbulence and cutting forces. As the cloth rotates with the drum, the particles are pressed gently up against the cloth. The drum with the cloth turns a full rotation before reaching a water jet that continuously flushes off accumulated particles. These particles are collected in a trough that is inside the drum and shipped out of the filter for further processing. 90% of the water is removed through a belt / belt filter before the remaining dry mass is collected in separate containers. The drum filter filters the water very carefully and works almost without pressure (differential pressure). This cautious way of filtering causes the solid particles to avoid being dissolved into smaller fragments that disappear through the filter. The filter also has a long service life and low maintenance costs, as it works almost without any form of pressure.

Areas of use

- Filtering of intake water from river and sea to public or industrial water supply
- Filtering of intake water and waste water in aquaculture to prevent parasites and infection from entering and exiting plant/facilities
- Filtering of water in the plastics industry
- Purification of water in cooling towers in thermal power plants
- Purification of intake water and waste water in the food industry

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Technical differences between pressurised and pressureless filters

Pressurised filters are relatively small and easy to place on board a wellboat. However, they have a higher differential pressure (minimum 150 cm) than a pressure-free filter (down to 10-20 cm). The higher the differential pressure, the higher the friction. Therefore, relatively soft particles that do not have a solid structure will more easily break into fragments when they pass the filter element in a pressurised filter. Pressurised filters are self-cleaning (automatic process), but require full disassembly for inspection and checking after use, as well as service and maintenance. Pressureless filters, on the other hand, are large and require space, necessitating careful consideration as to where they are placed on a wellboat. In return, they are cheaper than pressurised filters, easier to maintain and clean, as the filter cloth is easy to access without any disassembly of the filter. Pressureless filters are generally very simple systems that require the minimum of service and maintenance, and operationally are very reliable.

	Trykksatte filter	**Trykkløse filter**
Differential pressure	Up to several metres	Down to 10-20cm
Quality of filtering	Inferior over time, allowing fine particles to pass through	Very good quality of filtering, good accumulation of tiny particles
Size	Small, space-saving, easy to place	Large, placement must be planned, requires a large area
Sample-taking	Difficult to access, requires disassembly of whole filter to enable taking of samples	Does not require disassembly, easy to access for inspection and to take ATP samples
Cleaning	Requires a large volume of water during backflush process when cleaning, makes inspection and internal control difficult	Simple, automatic cleaning, very easy to access for inspection and internal control after use
Maintenance	Time-consuming to maintain, as everything must be disassembled	Basic components, easy to maintain, basic system that requires minimum of maintenance
Reliability	Problematic to rely on quality and condition of filter when one does not have continual access	Highly reliable, operationally dependable filter
Surface area	Requires a minimum of surface area	Requires a large surface area
Price	High-priced	Low-priced
Energy/operating costs	Energy-demanding	Energy efficient, cheap to run

Differences in filtering quality between pressurised and pressureless filters

Using a pressurized filter with an aperture of 100-150 µm will result in a higher concentration of dissolved organic matter in the water than is the case when using a pressureless filter. This is because the soft particles, such as faeces and mucus, will be pressed through the filter when using a

pressurised filter with an aperture of 100-150 µm. When using a pressureless filter with the same aperture, these particles will naturally accumulate instead of disintegrating. This also applies to the filtering of the earliest stage (larvae) of salmon lice. Using a pressurized filter may result in larvae escaping through the filter into the sea. When using a pressureless filter with the same aperture, these larvae are also gathered. The filtration achieved by using a pressureless filter is thus of significantly better quality compared to using pressurised filters, because soft particles are not destroyed and are also collected in the filter cloth. The advantages of pressureless filters mean that you are able to collect very fine particles with a simple operation, you are able to easily carry out inspections and checking of the filter after use. This results in far superior water quality on the wellboat, thus ensuring good fish welfare throughout the transport stage, which helps toward reducing mortalities during and after transport.