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Recirculation Systems in Fish Farming

Recirculating aquaculture systems have become a significant new method of aquaculture. Recirculating aquaculture systems are gaining popularity in Finland as well, and since the 1990s, they have been the only method of aquaculture that has seen significant growth, although the production quantities are still small compared to traditional fish farming.

Recirculating aquaculture is a method that uses only a fraction of water compared to traditional aquaculture methods. Water in the fish tanks is pumped into a water treatment unit that removes nutrients and carbon dioxide from the water both mechanically and biologically. Next, oxygen is added into the water and the water is then re-introduced into circulation.

One of the best known benefits of recirculating aquaculture is its low environmental impact: the water consumption is much lower than in traditional flow-through farms, and the recycling of nutrients and removal of waste is efficient. In addition, recirculation has several production benefits, since it enables the environmental conditions to be controlled.

From the perspective of the health and well-being of the fish, the water quality in a recirculating aquaculture farm differs significantly from that in traditional methods. In flow-through and pen farms, water is continuously exchanged, and the fresh water brings in the required amount of oxygen, while the metabolic products of the fish are diluted and disposed of downstream or into the surrounding body of water. Since a recirculating farm uses significantly less water, all of the above must be implemented by technical means. In recirculating aquaculture, the key water quality factors affecting the health and well-being of the fish are associated with the concentration of oxygen, carbon dioxide and various nitrogen compounds ($NH4^+$/NH3, NO2 and NO3), and the quantity of suspended solids, pH and temperature. A significant impact on fish health can be achieved by the possibility to control environmental conditions: the possibility to treat and disinfect the incoming water, combined with efficient control of water quality and temperature.

A disadvantage in recirculating aquaculture is its dependence on expensive and energy-consuming technology. Furthermore, the risk of human error in the operation of the technology is high. High fish densities and the rapid and continuous growth of the fish present a challenge for the well-being of the fish. Control of fish diseases in a recirculating system might be difficult: an “all in-all out” method is often expensive to implement, and pathogens might accumulate in biofilms, which makes the transmission of diseases difficult to stop. Thus, to ensure the future popularity of recirculating aquaculture, it is absolutely necessary to control fish diseases more effectively than at present. Moreover, recirculating aquaculture systems must take into account the negative effects that medications might have on the biofilter. In addition, pharmaceutical substances, minerals and various fodder components might accumulate in the water and gradually in the fish as well.