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## **Atlantic salmon from the Swiss mountains**

Innovative indoor farm relies on hi-tech metal mesh

**Throughout the world, around 2.5 million tons of salmon are bred every year under conditions that are often ecologically problematic. Ninety percent of the salmon in supermarket refrigerators comes from these marine aquacultures – primarily from Norway and Chile. In Switzerland, Swiss Alpine Fish AG is demonstrating a sustainable alternative in environmentally friendly salmon rearing with indoor aquaculture in the middle of the Alps. The core element of the farm is the innovative RAS 2020 recirculating system from Veolia. Yet with metal mesh from GKD – Gebr. Kufferath AG, the Swiss salmon breeder is also breaking new ground beyond this: In the drum filters for mechanical water cleaning, the company is using stainless steel Porometric mesh, which is unparalleled in terms of flow rate and cleaning. In the future, two different metal meshes from GKD – Gebr. Kufferath AG will also be used for fish handling.**

Since the start of the millennium, salmon consumption has tripled in Germany alone: According to current surveys (date: December 2019), the annual per-capita consumption of salmon in the Federal Republic is three kilograms. One million salmon are caught around the world each year. The vast majority of them are bred in net enclosures anchored to the seabed – marine aquacultures. This results in crowded spaces, an aquatic environment heavily soiled by excrement and food remnants as well as heavy use of antibiotics and pesticides to treat the animals for illnesses and parasites. For a long time, this type of breeding has therefore been the object of worldwide criticism from environmental, animal welfare, and consumer organizations. Indoor recirculating systems have existed as a proven yet costly solution to the problem since the 1980s. They can be used to rear fish



anywhere – with high environmental sustainability and optimum living conditions for the animals. It is a principle that Swiss Alpine Fish perfected with a total of three recirculating systems and the latest technology for salmon culture from egg to ready-for-slaughter fish, making it an exemplary company in Switzerland and beyond. The spawning station and quarantine station each have one recirculating system. For the *grow out* – the fattening phase, which is the last and most expensive stage of salmon farming – the company uses the pilot system of an RAS (**Recirculating Aquaculture System**) 2020 system. This is an innovative, compact ring tank system with three concentrically arranged rings and sections of variable sizes. The capacity of the entire system at Swiss Alpine Fish is 3,900 cubic meters of water. Spring water from a 28-meter-deep well is pumped through the system with the constant addition of oxygen. 99.5 percent of the water used is treated every hour in a multi-stage process involving mechanical and biological cleaning and fed back into the system. Only 0.5 percent of water soiled with sediment is channeled into the company's own water treatment plant. After complete processing, it is fed into the nearby Moesa river. The remaining sludge with a dry matter content of around nine percent is recycled in a local biogas plant. A state-of-the-art control system permanently monitors all parameters, such as oxygen concentration, pH-value, or temperature of the water and units. For instance, reference value settings trigger the automatic addition of base in order to stabilize the pH-value. As such, this closed recirculating system guarantees fish farming without antibiotics or chemicals and the production of correspondingly high-grade meat. Twelve generations of salmon are bred in parallel at Swiss Alpine Fish, and six generations of different ages are currently in the RAS 2020.

### **From egg to ready-for-slaughter salmon**

With the farming system, the young company in Lostallo – a small locality in the Italian part of Grisons, south of the San Bernardino Pass – recreates the



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natural stages of life of the salmon. Every two months, 50,000 fertilized salmon eggs are imported from a reputable producer in Iceland – exclusively female due to their faster growth and better meat quality. The six- to seven-millimeter eggs arrive in incubators with pure fresh water flowing through them at a temperature of around eight degrees Celsius. The fish hatch after about ten days. After almost two months, the fish have consumed their yolk sack and have to be accustomed to external food in a larger flow tank. To do this, salt is added at the end of what is known as the *first-feeding* phase in order to prepare the fish carefully for the next phase in the first recirculating system at a salinity of 1 ppt. At the start of this two-month-long *first-feeding phase*, the fish weigh approximately 0.2 grams and at the end they are transferred to the *hatchery* in the first recirculating system with a weight of two grams. In the first two tanks for the fish that are now known as *fry*, the salinity of the water is 2 ppt. At a weight of 20 grams, they move into the last three tanks of this recirculating system after eight weeks. Another two months later, at the end of what is known as the *pre-smolt* phase, they already weigh 70 grams. They move to the farm's second recirculating system via a pipeline. This is where the smoltification of the fish takes place – their physiological adaptation to water with 6 ppt salinity. When changing tanks, all salmon are vaccinated by hand. After a further two months, the fish, now weighing 250 grams, move into the third and largest recirculating system, the RAS 2020. This *grow-out* system with a diameter of 32 meters and a depth of 4.5 meters holds 2,700 cubic meters of water – 700 cubic meters in the inner ring and 1,700 cubic meters in the outer one. Each of these rings consists of three sections, into which the fish are pumped once they have been there for two months. When they move into the second section of the inner ring, the fish weigh approximately one kilogram, after the first section in the outer ring 1.6 kilograms, and at the end of the last of the six sections 3.5 to four kilograms. At this weight and a length of around 80 centimeters, they are ready for harvest or slaughter. At this stage they are



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first moved into the 223-cubic-meter purge tank, where they stay for seven days – now in fresh water again – until they have lost the earthy *off-flavor* of geosmin, which is caused by bacteria. During processing, the fish are electrically stunned and their gills cut. After gutting, the fish are packed in ice and the next day they are then filleted, vacuum-packed, or smoked for 18 hours at a low temperature (20 degrees Celsius) to delicious recipes by the Scottish smokemaster, depending on the orders received. Of the 50,000 eggs imported by Swiss Alpine Fish, on average 20,000 fish currently manage to pass through all the stations. Since the indoor farm, which was set up with an investment volume of 14 million Swiss francs, opened in 2013, the production volume has grown continuously. The aim is to produce 600 tons of salmon per year; in 2019, the output was 400 tons. This year, the company expects annual production of up to 550 tons – due in part to important improvements that include GKD metal mesh. However, plans to expand the plant by a further 1,200 tons in salmon production are already well underway. The first harvest following the capacity expansion is planned in three to four years.

### **Top-quality water treatment**

The crucial element of every fish farm is the water quality. The main reason for selecting Lostallo as the site was the high quality of the spring water. After being drawn from the spring, it is sterilized by a UV system and supplies the various systems with fresh water from a holding tank. In the RAS 2020, the fresh water is supplied to the purging tank. From there, it passes into the three drum filters via an overflow and, following UV disinfection, into the biofilter. This, together with a denitrification reactor that also functions as a second biofilter, is located in a third concentrically arranged ring with a radius of 7.5 meters in the middle of the inner grow-out ring. Here, the almost 100-percent oxygen saturation of the water is reduced virtually to zero and ammonium, ammoniac, and nitrite are converted into



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nitrate. Due to the permanent water exchange, the correspondingly low nitrate content has no adverse effects on production. After treatment in the biofilter, a degasser removes CO<sub>2</sub> and nitrogen from the water. Next, three suction pumps each convey 1,200 cubic meters of the treated water per hour into a tank. Some of it is fed into oxygen cylinders and enriched with oxygen at a pressure of three bar. Together with the remaining, unenriched, water, the water processed in this way flows back into the recirculating system.

Three HDF 2009-1AS drums filters are used to clean the water mechanically before the biofilter. With a length of 3,600 millimeters and a diameter of 2,000 millimeters, they each have a filter area of 21.6 square meters. Uneaten food and fish excrement are removed from the intake water at this stage in order to support the function of the biological filters. In each of the three drum filters there are 45 filter panels, each of them 1.20 x 0.40 meters in size. The construction of their shovel-like support structure, consisting of many small squares of mesh connected with one another, augments the filter effect. The panels are cleaned automatically several times per minute by spray bars. In addition, the filter panels are cleaned once a week with a pressure cleaner to remove fatty deposits from the fish food. Over time, the synthetic mesh supplied with the system failed to stand up to the strain of this maintenance, which caused increasing problems with 24-hour operation of the salmon farm, explains Christopher Shaw, Farm Assistant Manager at Swiss Alpine Fish. Holes in the mesh and tears at the edges jeopardized the quality of the mechanical cleaning. "Cleaning quality and filter efficiency are extremely important for our process," says the expert. He adds: "The salmon need clean water with no suspended sediment for their well-being and optimum growth. Solids and suspended sediment are also a source of bacteria build-up and must therefore be removed from the processing water as quickly as possible." When looking for a solution online, he came across GKD and the high-performance Porometric mesh made of stainless steel that



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it develops with the required pore size of 25  $\mu\text{m}$ . With almost 90 percent porosity, its three-dimensional slit structure achieves an unsurpassed flow rate. At the same pump output, the throughput can therefore be significantly increased. Thanks to the high dirt holding capacity, Porometric also requires fewer cleaning cycles, despite the greater filter performance. In independent comparisons by the Karlsruhe Institute of Technology (KIT), the hi-tech mesh proved to have the best cleaning performance – while also exhibiting a lower backwashing rate. This aspect was also interesting for Christopher Shaw, as the wastewater system at Swiss Alpine Fish was at its limit. As such, he had several panels in a drum filter fitted with this stainless steel mesh from GKD as a test. The global market leader for industrial and architectural mesh developed a new application technology especially for this purpose. The subsequent tests under real-time conditions confirmed the expectations of the Assistant Farm Manager across the board: "The panels can be cleaned much more easily – without the danger of damaging the mesh." The intervals between cleaning cycles were also increased considerably. Although it is somewhat easier to fit the drums with the more flexible synthetic mesh panels, these results clearly indicated that it would be wise to expand testing with the metal mesh panels. Which is why Christopher Shaw then had the first of the three drum filters fully fitted with Porometric 25. This test will continue for a good month. If it also succeeds in meeting the expectations of Swiss Alpine Fish, the two remaining drum filters will be successively fitted with the Porometric mesh. GKD produced 55 Porometric panels in total: 45 of them are intended for the drum filters. Ten more of these panels were used on the farm for testing purposes in the drum filters of the wastewater treatment plant. The percentage increase in efficiency is not yet final. However, Christopher Shaw can already envisage equipping all drum filters with the supremely robust and highly efficient stainless steel mesh in the planned expansion of the system right from the start – perhaps at an even higher separation rate, as Porometric is available up to 13  $\mu\text{m}$ .



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### **Optimum fish-handling with metal mesh**

Christopher Shaw is already full of praise for the good cooperation with GKD: "We received a great deal of support in choosing the mesh and producing the panels from the outset." He came to value another aspect of this great expertise and the broad offering of metal meshes of many different types during a visit to the GKD headquarters in Düren near Cologne. The RAS 2020 has grids that enable the sections in the grow-out rings to be flexibly adjusted. The purpose of this is to set the optimum density for the respective size of fish while also increasing the capacity of the system. In practice, however, these allegedly movable grids didn't work, so Swiss Alpine Fish had already designed new grids themselves. In GKD, Christopher Shaw again found the right solution partner for producing the grids, opting for *Pegasus* architectural fabric as the suitable mesh. Its pore size of 50 x 13.7 millimeters holds the fish in the respective section while offering the required lowest water resistance possible. From now on, four movable barriers with this stainless steel mesh in fiberglass frames will be used in the system in Lostallo, enabling stress-free transfer of the fish from one section to the next. With *Tucana*, another metal mesh from GKD, the aquaculture expert identified a third mesh to solve an existing problem: As a retention grid on the overflow of the purge tank, this rigid mesh now prevents fish from getting into the drum filters. By permanently optimizing what is already the most technically advanced and sophisticated kind of aquaculture, Swiss Alpine Fish produces Atlantic salmon of the highest quality that damage neither the environment nor ecosystems. Considering that the market continues to grow strongly around the world, the company and the metal meshes from GKD are setting benchmarks for other indoor salmon farms with recirculating aquaculture systems that are currently planned or under construction.

*14.726 characters incl. spaces*



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## **GKD – WORLD WIDE WEAVE**

As a privately owned technical weaver, GKD - Gebr. Kufferath AG is the world market leader in metal, synthetic and spiral mesh solutions. Four independent business divisions bundle their expertise under one roof: Industrial Mesh (woven metal mesh and filter solutions), Process Belts (belts made of mesh and spirals), Architectural meshes (façades, safety and interior design made of metal fabrics) and Mediamesh® (Transparent media façades). With its headquarter in Germany and five other facilities in the US, South Africa, China, India and Chile – as well as its branches in France, Spain and worldwide representatives, GKD is close to markets anywhere in the world.

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