KUBE®hatch

Energy efficient
Turn- key system
Operational reliability
Hygienic and easy to clean
Compact and fully integrated

The first known turn-key recirculation system developed for the hatchery phase in the production of salmonides from "eyed-up" eggs to start of feeding

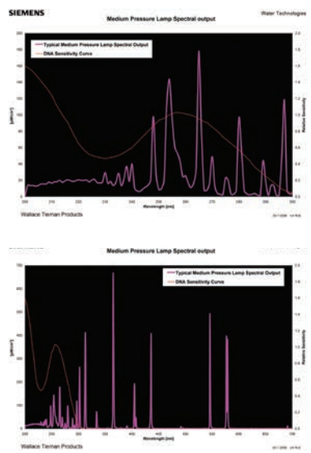
This period from hatching to start of feeding is a vulnerable time for the fish, in which both biological and physical/chemi- to keep a water temperature of 6- 10oC.cal environmental conditions have major impact. Providing a stable environment in this early stage of life may therefore be crucial for the health and development of the fish during the further growth after the hatchery. The energy demand for heating the water in a recirculation facility is greatly reduced compared to flow through systems because of much lower water consumption. The reduction is 95-99 % depending on how the system is operated. Thus, KUBE®hatch offers both costs and environmental advantages, and allow for season independent production of start feeding fry in optimal aquatic conditions.

Recirculation Technology

Intensive recirculation of water in a fish production system entails that the water is treated in a comprehensive water treatment system. The treatment involves solid captures by means of sieving, removal of dissolved pollutants in a bioreactor (biofilter), disinfection, degassing (CO2 and nitrogen), as well as oxygen injection. The circulation of the water through the water treatment adds physical energy to the water which is converted into heat, and in certain conditions, it may be necessary to cool down the water in order to obtain the correct temperature..

Removal of large particles
During the hatching period there is a peak in the production of particles (particularly in the hatching stage) which must be removed. KUBE®hatch is equipped with a micro sieve for efficient removal of particles greater than 30µm which are removed together with the flushing water from the sieve.

Disinfection
In KUBE®hatch the disinfection system is based on UV light radiation of the recirculated water which is efficient without producing poisoning by-products. The UV intensity is measured by means of a UV sensor. The disinfection unit employs medium pressure UV lamps, which produce light with a broader spectre of wavelengths than low pressure lamps.
So-called medium pressure lamps are more efficient than low pressure lamps in preventing the microorganisms coming alive again after having been subjected to the UV radiation as it produces a broader spectre of UV-C waves. Whereas the low pressure lamp only affects the DNA, the medium pressure lamp destroys DNA, cell walls, proteins and enzymes, making the microorganisms unable to reproduce.



Medium pressure lamp spectral output (pink) and DNA sensitivity curve (red)

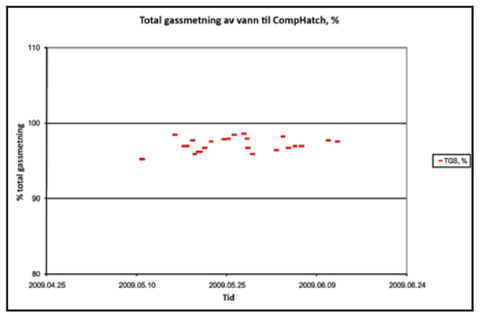
Fine solid and dissolved organic matter capture
The filtered and UV treated water enters into a so-called skimmer which in principle removes tiny particles and partly dissolved matter in that it is "attached" to small bubbles of air and creates a foam which contains the waste products. In the skimmer, there are diffusers which create small bubbles of air in the flow of water. The foam that is formed – and there may be considerable quantities of it in the hatching stage – is removed on the top of the skimmer by means of a vacuum suction system.

Bioreaktor
In KUBE®hatch , a biofilter which is designed as a "moving bed bioreactor" is employed. The biofilter medium consists of specially designed plastic units (BF Chip 1200) on which colonies of bacteria are established by growth on the surface of these plastic units. The bacteria growth is called a biofilm, and as the plastic units are constantly moving in the water, there is good contact between the water volume in the reactor and the biofilm. The biofilter is divided into 3 chambers placed in series and separated by a grid between each chamber so that the medium are restricted from floating freely.

The MBBR technology has many advantages compared to stationary biofilter media. This is particularly the case in the exploitation of the filter capacity and the flexibility with reference to operational routines for a system in operation. As an example, cleaning and disinfection of a MBBR system can be considerably easier than for example a stationary system.

The reactor in KUBE®hatch is designed for optimization of hydraulic dynamics and avoidance of dead zones. A diffuser situated in the bottom of the reactor adds oxygen to the water and at the same time removes CO2. The diffuser also ensures continuous movement of the bio carriers so that there is sufficient stirring of the water, a good contact surface between bio carriers and the water, and less accumulation of solids.

Gas exchange and control of the total gas level
IIn KUBE®hatch, a vacuum degasser is applied to keep optimal TGS-levels (total gas saturation) throughout the hatching process. In the vacuum degasser, some of the dissolved nitrogen (N2) in the water is removed so that the saturation of nitrogen in the system will always be below 100%. This secures that no bubbles of gas will be created under grids in the hatching cabinets connected to the water treatment system.

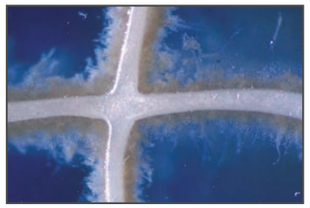


Total gas saturation of the water to CompHatch from a test-run of KUBE®hatch prototype.

Cooling/heating system
In contrast to the flow- through systems, the water in a recirculation system has to be cooled down. In KUBE®hatch the heat gain is 0.2oC in every cycle due to excess heat from the various processes of the water treatment. The cooling/heating system is controlled by sensors and integrated with a Programmable Logical Control (PLC) system. The compressor is frequency controlled to regulate its speed according to the temperature difference in the system, thus energy saving. The cooling/heating system can treat make-up water with temperatures between 0- 16oC and is designed This period from hatching to start of feeding is a vulnerable time for the fish, in which both biological and physical/chemi- to keep a water temperature of 6- 10oC.

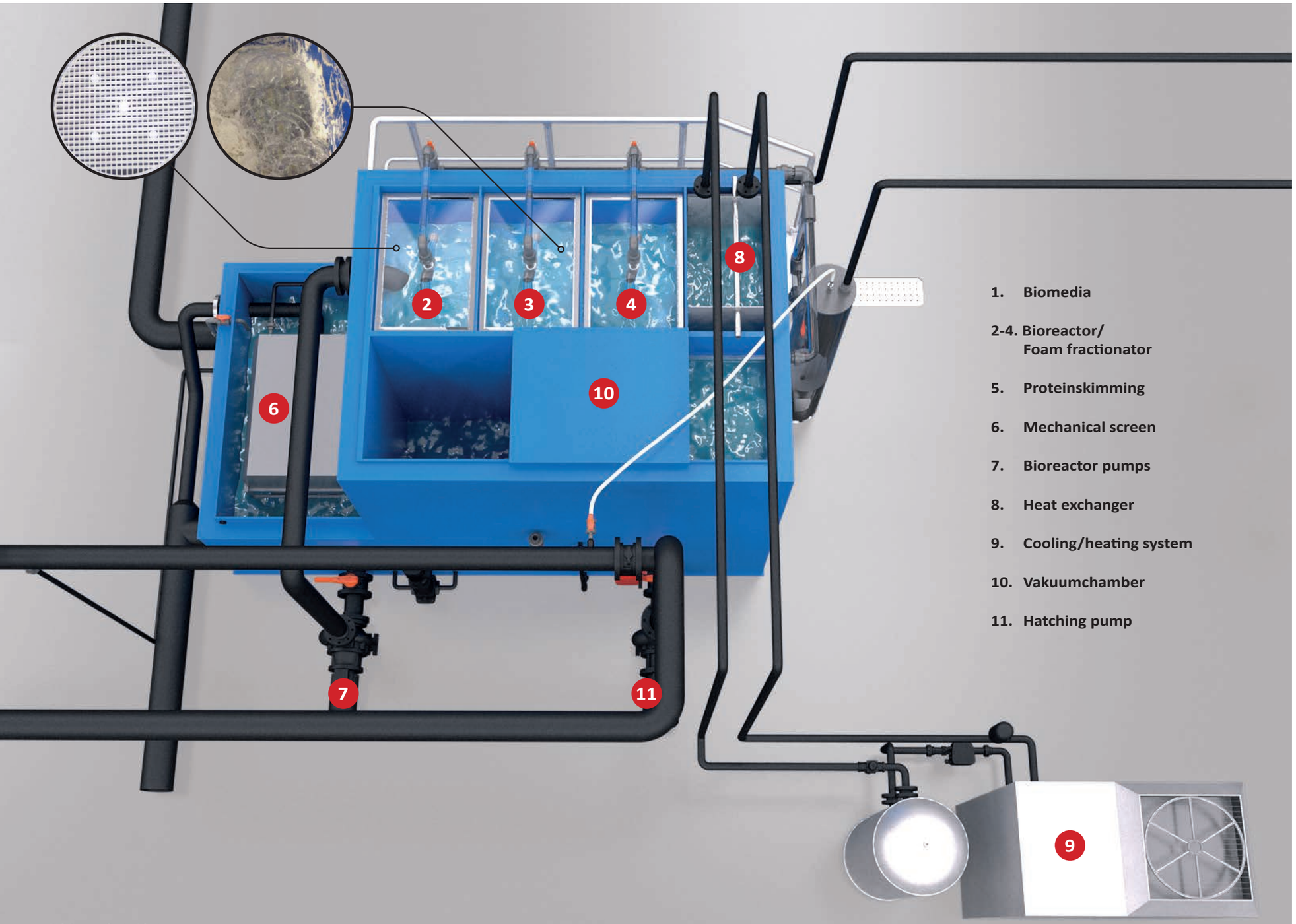
Bacteria

The “core” of a recirculation systems is often a biofilter, in whichthe bacteria convert dissolved waste (ammonium and organic matter) produced by the fish into harmless compounds. In addition to the biological water treatment, one also believe that the properties of the microorganisms in a well functioning biofilter contribute to creating a stable water environment for fish in recirculation facilities. In intensive production systems, “opportunistic” and undesirable bacteria and fungi may establish; a situation which may easily result in damage to the eggs and fry. If one succeeds in controlling these and rather add “friendly” microorganisms to the system as these that are found in a biofilter, this will be an advantage. In particular, this may be advantageous in the very first stages of the fish’ life during which it has a limited immune defence. A good start is important for the results later in the production cycle.sen.



Polyetylen (PE)

In the KUBE®hatch, the biofilter, tanks and tubes are made of polypropylen, a material with longer durability, better strength and with less maintenance than traditional materials. In addition, Polypropylen is chemical and corrosion resistant and easier to clean and disinfect.



1. **Biomedia**
2-4. **Bioreactor/ Foam fractionator**
5. **Proteinskimming**
6. **Mechanical screen**
7. **Bioreactor pumps**
8. **Heat exchanger**
9. **Cooling/heating system**
10. **Vakuumchamber**
11. **Hatching pump**

PLS Process Control System

Control and Security

Integrated system for optimal quality assurance

Programmable Logical Control (PLC)

To ensure that all processes and water quality parameters remain stable, a reliable monitoring and control system is needed. KUBE®hatch has an integrated system for optimal quality assurance in which all system information is transmitted to a PLC system. The PLC is connected to a touch screen in vicinity of the hatchery for daily operations. All the information is also transferred to a computer where data can be logged, and from the computer, the operator can monitor the production, control the flow, temperature and quality of the water.

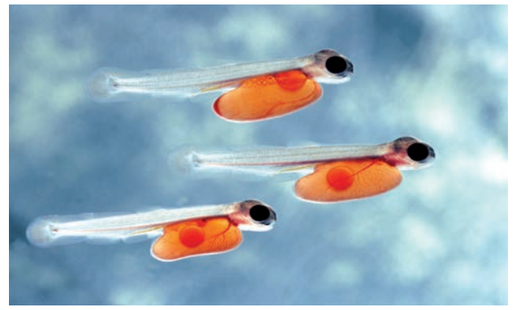
The PLC controls the frequency converters and adjusts the pumping rate according to the requirements. Moreover, the PLC performs electronic logging of:

- The oxygen level, pH, and temperature before and after the hatching units.
- The flow to the bioreactor and before the hatching units.
- TGS (Total Gas Saturation) before the hatching units.
- The water level in the mechanical sieve and the buffer tank.

When the PLC detects errors in the system, an alarm goes off. The person on duty/call and/or other persons on a list will receive a call or be informed by SMS. It is then possible to operate the system from the mobile phone..

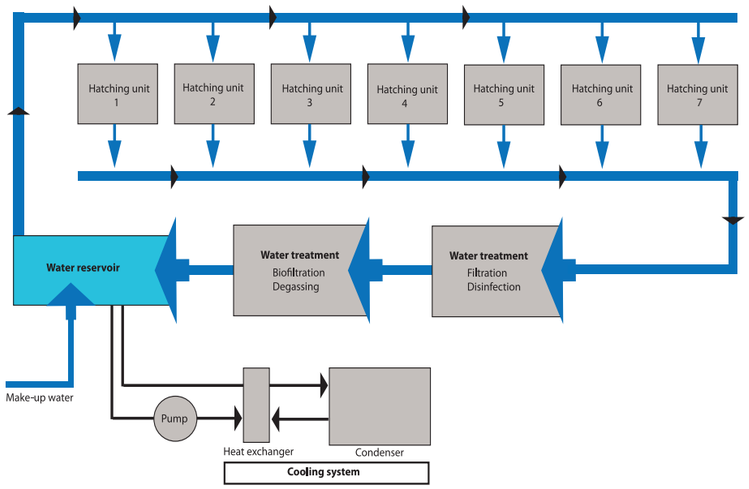
Back-up system

- In case of an electric breakdown, the PLC, the automatic sensors and alarms will receive electricity from a UPS with a battery bank so that the monitoring and control is feasible until the power supply is back.
- Each pumping operation has two sets of pumps that work in parallel at half the rate. If one of the pumps fails, the other pump will automatically be set to work at higher rate.
- A water reservoir (buffer tank) will automatically connect to the hatching units if the water flow stops. Thus the egg/fry are supplied with water for a limited time period of time while the system error is solved.



When the environment around the fish is stable without any marked fluctuations in temperature, pH, and other stress factors such as for example daily work operations, the fry will exploit more of the yolk nutrition for growth and development.

Water circulation in KUBE®hatch



KUBE®hatch 8000 is able to supply 7 CompHatch units, which equals a production of 2.5 million eggs/fry. The water flow in the system is 800 l/min, of which 5-10 l/min "new" water is supplied per recirculation cycle. This means that 98.5% of the total water volume in this system is recycled.

Economy

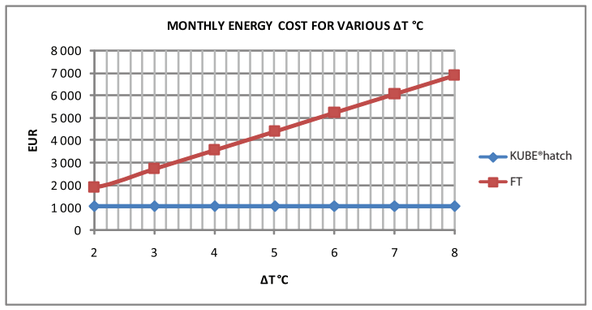


Fig 1. The diagram shows the monthly energy costs during operation of the recirculation system KUBE®hatch and a flow through system (FT) at various heating/ cooling rates (ΔT°C).

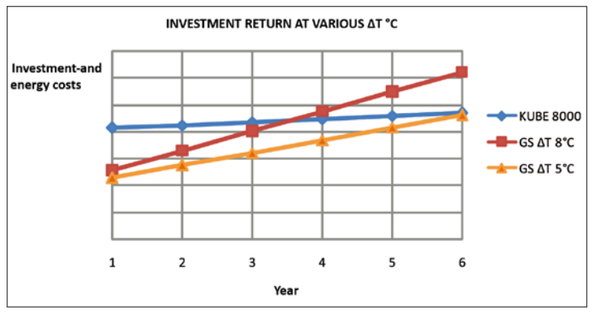


Fig 2. The diagram shows the investment costs and the energy consumption during operation of the recirculation system KUBE®hatch and a flow through system (GS), for a 6 year period at various heating/cooling rates (ΔT°C).

KUBE®hatch will be a profitable investment as the energy costs are considerably reduced both for heating as well as cooling of the intake water. The number of years before the investment is profitable will depend on the intake temperature and the number of days in operation.

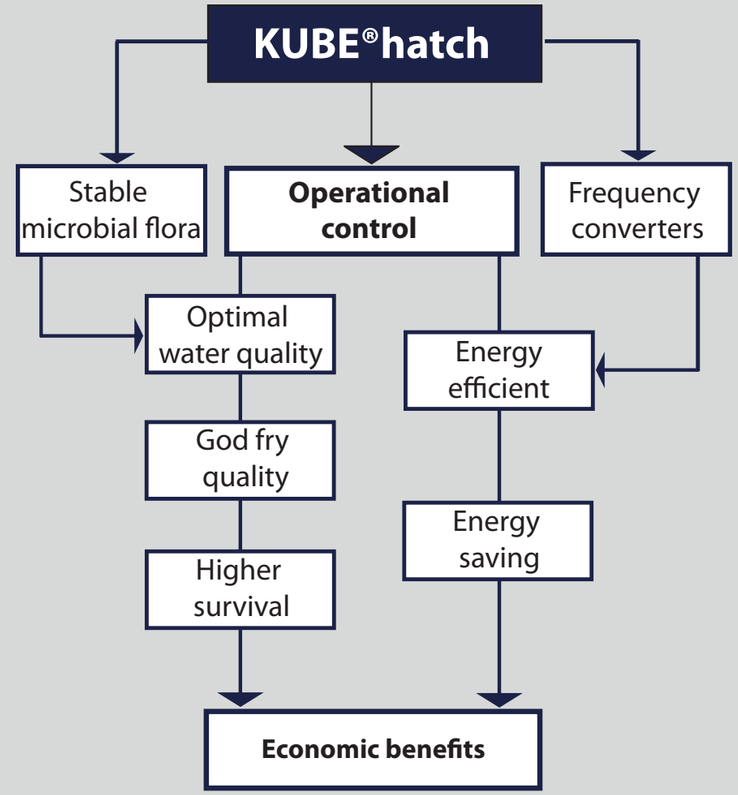
The energy and cost calculations that are based on a production volume of 2 million fry and a water flow of 800 l/min, where the energy installation of the flow through system consists of a heat pump and a heat exchanger, shows that:

KUBE®hatch requires approximately the same energy costs at increased ΔT°C, whereas a flow through system on the other hand, presents a considerable linear increase at increased ΔT°C.

If the intake water is heated/cooled down by 8°C, the monthly costs for KUBE®hatch will be close to 6 times less than for a flow through system (Fig1).

With a ΔT of 8°C, it will take only 3 ½ years before the investment and energy costs of a flow through system exceed the investment and energy costs related to KUBE®hatch. From this point on, you will have a yearly (6 months' operation) saving with KUBE®hatch of about €35, 000 compared to a flow through system (Fig2).

Energy efficient system - Optimum water quality - higher survival rate



The diagram shows the advantages with KUBE®hatch which has good operational control, a stable microflora and energy saving devices.

In addition, the expectations are to experience reduction in the mortality rates as a result of better water quality and more stable environmental conditions. If the mortality rates are reduced there will also be associated cost advantages.

In KUBE®hatch, all material and equipment are selected with reference to durability and long service life. The integrated system's design makes satisfactory cleaning and disinfection easy. It can be expected that the time/costs related to cleaning and maintenance will be considerably reduced after the transition to KUBE®hatch.