

Egtved 30-08-2009

Main Group: 100 Buildings

Function of section To protect the recirculation system and the biomass against from outside coming diseases, and to keep the entire system warm at winter time and cold at summer time.

Description of section The building shall be made of waterproof and corrosion free materials and it is recommended to have minimum 100 mm high performance isolation.

Main group 150 Water intake system

Function of section Removal of particles and sterilisation of make-up water (new water / intake water) from sea or fresh water source

Benefits in section Both UV and Ozone sterilising treatment secures disease free intake water to the system. The UV system is designed for easy and quick cleaning of the quartz sleeves. A whole section of lamps are lifted up together and cleaned while the system keeps running.

Description of section Both the Ozone and UV system are monitored and controlled by the central PLC system. The ozone levels are sensed and doses are controlled accordingly in order to maintain stable levels. Extra security sensors alarms if residual ozone level beyond acceptable levels are registered in water and air. The PLC system secures that the gearmotor of the drumfilter will stop in case the spray nozzle pump pressure is too low, this action is taken in order to protect the drum against overload - this action also gives alarm
There are particle filters both before and after the spray nozzle pump, in order to protect the impeller and the spray nozzles against blocking.

Section 200 Pipe system for main flow

Function of section Transport of water between fish tanks and water cleaning system and from water cleaning system back to fish tanks oxygen cones.

Description of section The pressurised inlet pipe system is made in PN 3 - 6 and outlet pipe system in class N pipe

Main group 200 Water treatment**Section 201 Mechanical filtration**

Function of section Removal of particles such as feed waste and faeces

Benefits in section Reduces the load of the biological filter, and free up biofilter surface for break down of ammonium and to catch fine particles

Description of section The PLC system secures that the gearmotor of the drumfilter will stop in case the spray nozzle pump pressure is too low, this action is taken in order to protect the drum against overload - this action also gives alarm
There are particle filters both before and after the spray nozzle pump, in order to protect the impeller and the spray nozzles against blocking.



Main group 200 Water treatment**Section 202 Biological filtration****788.114****Nitrification****Function of section**

Removal of fine particles and break down / conversion of ammonium to nitrate. Makes it possible in combination with the mechanical filtration to reduce new water intake to 15 - 20% per day of total water volume in the fish farm system

Benefits in section

Designed for easy and quick cleaning without hard manual work. 1 person cleans a biofilter in 3 - 4 hours, and it has to be done every 3 - 5 weeks depending on the load of feeding. The low water speed into the bottom of the biofilter makes it possible to settle flocks of organic material, which easy can be taken from the special designed bottoms of the biofilter by the use of the sludge extraction pipe system that covers all the bottom. Further more a low water speed is maintained up through the biofilter media, which allows fine particles to be captured by the filter media, and flushed out during cleaning of the biofilter. The enormous reduction in new water usage results in large savings in energy for heating the system.

Description of section

In each biofilter chamber there is head loss indicator (transparent pipe) so the operator easily can register when the biofilter is creating a small head loss and needs cleaning. Sludge settlements in bottoms of biofilters are taken out every day, and the same system is used for taking out sludge during actual cleaning of the biofilters. When cleaning the biofilter the last process is the flushing of the filter media to get the last sludge out, this can be checked by watching the transparent pipe in the outlet of waste water pump, in order to be secure that the biofilter is fully cleaned before connecting back to the main water flow of the system. The biofilter blowers are monitored and controlled by the central PLC system, and in case of the breaker falls out, the PLC system starts automatically the back-up blower.

Further more the PLC system changes the position between ordinary blower and back-up blower on a weekly basis, in order to keep them running on shift and this way keep all blowers fit. When cleaning one biofilter chamber, then a bypass gate is opened slightly in order to bypass part of the main water flow during the cleaning procedure. In order to prevent filter media to escape from the bottom of biofilters during cleaning there is one-way valves on the inlet pipe which prevents that.

pH is controlled be pH sensor in degassing tank 1, the PLC system then doses base until set point is reached. If the pH level goes outside the preset high or low alarm level set points, there will be an alarm. As a safety precaution, there is an extra pH sensor in degassing tank 2.



Main group 200 Water treatment**Section 202-1 Biological filtration****De-nitrification****Function of section**

Degrading of Nitrate to gas (N₂) and fine particle removal from sludge water from mechanical filter after plate separator. This option makes it possible to reduce new water intake from 15% down to 5% per day of total water volume.

Benefits in section

Designed for easy and quick cleaning of biofilter which is done ca. 1 time per week. The low water speed into the bottom of the biofilter makes it possible to settle flocks of organic material, which easy can be taken from the special designed bottoms of the biofilter by the use of the sludge extraction pipe system that covers all the bottom. Further more a low water speed is maintained up through the biofilter media, which allows fine particles to be captured by the filter media, and flushed out during cleaning of the biofilter. The enormous reduction in new water usage results in large savings in energy for heating the system. Effluence water from the fish farm has limits in the allowed amount of N, so effluence water is taken from outlet water from de-nitrification system

Description of section

Waste water from drumfilter is lead to the plate separator where the particles flocculates and settles on the plates and this way is captured in the plate separator. The clean part of the waste water then is pumped to the de-nitrification filter. In the bio-filter chamber, there is a water pressure loss indicator, in order for operators to see how dirty the bio-filters are. In order to avoid too high pressure in the bio-filter chamber, the central PLC system will on response from the sensitive pressure switch activate the alarm system and stop the pump and methanol dosing in case of over pressure. In order to avoid filter media escaping during cleaning there is installed grids at the bottom of the bio-filter. In order to reduce the numbers of cleanings of the bio-filter there is installed a semi automatic cleaning systems, that take dirty filter material from top of bio-filter, clean it and inject the filter media in the bottom of the bio-filter.

Main group 200 Water treatment**Section 203 Water Sterilisation****Function of section**

To reduce bacteria levels in recirculation system, by means of UV or Ozone treatment of the whole main flow in the recirculation system.

Benefits in section

Both UV and Ozone sterilising treatment increases the hygiene and general stability of water quality in the system. The UV system is designed for easy and quick cleaning of the quartz sleeves. A whole section of lamps are lifted up together and cleaned while the system keeps running.

Description of section

The AQS UV and the Ozone system is monitored and controlled by the central PLC system. There is a sensor controlling the dose of Ozone, and as a safety precaution there are extra Ozone sensors for measuring eventual too high residual of ozone in water and air which will activate the alarm system.



Egtved 30-08-2009

Main group 200 Water treatment**Section 204 Water Degassing**

| | |
|-------------------------------|--|
| Function of section | Stripping CO ₂ and N ₂ and enriching main water flow with oxygen up to 98 - 100% |
| Benefits in section | This type of degassing technology separates from other degassings technologies by being more efficient and stable in performance. Further more the system is giving energy to the system whereas other traditional trickling systems are working in some degree as cooling towers |
| Description of section | By means of pvc pipe diffusers, air is distributed from blowers to 2 degassing tanks of which one (1) is prior to bio-filter and the other (2) after bio-filter. There is one blower for each degassing tank, and one back-up blower, so it can replace any of the 2 ordinary blowers in case of failure. The central PLC system is monitoring the power supply and running of the blowers, and will activate the alarm system in case of failure. A spray nozzle system is preventing foam build up in both degassing tanks |

Main group 200**Waste & Sludge treatment****Section 205 Waste Treatment**

| | |
|-------------------------------|--|
| Function of section | To collect all effluence sludge water and separate water from sludge, in order to make sludge with 10% dry matter or sludge cakes with 30% dry matter. |
| Benefits in section | In projects with a need to transport away all organic waste from the site, it is of great importance with a high dry matter in the sludge in order to reduce the transport costs. AQS guarantee minimum 10% dry matter when using bandfilter system and 30 % dry matter in sludge cakes from filter press. |
| Description of section | Waste water from cleaning of bio-filters is pumped to waste water buffer tank for settlement and later the settled sludge is pumped to sludge mixer tank. Sludge from plate separator, bottom sludge from bio-filter, sludge from de-phosphors system and sludge from settlement in waste water buffer tank is all directed to the sludge mixer tank in order to make a homogeneous sludge mix for further treatment. From sludge mixer tank a small flow is lead to the sludge settlement tank from where the settled sludge is pumped to the filter press. |



Main group 200**Section 206 De-phosphorus system**

| | |
|-------------------------------|--|
| Function of section | To remove phosphor and dissolved particles from effluence water prior to release back to river, and in case of fully closed recirculation the water is returned back to recirculation system as a replacement of new intake water. |
| Benefits in section | Designed for easy and trouble free operation. Sludge is taken out in less than 2 minutes. The process in the de-phosphorus system makes it possible in combination with the de-nitrification system to run "ZERO" water change as the de-phosphorus process extracts a large number of heavy metals and other dissolved materials and "so to speak" creates "new water" that perfectly can be re-introduced to the recirculation system, or can be lead back to the river clean of P and N. The significant reduction of new water intake allows for elimination or heavily reduction in heating costs and eventual usage of salt. |
| Description of section | Outlet water from de-nitrification system is pH adjusted via the central PLC system and after iron chloride is dosed and mixed into the water through an oxygenation tank and several different mixing tanks, and finally the phosphorus and other dissolved particles are settled in the settlement tank. Sludge is taken out automatically from settlement tank by one of the sludge pumps which is controlled by the central PLC system. |

Main group 200**Section 207 Water Heating / Cooling****96.358**

| | |
|-------------------------------|---|
| Function of section | The system recover heat from effluence water and the central PLC system control temperature in the system, the system also can cool the system water. |
| Benefits in section | Designed for easy and automatic operation. If there is a wish to run the system with variation in water change or salinity during usage of sea water or during grading or delivery of fish, then the system secures optimum extraction of the water leaving the system. |
| Description of section | <p>Effluence water is lead through heat exchanger to heat up / cool down new water intake, and if more heat is need, the boiler will supply the heat through another heat exchanger in order to have the correct temperature in the system. If more cooling is required, cold ground water will flow through another heat exchanger, alternatively heat pumps can be used for chilling</p> <p>In case of outbreak of IPN or for other reason, and the system have to be heated up by 4 degrees within 24 hours, the boiler will start and heat up by means of the third heat exchanger. If there is a need for cooling the system, the PLC system will start the flow of cooling water through heat exchanger (if cold water is available) alternatively the heat pump can be converted to chill the system down.</p> <p>The caustic soda system is used for easy cleaning of heat exchanger in order to maintain high efficiency</p> |



Main group 200**Section 209 Salinity control system**

- Function of section** To hold the wanted salinity level by means of sea water or by dosing of a high salinity solution for control of salt level in recirculation system.
- Benefits in section** Designed for easy and automatic operation. If there is a wish to run the system with variation in water change or salinity during usage of sea water / artificial salt or during grading or delivery of fish, then the system secures that the wanted salinity levels are kept at all times.
- Description of section** 20 or 40 m3 out door 20% salt solution holding and mixer tank with dosing motor valve controlled by salinity sensors via the central PLC system. Alarm appears if the salinity level get out side the high or low set point levels.

Main group 300 Fish tank**Section 302 Tank inventory****210.223**

- Function of section** Inlet pipe system for optimum water distribution into fish tanks.
The Fish Tank Cleaners (FTC) enables operators easy access to collecting and monitoring mortality without disturbing the fish, and to monitor potential feed waste immediately during feeding.
- Benefits in section** The Fish Tank Cleaners (FTC) enables operators easy access to collecting and monitoring mortality without disturbing the fish, and to monitor potential feed waste immediately during feeding.
- Description of section** Utilising existing or new inlet pipe system, water from oxygen cones are distributed into the fish tanks.
Water going out of the fish tanks is lead by a suction pipe taking the water from the bottom of the centre of the fish tank into the FTC placed at the surface of the water level in the fish tank. The water flow from the bottom of the fish tank will carry any dead or weak fish as well as feed waste and excrements up into the FTC and from here the water, excrements and feed waste goes through the grid inside the FTC for immediate filtration in the drum filter. The grid keeps back any mortality and alive fish will swim out through specially made escape points in the FTC.
The immediate appearance of weak or dead fish as well as feed waste, makes it easy for operators to get a good monitoring of the present situation in the system as well as good measures of if feeding levels are correct.

Main group 400 Oxygenation

- Function of section** Injection of oxygen into oxygen cones, individual fish tank oxygen measurement, monitoring and control of oxygen levels. Emergency oxygen in case of treatment or power failure.
- Benefits in section** Designed for oxygenation of the total water flow in the system, which secures absolute optimum utilisation of the added oxygen, and minimum difference in oxygen levels of fish tank water and incomming water
- Description of section** Each fish tank has an oxygen sensor, which via the central PLC system monitors, controls, logs and alarm the oxygen levels.



Egtved 30-08-2009

Each fish tank have an oxygen level set point, set by the operators, and the PLC system will ensure oxygen levels close to the set point, in case the oxygen levels get outside the set points of high and low alarm levels, an alarm will appear, and operators can adjust the oxygen flow on the oxygen panels flow metres and / or adjust the water flow to the related fish tank.

In case for some reason (during grading, power failure, operators failure, treatment) that the oxygen level get further below the low level alarm set point, and reaches the emergency oxygen set point level, emergency oxygen will be released to the related fish tank until the oxygen level gets above the emergency oxygen set point level. Each oxygen sensors measurements and all alarms are logged on the PLC, so historical data is available.

The central PLC system measures the pressure in the inlet pipe system manifold, and will start or stop main pumps depending on the required amount of water needed, so in case operators closes for some tanks for grading, the correct numbers of pumps will be stopped automatically in order to maintain the correct water pressure. The level of water pressure is pre set by operators.

Main group 450 Oxygen generator

Function of section Onsite production of oxygen, Oxygen purity and flow measurement, monitoring and control of oxygen generator. Alarms for high and low levels of pressure, purity and flows.

Benefits in section Production costs for 1 kg. on-site oxygen is close to 1 kW electricity + capital costs. Often it is seen that net prices are close to 1/3 - 1/2 of the price of liquid oxygen. If waste heat from oxygen generator compressors can be utilised, the savings are even higher.

Description of section The oxygen produces by the oxygen generators can handle the basic oxygen usage, where as peak usage and emergency oxygen comes from LOX tank. As an alternative to the LOX tank there can be installed a back-up oxygen generator in combination with an extra back-up electrical generator. Further more the central PLC system is prepared for reading of LOX tank pressure and level, as well as calculating the daily usage in kg. Yderligere er PLC systemet forberedt for måling af flyden oxygen tankens tryk, indhold samt dagsforbrug.

Main group 500

Grading and vaccination system

Function of section Grading the fish into different size groups and potentially combine it with vaccination. Taking fish out from fish tanks for delivery / harvest.

Benefits in section By having central grading platform or area, and having fixed pipe system both for taking fish out of the fish tanks and returning the fish to new tanks, there is significant savings in man power as there is not a lot of hoses to be moved around when approaching a new fish tank for grading.

Description of section In bottoms of all fish tank there is a plug or standpipe that is removed from the specific fish tank to be graded. When removed, the fish can flow into the pipe system that connects to the central out fishing cellar, where the fish pump is connected to the pipeline from the fish tank to be graded. The fish pumps delivers the fish to the grader / vaccination systems, and after grading / vaccination, each size group of fish are counted by fish counters, and flushed



Egtved 30-08-2009

in pipes with water back to the new fish tanks

Function of section**Main group 600 Electrical equipment**

The electrical panel must have supply from the customers main panel. Included is transient protection (protection against lightning) both for existing main panel and the electrical panel in this quotation.

In case of power failure, there is battery back-up for the PLC systems oxygen sensors which allows operators to be able to read the actual oxygen levels during power failure, as the included laptop computers have the ordinary back-up batteries build in as standard. In case of emergency, there are manual start contactors for all key motors.

The electrical back-up generator will start up as soon as a power failure is recorded. The PLC system will start up each motor in a pre-planned order after power failure in order to prevent overload on the electrical generator. The PLC system is measuring the temperature, oil pressure and fuel level in the electrical generator, and give alarm prior to un planned stops of the generator due to these measurement points.

Electrical panels

Including motor protection, 24 VDC power supply, protection against lightning, 24 VDC battery back-up for PLC system

Aquatec *Management Solution*

PLC system monitoring, control, alarm & log system for pH, salinity, CO₂, temperature and oxygen, high and low water levels, oxygen generator systems and all other electrical equipments. Automatic start up of back-up equipment.

Aquatec *Production Data Solution*

Intergraded computer software, that automatically collects readings from *Aquatec Management Solution*, and manual readings are typed into the *Production Data* as well, this way it shows all necessary readings on one page for controlling production, including CO₂ and Ammonia calculations.

In addition the software holds a system that reminds operators of when and where daily practices have to be carried out. The operators has to log into the system using password, this way there is tracks of who has been doing what.

The system also calculates the present stocks and estimated growth of fish, when you type in the amount of feed and dead fish every day.

Finally the system deliverers daily and monthly performance report on usage of electricity, water, feed, lime, oxygen, fish production, mortality etc.

