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Experimental farm for sturgeons breeding

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Abstract

Breeding of sturgeons in fish farm is at it's beginnings in Romania and there are still many unknowns regarding the adequate technology for the super intensive recirculating aquatic systems. For testing and checking the technologies that are used in this kind of systems, INMA Timisoara had set up at Herneacova an experimental farm for sturgeon breeding. The farm is designed in such a manner that it allows the testing of many types of equipment used for water conditioning and also to monitories permanently the physical and chemical parameters of the water. Also, the farm is equipped with modern installations for heating or cooling the water and the farm hall, and in the near future the goal is to adapt energetic systems that use renewable energy to power on the farm installations.
Key words: *sturgeons, superintensive breeding, recirculating system*

Introduction

Aquaculture it's identified as the only possible way to increase the fish production, due to the fact that by industrial fishing world wide, quantities close to the maximum sustainability grades it is harvested. Diversifications of species breed in farms it's a potential way for cultures increasing for fresh water aquaculture.

In the last years more economical agents are interested in super-intensive fish breeding in recirculating aquatic system. Due to the fact that this breeding system is at it's beginning in Romania, the INMA branch from Timisoara has involved in realization of this kind of projects since 2006. The recirculation systems for aquatic production are an important alternative to the traditional aquaculture in pond. By treating and recirculating the water the recirculating systems require a much smaller quantity of water than a pond for the same amount of fish. Because the recirculating systems use highly populated tanks for obtaining the culture product the land requirement is also much smaller than for the classic aquaculture.

A recirculating aquatic system it is a partially closed system, which by water treatment and recirculation allows the breeding of fishes in control environment. Water treatment from the system involves in solid residue removal, oxidation of

ammonia and nitrates, elimination of carbon dioxide, aeration or (and) oxygenation, water disinfection.

Description of the experimental installation

The super-intensive breeding system, figure 1, it is composed from 6 round culture tanks, 2 with 3 m diameter, height of 1, 2 m, useful height of 0,8 m and useful volume of water of 5,65 cm, (*fig. 2*). The other four tanks (*fig. 3*) are round tanks with a diameter of 1 m, 1m height, useful height 0,6 m and useful volume of 0, 5 cm. The total volume of the system is about 15,4 cubic meters of water. Total surface of the system (of the 6 breeding tanks) is 17,3 square meters.

The system is composed from:

- Water supply installation for tanks;
- Installation for water evacuation from tanks;
- Mechanical water filtration installation;
- Pumping group;
- Biological water filtration installation;
- UV installation for water disinfection;
- Aeration installation;
- Oxygenation installation;
- Feeding device;
- Water quality monitoring system;
- Heating/cooling installation with heat pump;
- Safety system (electric power generator);
- Automation, command and control installation.

Water supply installation it is used to assure the permanent supply of technological water for the breeding tanks. From the filtration installations, the water cleaned of the brutish impurities and chemically conditioned (ammonia and nitrate neutralization) it is lead in the tanks supply installation. This is made from a circular network of PVC pipes from where the technological water it is lead to the tanks with the help of some taps. Water flow optimization it is made by using this taps for each tank. The evacuation from the biological filter it is above the water level of the breeding tanks and so the alimentation of the tanks it is done gravitationally.

Used water from the breeding tank it is gathered and evacuated, trough a sieve, into a horizontal pipe which is found under the tank and through a device which maintains the water level passes in the evacuation installation towards the mechanical filtration group.

The device which maintains the water level (presented next to the tanks in *fig.2 and fig.3*) it is made from two telescopically concentric tubes. By lifting or lowering the central tube the water level from the breeding tank it is increased or decreased.

This device also has the role to evacuate the brutish impurities gathered in the middle inferior zone of the tank, by quickly pulling the internal tube. Doing this, a sudden water pressure increasing it is realized in the lower side of the tube and the water loaded with these impurities it is evacuated straight to the used water basin. This operation has to be done once a day or often if it is necessary, depending on the level of the biological load of the system.

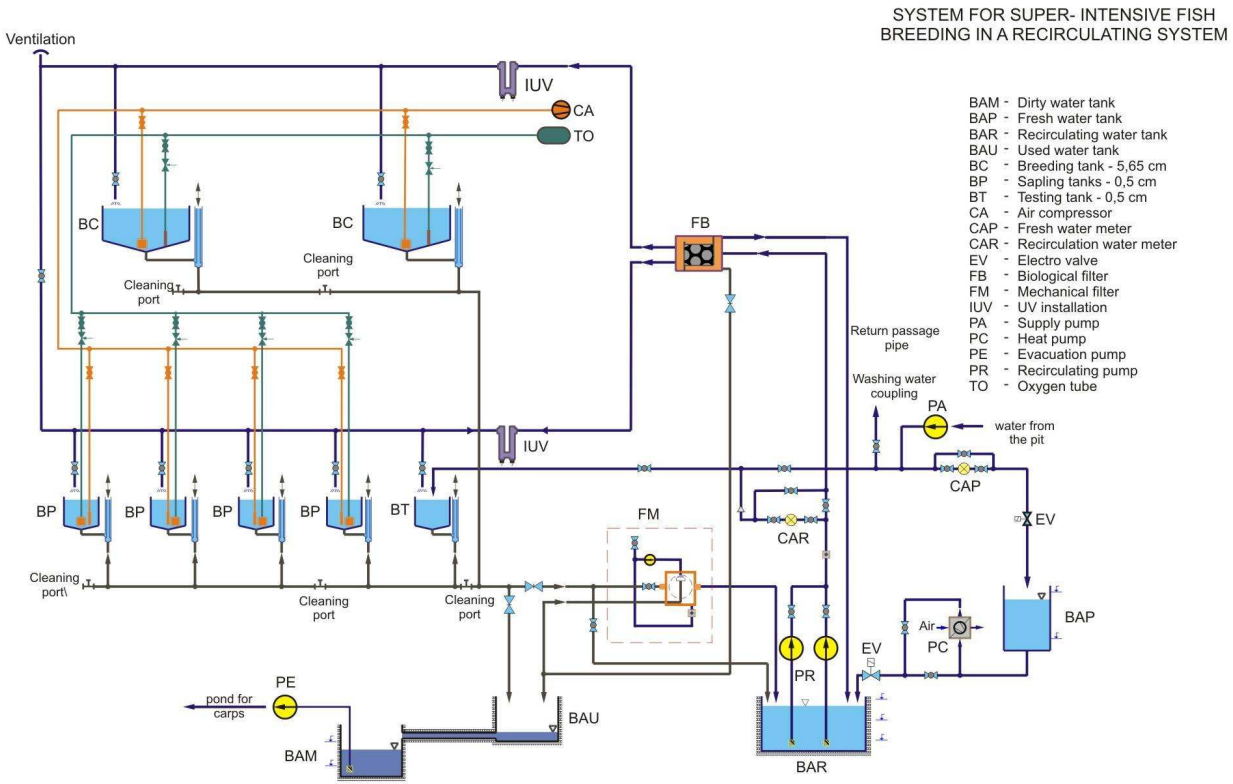
SYSTEM FOR SUPER- INTENSIVE FISH BREEDING IN A RECIRCULATING SYSTEM
Ventilation
IUV
CA
TO
BC
BC
Cleaning port
Cleaning port
FB
Return passage pipe
Washing water coupling
PA
water from the pit
IUV
CAP
EV
BP
BP
BP
BP
BT
FM
CAR
Cleaning port\
Cleaning port
Cleaning port
Air
PC
BAP
EV
PR
PE
pond for carps
BAU
BAM
BAR
BAM - Dirty water tank
BAP - Fresh water tank
BAR - Recirculating water tank
BAU - Used water tank
BC - Breeding tank - 5,65 cm
BP - Sapling tanks - 0,5 cm
BT - Testing tank - 0,5 cm
CA - Air compressor
CAP - Fresh water meter
CAR - Recirculation water meter
EV - Electro valve
FB - Biological filter
FM - Mechanical filter
IUV - UV installation
PA - Supply pump
PC - Heat pump
PE - Evacuation pump
PR - Recirculating pump
TO - Oxygen tube

Figure 1

Figure 2

Figure 3

The mechanical filtration installation represented in figure 4, equipped with a "drum" type rotational sieve, has the role of assuring the chemical and physical quality of the supplied water in the breeding tanks.

The rotating sieve is a filter with a high capacity with smaller dimensions than other sieves used to separate the liquid from the solid. The filtration proportion in this case it's five times higher, comparing to the static sieve filters, and the possibility of clogging this filter is almost null due to its own self-cleaning system.

The water flow enters axially into the drum and goes out filtered in a radial direction trough the gap network of the sieve. The liquid phase from the used water it is centrifuged due to rotational movement of the sieve towards the external wall from where it is collected, and the filtered material (the solid phase) it is evacuated from the sieve gravitationally. The solid particles retained by the sieve are washed with a pressure jet of water positioned externally and above the sieve; the solid material it is collected into a trench and lead out through pipes into the used water basin.

The efficiency of this type of filter depends on the optimum correlation of sieve characteristics, the spinning velocity of the sieve, the flow of the used water and also on the solid suspension concentration.

The maximum capacity of this type of sieve it is 50 cm/h, but for obtaining a maximum efficiency the flow capacity must not exceed 20 -25 cm/h.

The water cleaned of the brutish impurities it is slopped through the evacuation hole of the mechanical filter in the basin next to it. From here the water it is exhausted by a centrifugal pump and lead to the bio-filter which is set up nearby at a 1,7 m height.

The pumping group has the role to maintain the water flow in the system. It has two pumps with a 24cm/h capacity and the pumping height of 6m each. One pump plays the back-up role. The pumps can be independently connected by using the separation taps with the purpose of changing or replacing one of them. Every pump has in its aspiration circuit a "Y" type filter for reducing the solid particles load from water.

The biological filtration is a filtration technique which uses live organisms to remove a series of chemical compounds from the water. For RAS, a special interest is presented by the nitrification filters which allow the control of nitrogen compounds and elimination of ammonia.

Figure 4

Figure 5

The main problems taken in sight when the functioning principles are established for the nitrification filters are: the kinetic of the nitrification process, the configuration of nitrification filters and the physic-chemical and biological parameters which influence the functioning of this filters.

Decomposing the nitrogen compounds has a major importance in aquaculture because a part of the decomposing products, mainly the ammonia – NH3 and nitrogen dioxide NO2 are toxic; in a small amount the nitrogen dioxide – NO3 are toxic too when they reach high concentration. In the recirculating systems the uneaten food and the ordure are decomposed by special bacteria in simple organic compounds, the final product of this process is the ammonia, an unstable compound which transforms into ammoniac. In the first phase the bacteria oxides the ammonia into nitrogen dioxide (NO2). In the second phase, under the action of some other bacteria, by oxidation, the nitrogen dioxide transforms into NO3 which are not toxic unless they get in high concentration.

For the realization of the breeding system two types of biological filters has been chosen, both made by the German FIAP company:

a. Biological filter equipped with UV installation for sterilization and air pump with the following characteristics:

- flow capacity of filtered water: minimum 15 cm/h;
- power of the UV lamp: 130 W;
- air flow capacity: 60 l/min;
- maximum overall dimensions: 625x1000x850 mm

b. Compact biological filter (fig. 5) with the following characteristics:

- flow capacity of filtered water: minimum 25 cm/h;
- maximum overall dimensions: 625x1000x850 mm

The process of *disinfection with UV* light it is based upon the properties of the UV radiation to penetrate and destroy all forms of bacteria present in liquids or gases.

The action is instantaneous, no chemical substances are used, no chemical compounds are formed and the maintenance of the system has low costs.

A module made from 2 UV lamps it is set up on the evacuation pipe of the biological filtration installation. One lamp allows the disinfection of a water flow capacity of 15 cm/h with a used power of 130 W, so the entire module will disinfect 30 cm of water with a consumed power of 260 W. The lifetime of a UV lamp is 7500 hours.

Figure 6

Figure 7

Figure 8

Figure 9

Each tank has an air *blowing device* made from a frame of PVC pipes with holes through which the air is blown. The devices are linked to an air blower which assures the necessary air pressure and quantity.

Each tank has a special device for blowing oxygen and is made from a ceramic plate connected to an oxygen tube with a rubber hose.

The 1 m diameter tanks have automatic feeders with strap, with a capacity of 5 kg food. The strap of the device it's activated by a clock mechanism, adjusted for 12 hours functioning. The 3 m diameters tanks have feeders with spiral and a 10 kg food capacity. Using these feeders, the exact amount of food consumed for each tank can be monitored.

The installation for water heating/cooling has an air-water heat pump, which also control the air humidity, and the air heating/cooling from the hall it is made with a water-water heat pump type.

The recirculating aquatic system must be equipped with a *safety system* in case of power brake down. An eventual power brake down of a recirculating system where the bio-mass is high causes, in a few minutes, the reduction of the dissolved oxygen concentration to critical values. The other water quality parameters deteriorate slower. A long power brake down affects all the system components and respectively the quality parameters of the water which deteriorate under all aspects. This is why the system has been equipped with an independent power generator of 18.2 kVA, *Figure 7*, which will supply with power the main installations of the system in case of the power brakes down. The power generator it is commanded by an auto-

mated transfer switch which automatically starts the generator to assure the continuous functioning of the installations once the power breaks down.

Posibilities of using the recirculating system for reaserch and development activities

The recirculating aquatic system for super-intensive fish breeding, designed and realized by INMA, Timisoara branch, allows:

a. Continue monitoring of physic-chemical water parameters, made with 6 probes, which measure 9 parameters and are linked to a controller with an electronic display. These are:

- probe for the dissolved oxygen with the luminescent technology;
- probe for determination the nitrates and ammonia using the photo-metric principle;
- probe for the pH determination;
- probe for conductivity determination;
- probe for determination the solid suspensions and of turbidity with double infrared ray, for exact measurement color independent;
- probe for ammonia determination with selective ions electrodes for ammonia and potassium.

b. Use of different filtration installations aiming to establish their efficiency.

c. Researches to establish the optimal parameters of a recirculating aquatic system and of an optimal technology for intensive fish breeding.

d. Organization of some practical demonstrations for producers, specialists and for possible investors which are willing to invest in this domain.

Conclusions

The experimental system for super-intensive fish breeding in recirculating system, after it will start to function, will allow the continuation of the researches in the intensive aquaculture field, the testing of efficiency of different types of equipments used in recirculating systems. This achievement is a first step that will create a base of research and participation in future projects within national and international research programs.

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Összefoglaló

Romániában a tokfélék tenyésztése még gyerekcipőben jár, így számos bizonytalanság merül fel a recirkulációs rendszerekben való nevelésük tehnologiájával kapcsolatban is. A romániai Mezőgazdasági- és Élelmiszeripari Gépesítési Kutatóintézet (INMA) temesvári részlege Herneacova községben egy kisérleti rendszert állított fel, amely rendszer alkalmas különböző vízkezelő műszerek hatékonyságának tesztelésére a víz fizikai és kémiai paramatéreinek állandó monitoringján keresztül. A kísérleti rendszerben a levegő és a viz melegitése és hütése egy viz – viz tipusú hőszivattyu segitségével tőrténik.