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MONITORING THE WATER QUALITY IN THE AQUACULTURE RECIRCULATING SYSTEMS

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Abstract. The recirculating aquaculture production systems are an important alternative to the traditional pond aquaculture. The recirculating systems usually require control for monitoring the water quality parameters, such as: temperature, dissolved oxygen, pH and other indicators, directly or by using the monitoring equipments which keep these parameters within the optimum limits for the species. The monitoring and control of water quality have been done as follows: OD with WATT TriOxmatic 700IQ(SW), pH with WATT Sensolyt 700 IQ (SW), temperature with WATT TrioxiTherm type sensors, and other parameters by using the colorimetric determination with Merck and Spectroquant Nova 400 type kits.

Keywords: recirculating system, water quality, chemical parameters of water.

AIMS AND BACKGROUND

Lately, as a consequence of the surface water pollution and of the excessive fishing, but also thanks to its benefits, many farm fishers choose the recirculating aquaculture system (RAS), thus less practising the traditional fish pond farming system. Because the implementation of this raising system is still at the beginning, in the Aquaculture, Environmental Science and Survey Department, following the development of the project 'Scientific partnership for developing an experimental recirculating system with a view to promoting and implemeting innovatory extensive aquaculture technologies', a proper sized platform has been created, which would be a center of theoretical and practical training not only for students, but also for everyone who is interested in this field.

EXPERIMENTAL

The experimental recirculating system is provided with four EcoTank fish tanks (2.5 m^3), with double drain, made by AquaOptima–Norway, whose geometry and

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hydraulics meet the technological high standards regarding the solids fast removal efficiency. Water replacement from the rearing tanks was done with a drain, which captured the solids (settleable, suspended), because of its construction and proper position. Together with the inflow structure and with the rearing tanks capacity, using a modified Ecotrap double drain by AquaOptima is required. The scheme of the fish intensive rearing recirculating system, whose equipments have been sized according to the used technology, is shown in Fig. 1.

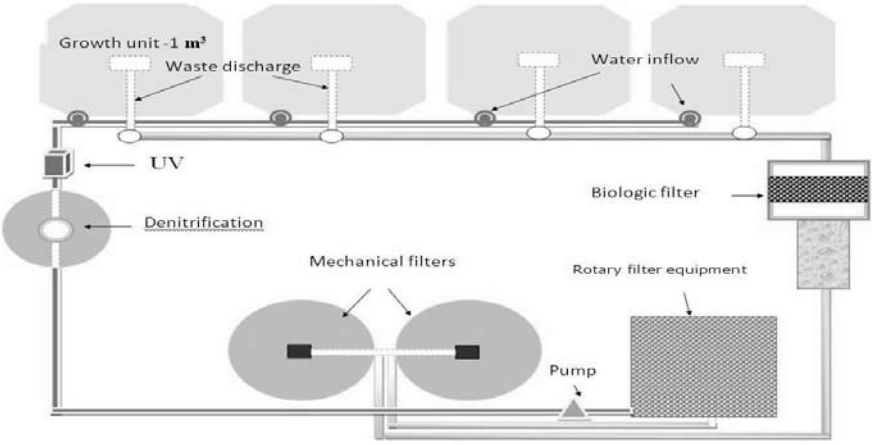

Fig. 1. Configuration of the experimental recirculating system

The conditioning module was sized according to the wastewater flow which needs filtration, so that a corresponding removal of the most important parameter influencing the quality of technological water can be achieved, namely the total unionised ammonia-nitrogen (TAN) and the oxygen required by the fish culture[1].

The water quality control of such a rearing system was critically determined by maintaining at optimum levels the dissolved oxygen concentrations, the unionised ammonia-nitrogen, nitrite concentrations and carbon dioxide. The nitrate-nitrogen concentration, the pH and the alkalinity are also important parameters of water quality monitoring.

A series of instruments and laboratory equipment were used to monitor the water quality parameters, as shown in Table 1. In Table 2 are presented the optimum admissible levels of the main physical and chemical water parameters of a recirculating aquaculture system for *Cyprinus carpio*.

Table 1. Equipment used for monitoring the water quality parameters during the experiment

Indicators/ quality parameters	Equipment used	Metod of determination	Measuring range
Oxygen	WATT Sensolyt 700 IQ (SW) type sensors	sensor method	0.0–7.89 mg/l
pH	WATT Sensolyt 700 IQ (SW) type sensors	sensor method	6.5–8.1
Temperature	WATT Sensolyt TrioxiTherm	sensor method	19–26.2ºC

Table 2. Optimum admitted levels[2,3] of the main physical and chemical water parameters of a recirculating aquaculture system for *Cyprinus carpio*

Indicators parameter	M.U.	*Cyprinus carpio*
Temperature	°C	21–27
Dissolved oxygen	mg/l	6–8
	% (saturation)	70–105
O_2	mg/l	<10.00
pH		7.0–8.0

RESULTS AND DISCUSSION

The growth experiment of *Cyprinus carpio* has extended over a period of 28 days and its main purpose was to establish an optimum feeding rate for the *Cyprinus carpio*, proper to the age of one summer; the weight of the fish has been approximated to 22.68 g/fish.

The researches have assumed that the feed rate, the feed composition, the metabolism rate and the uneaten fish feed influence the water quality from the culture tanks[4].

Of all the water physical and chemical parameters, the water temperature and the pH (Fig. 2), the dissolved oxygen (Fig. 3) have been monitored daily, with the sensors of the culture tanks. Because it is a system with minimum 90% recirculating water, the equipment which ensures the water quality (mechanical, biological and chemical filters) must be efficient. In addition, pressure aeration is introduced in every tank so as to provide an optimum level of dissolved oxygen in the technological water[5].

Water temperature. It represents one of the main factors of the aquatic environment[6], which affects not only the breathing process, feeding, metabolism, growth, behaviour, reproduction of the fish, but also their detoxification rate and bioaccumulation. During the experiment, water temperature was measured with WATT TrioxiTherm (Fig. 2).

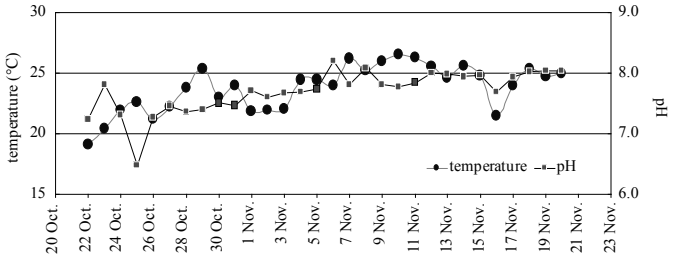

Fig. 2. Water temperature and pH variation during the experiment of common carp rearing in RAS

Dissolved oxygen. It is by far one of the most important quality parameters in aquaculture[7]. The amount of oxygen needed is based on the ecophysiological requirements of the species, on the size, feeding rate and temperature of the fish. For a short periods of time, the carp can survive with relatively reduced amounts of dissolved oxygen, lower than 3 mg/l. The metabolism, growth and even the resistance to some diseases can decrease when fish are exposed to dissolved oxygen concentrations under the optimum level, for a long period of time[8]. In the present experiment, the dissolved oxygen concentration monitored with the help of WATT TriOxmatic 700 IQ(SW) sensors has displayed heavy oscillations (Fig. 3), declining to drastical low values which, normally, could be lethal to the entire fish culture.

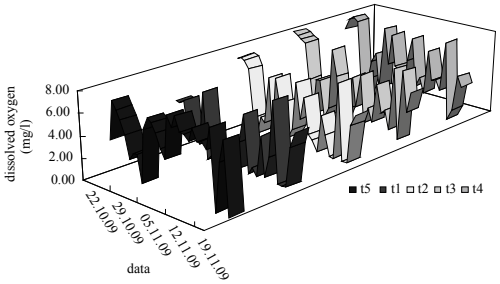

Fig. 3. Variation of the DO concentration during the experiment of common carp rearing

Water pH. In a recirculating aquaculture system, the pH is considered an important parameter which needs to be continuously monitored and verified because the water reaction affects a multitude of variables, and also the speed of many biological and chemical processes. Although the pH tends to decline in recirculating systems as bacterial nitrification produces acids and consumes alkalinity, and as carbon dioxide is generated by the fish and microorganisms, still, in our system ascending levels are progressively noticed, which indicates a slightly basic reaction of the water[9]. The water pH levels have been measured with the help of WATT Sensolyt 700 IQ (SW) sensors and ranged within the admitted limits for the crop species

(common carp) and the evolution of this parameter that has an ascending trend is shown in Fig. 2.

Weekly analyses have been performed during the experiment, in order to determine the nitrites, nitrates and ammonia through Merck kit colorimetric determinations with the help of a Spectroquant Nova 400 device.

CONCLUSIONS

• Evaluating the water chemical quality by using an automatic monitoring and control system ensures the permanent maintaining of optimum water quality parameters, imposed by the technological requirements.

• The oxygen represents the most important parameter, but the values of pH, temperature, ammonia and the nitrites are also important.

• The analysis of stress and critical control points over the technological flow demands the functioning of the technological equipments and the optimisation of the water quality parameters.

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