IMPROVEMENT OF WATER QUALITY FROM THE FISH FARMING IN RECIRCULATING SYSTEM USING ADDITIVES BASED ON ZEOLITES

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Abstract

Present scientific work propose to evidenced the chemical composition of the volcanic tuff, regarding the water quality maintenance at the optimum parameters, for breeding technologies in recirculating system, for the different fishes species with economical value. During the last years, zeolites represent a material used frequently in the technology for environment protection, based on the ionic transfer capacity and the adsorption capacity. Due to these chemical proprieties, it is regarding its implementation into the Romanian aquaculture, for a technological assurance, with optimum physical-chemical proprieties for fishes farming. The performances of experimental module were verifying trough rearing operations of Huso huso sturgeon specie. Rearing experiment developed during a 136 days period in the following conditions: monitoring of hydro-chemical parameters of the system's technological water, using as filter the zeolyte; monitoring of health state; establishing of rearing rate in experimental units. According with the experiments, these zeolites could be and must to be a technologically constant in aquaculture through the role of depollutant, in generally.

Key words: zeolites, aquaculture, fish, recirculating system, water quality

INTRODUCTION

Present scientific work propose to evidence the chemical composition and the effect of volcanic tuff, regarding the maintenance of water quality to the optimum parameters, for rearing technologies in recirculating system, for different fishes species with economic value. [1]

MATERIAL AND METHOD

The performances of experimental module were verifying trough rearing operations of *Huso huso* sturgeon specie.

Rearing experiment developed during a 136 days period in the following conditions:

- monitoring of hydro-chemical parameters of the system's technological water, using as filter the zeolyte;
- monitoring of health state;
- establishing of rearing rate in experimental units.

Description of experimental modality.

Regarding the experiment development has been accomplished a system for fish species rearing, compounded from:

-rearing units

-units for water quality conditioning, compounded from:

-unit of water filtration

-unit of water aeration and oxygenation

-installation for water distribution to rearing module.

RESULTS AND DISCUSSIONS

It has been accomplished determinations of the water chemical parameters, before and after the treatment with zeolite, for the assessment of this effect upon these parameters correction.

To determination of the main parameters who are implied in quality assessment, from chemical point of view, have been respected the work protocols, indicated in analyzing standard methods for surface waters, and also, the methods from domain literature, obtaining accurate results.

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For the assessment of zeolite effect upon the quality of water chemical parameters from the experimental units, sampling the following tests:

P1 – Sample 1 water without zeolite
P2 – Sample 2 water with washed zeolite
P3 - Sample 3 water with unwashed zeolite
P4 - Sample 4 water with unwashed zeolite
P5 - Sample 5 water with unwashed zeolite – populated with fishes

According to analyze of water from experimental units, it could be observed the following:

- **Water pH** has a decrease initially, with values between 7,98 upH, for initially water, to 6,90 upH for water with unwashed zeolyte, and after that to 7,96 upH in unit with fishes. Maintenance of similarly pH values is by reason of the increase of contain in calcium ions and bicarbonates, which leads to the improvement of water tamponade capacity. (figure 1). [2]

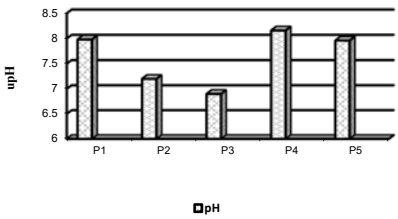

Fig. 1 pH variation in experimental units using zeolite as filter

- **Organic matter**, expressed trough the chemical consumption of oxygen at the potassium permanganate, was detected trough the volumetric method, based on the oxidation of oxidizable substances from water (especially organic matters) with potassium permanganate.

Contain in oxidizable organic matters, expressed in mg KMnO4/l, has values between 49,67 mg KMnO4/l, for initially water, 41,31 mg KMnO4/l in water with zeolite, and after that to increase at 58,33 mg KMnO4/l in unit with fishes, in all of these cases being under the maximum accepted value for fishy water, respectively 60 mg KMnO4/l. Correlated with this, the chemical consumption of oxygen at potassium permanganate (CCO-Mn), in mg O_2/l, has a similarly evolution.

It could be observe a decrease of organic matter in the zeolyte presence, as a result of its adsorption capacity, trough its retention into the net, but also as a results of enrich of environment with oxygen and its mineralization.

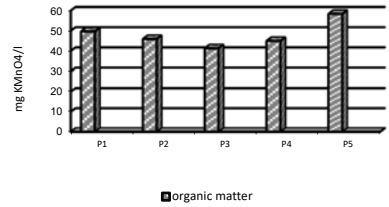

Fig. 2 Organic matter variation in experimental units using zeolite as filter

- **Ammoniac and nitrogen (NH_3 and NH_4^+)**, and also, the **nitrite ions (NO_2)** were been determine with the spectrophotometer. These registered lower concentrations in water passed through the material with unwashed zeolite than the initially water, untreated, and than the water treated with washed zeolite, by the reason of a better capacity of this, to retention these ions in its net (fig. 3, 4, 5). [2]

Into the treated water, but with fishes' presence, their values increase again, but with lower values than untreated water or than water treated with washed zeolite, as a result of the increase of quantity in organic matters from fodder and fishes metabolism.

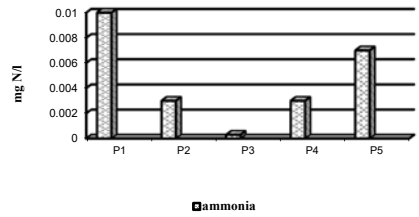

Fig. 3 Ammonia variation in experimental units - using zeolite as filter

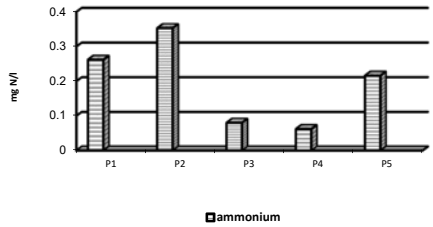

Fig. 4 Ammonium variation in experimental units - using zeolite as filter

In all cases, ammonia and ammonium registered values under the maximum accepted value for fishy waters, but the nitrites concentration exceed the limited value in untreated water, in water treated with washed zeolite and in water with fishes (figure 5).

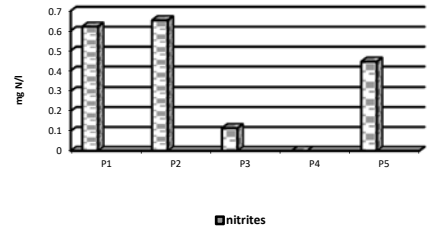

Fig. 5 Nitrites variation in experimental units - using zeolite as filter

- Regarding the **nitrate ion (NO_3^-)** – have been determinate with the spectrophotometer, except water with fishy material, where was a significance increase of nitrates, appreciatively of 8 times more, a fact that could be explained trough a mineralization in optimum conditions of the organic matter from this water (figure 6).

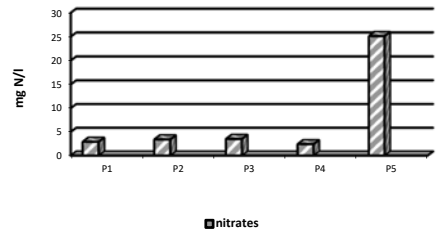

Fig. 6 Nitrates variation in experimental units - using zeolite as filter

- Quantity of **phosphate ions (PO_4^{3-})** determinate with spectrophotometer, decrease in water treated with unwashed zeolite from 0.229 mg/l in control sample (untreated) to 0.120 mg/l, but increase again in water with fishy material, solving in higher quantities, in optimum conditions of pH and register 0.702 mg/l value (figure 7). [2]

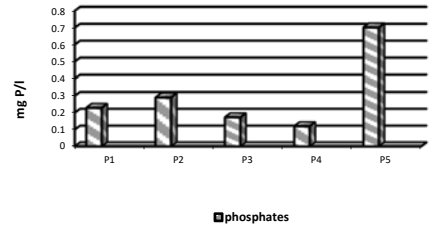

Fig. 7 Phosphates variation in experimental units - using zeolite as filter

- Concentration of **calcium ions** has been volumetric determined through the complexing of calcium ion with disodic salt of etilen-diamino-tetraacetic acid (Complexon III), in the presence of the mixture between murexid indicator and ß – naphthol green. [2]

- **Magnesium** concentration from water has been volumetric determined through the complexing of calcium and magnesium ions with disodic salt of etilen-diamino-tetraacetic acid (Complexon III), in the presence of the indicator ericrom T black and then effectuating the difference between the amount of calcium cations and magnesium and calcium cations, previously detected. [2]

Variations in calcium ion concentration are in strong connection with magnesium ion variations. (fig. 8 and 9). Ion exchange at zeolite surface is divided between these two ions, depending on the pH value also.

Lower values of pH encourage magnesium retention and the increase of calcium in water. In addition, Ca^{2+} in water is determined also through the exhaustion grade (a decrease of exchange capacity) of zeolite. During the experiment the quantity of Ca^{2+} has a subtle increase, but continuous compared with the concentration from the untreated water, but the concentration of Mg^{2+} ion decrease compared with untreated water, and than maintain

constantly until the unit was populated with fishes, when it has a decrease again.

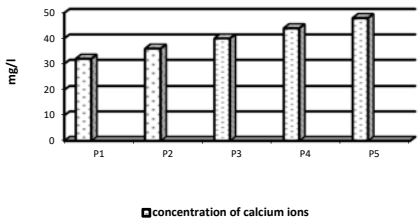

Fig. 8 Calcium ions variation in experimental units - using zeolite as filter

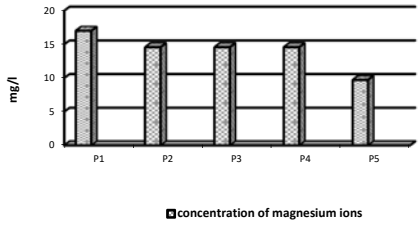

Fig. 9 Magnesium ions variation in experimental units - using zeolite as filter

The report Ca^{2+}/ Mg^{2+} is supra-unitary, net favorable to calcium ion, increasing from the value of 1.8 in untreated water to 2,4 in water treated with washed zeolite and finally to 4,9 in water treated with unwashed zeolite.

Water hardness has been maintained relatively constantly, independent from the report exchange between both cations.

- **Bicarbonates** have been volumetric determine and the principle of the method consists in titrating them with chlorine hydride in presence of methyl-orange. [2] Quantity of bicarbonates from water has a continuous increased in treated water beside the untreated water and decreasing subtle in treated water with fishes (figure 10). This thing, alongside the increase of the quantity of solved calcium, leads to improvement of environment tamponade capacity. Water alkalinity had the same variation as bicarbonates, as a result of their presence in water.

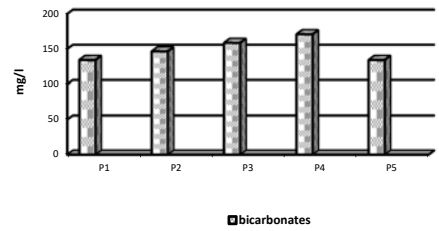

Fig. 10 Bicarbonates variation in experimental units - using zeolite as filter

- The value of **ion (Cl^-) and sulphate (SO_4^{2-}) -** volumetric determined through Mohr method and respectively with spectrophotometer – have been register subtle increases of the concentrations in treated water beside the untreated control sample, being released from the net of zeolite material through the desorption process (fig. 11 and 12).

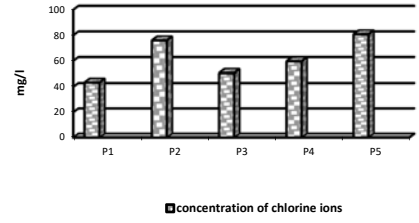

Fig. 11 Chlorine ions variation in experimental units - using zeolite as filter

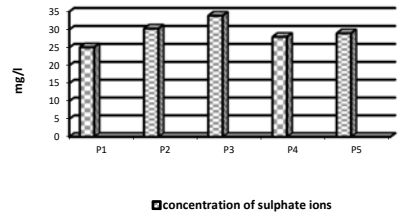

Fig. 12 Sulphate ions variation in experimental units - using zeolite as filter

Health state monitoring of the biologic material

Conclusions of the obtained results:

-general comportment of the biologic material into the rearing unit is typically for the specie

-clinically aspects registered to the analyzed lot are specifically to some exemplars with a well health

-parasitical specter is reduced, it has been register only one morbid entity with low values of extensively and infestation rate.

Correlated all these aspects, we can affirm that the analyzed lots, as exponents of the whole population from the rearing unit, are framed in the scale of normally parameters of health state.

Rearing rate of fishy material from the experimental units

Rearing rate of fishy material was monitories during the whole experiment period.

From the table no. 1 it could be observe that do not exist differences between the two experimental units. The values of rearing parameters are almost similarly.

Table 1 Values of the average masses registered to the control fishing

No.	Technological indicators	Experimental units	
		B1	B2
		Huso huso	*Huso huso*
1.	Population		
	Initially biomass – grams	1980	2040
	Individually mass - grams	330	340
2.	End of the experimental period		
	Finally biomass – grams	5640	5670
	Individually mass - grams	940	945
	Surviving	100	100
3.	Rearing parameters		
	Number of rearing days	120	120
	Individually rate of rearing - grams	5,08	5,04
	Totally rate of rearing	3660	3630
	R.M.G.I.	2,84	2,77

CONCLUSIONS

Present work is framed in the efforts of scientific research, with a goal of discovering and substantiated new domains of utilization of minerals zeolites (volcanic tuff) in aquaculture.

Accomplished study started from the theoretical proprieties of the natural zeolites, composites based on allumino-silicated, to function as ions exchanger and to correct some essential chemical parameters of technological water used in fish rearing.

Trough comparative analyze of water from the supplying source and after its passing through the filter with volcanic tuff, we can conclude: - it is confirmed the action of volcanic tuff used as filtration element, detected in laboratories analyses, regarding a decrease of NH_3, NO_2 concentrations, by the reason of exchanging capacity of aluminous-silicates and these adsorption proprieties in the holes of the structural net.

Through the passing of calcium ions in water and the retention of magnesium ions, it is modified the tamponed capacity of water, in the same time with bicarbonates increase, obtaining reduces in hydrogen ions concentration (pH reducing).

Catalytic activity is increase proportionally with the pores dimensions and if the available volume is higher.

The sanitary state of the fishy material was well.

According with the experiments, these zeolites could be and must to be a technologically constant in aquaculture through the role of depollutant, in generally.

ACKNOWLEDGEMENTS

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