NEW METHODS TO COMBAT THE EXCESS DEVELOPED VEGETATION INTO THE HYDROPOWER LAKES

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This paper refers at a recent problem appeared into hydropower lakes, vegetation excessively grown, which gradually leads to the "suffocation" of them. Deposits of rotten vegetation appear in low depths areas, followed by the drop of oxygen level in the water during the night. In the paper are analysed the factors which favoured development of vegetation, types of vegetations growing in excess into last decades. A new solution to combat this vegetation was proposed, realised and tested and implemented into Hydropower Lake Pangarati during two successive years. There are presented pictures during realisation and implementation of the barriers. After three weeks were analysed the first obtained results. There are presented some conclusions after one year and after two year after implementation. Some possibilities to extend into other hydropower systems are mentioned.

Keywords: ecologic balance, exploit management, durable development, risk analysis.

1. Introduction

In the last decades the national hydropower system is confronted with a new problem: the excessive growth of vegetation in hydro power lakes. This has seriously affected the ecological balance in those area by the drop of useful volume in the systems, decreasing of volume capacity with economical effects due diminishing of the quantity of water for turbines, and of the produced energy.

Excessive exploit of the hydro power resources in the past 15-20 years due to the lowest cost of produced MW led to a chain of negative effects which affects the ecological balance in the area. In this category are included the rivers Bistrita and Jiu. In this paper are analysed three lakes on Bistrita, respective Pangarati, Vaduri and Reconstruction. In the grills from the hydropower plants capitations very often during the period of growing vegetation, till April to October is necessary to clean them.

As a first objective to solve this problem was to analyse the environmental parameters from the analyzed critical areas, which leads during years at vegetation

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growth in excess. Where made analysis considering sediment, chemical structure, biological conditions, temperatures, rate water flow, type of vegetations to estimate the real situation. The adopted solution in combat excess vegetation must be realised taking into account the importance of continuous assurance of the useful flow rate transported through the system channel, the energy need to be produced, but also water alimentations for local population and for the downstream consumers.

During the past years have been tried different methods for combating the vegetation, but all of them failed. Some of them were strong energy consumers others suggested utilisation of chemicals (it's not allowed there is alimentation with water for population purpose), some others tried fish's acclimatisation (failed due low temperature from lakes) other mechanical combat. The last one had as result the acceleration of the natural phenomena, by the ramification of existing plants and by their strong development next year.

The proposed solution was to implement for the first time in our country, an economically and ecologically efficient solution, by placing "screens" in the root area of the plants, to suffocate the existing vegetation. The solution was tested until now only out-side Romania. The solution was implemented and tested into Lake Pangarati, on one of the shores, during one year. At each 3-4 weeks the barrier was moved into new location, adjacent to the old one. After a year were made comparisons and determined the efficiency of the solution by comparing the two shores (the one with the "screens" and the natural one).

The proposed solution is economically efficient, ecologically viable for the diminution of the developed vegetation in these lakes. It was conceived a real exploit plan, to allow the training of the deposed sediments, having as purpose the growth of the useful volume of the systems.

2. The physicochemical characteristics of analysed lakes

Till now it hasn't been made a complete model, for the analysis of the physicochemical parameters, which correlated with local sediments and stream flow favoured the excess development of vegetation. At international level, in the past years, a greater importance is given to the rehabilitations of the damaged areas by the irrational exploitations and to the restoration and the protection of the natural equilibrium. It is recommended to elaborate a plan of concrete measures, in respect of transport the sediments, to analyse their fault effects and of all the unfortunates consequences on long term to the phreatic waters (in many cases, the single source of drinking water for the inhabitants of the area).

It must be mentioned that:

- Substances dissolved into water favour development of the aquatic algae.
- Carbon is the principal element after hydrogen and oxygen and it is developed in

excess by the growing vegetations

- In natural conditions phosphor represent the principal nutrient which is favourable to vegetation development
- If into the rivers are cross-border of phosphor (as effects of human activities industrial or agricultural) the vegetation will develop faster.

Next are mentioned some parameters measured during years 2006 and 2007 into analysed area.

Table 1

Element concentration from natural water in lakes on Bistrita River

Element	Symbol	Consumption (vegetal) %	Water necessities %	Water necessary / offer (aprox)
Oxygen	O	80,5	89	1
Hydrogen	H	9,7	11	1
Carbon	C	6,5	0,0012	5.000
Silica	Si	1,3	0,00065	2.000
Azoth	N	0,7	0,000023	30.000
Calcium	Ca	0,4	0,0015	<1.000
Potassium	K	0,3	0,00023	1.300
Phosphor	P	0,08	0,000001	80.000
Magnesium	Mg	0,07	0,0004	<1.000
Sulpha	S	0,06	0,0004	<1.000
Chloral	Cl	0,06	0,0008	<1.000
Sodium	Na	0,04	0,0006	<1.000
Iron	Fe	0,02	0,00007	<1.000
Bohr	B	0,001	0,00001	<1.000
Mangham	Mn	0,0007	0,0000015	<1.000
Zinc	Zn	0,0003	0,000001	<1.000
Cuprum	Cu	0,0001	0,000001	<1.000
Molybdenum	Mo	0,00005	0,0000003	<1.000
Cobalt	Co	0,000002	0,000000005	<1.000

Table 2

Chemical concentration into the waters of Bistrita River

Station	PH	Ca^{+2} mg/1	NH_4^+ mg/1	NO_3- mg/1	$PO_4^{'3}$ mg/1	CCOMn $mgKMnO_4/l$
After dam Lady Batca	7,85	43,25	0,000	1,20	0,003	10,23
After PETROCART	7,60	55,18	0,060	2,60	0,250	68,00
After alimentation	7,03	40,28	0,013	1,20	0,032	15,80
Small river Cuejdi	7,98	99,39	0,056	3,70	0,210	20,85
Reconstruction Lake	7,85	46,69	0,009	4,65	0,067	18,40
After Cleaning Station Chemistry Platform	7,73	43,20	0,016	1,35	0,080	14,85
Canal after Zanesti	7,50	47,10	0,006	3,30	0,009	21,56

Table 3

Numerical density of plankton in Bistrita River, before Pangarati Lake

Nr.	Station	Data	Total algae nr. ex/ml	Media nr. ex/ml
1	Bistrita River	6.08	553	553
2	Canal UHE	16.09	851	851
3	Pangarati Lake	6.08	2213	1415
		1.11	617	
4	Vaduri Lake	6.08	3723	2333
		1.11	943	
5	Lake Lady Batca	6.08	617	883
		1.11	1149	
6	Reconstruction Lake	6.08	660	830
		1.11	1000	

3. Types of developed vegetations

Into next pictures are presented some images in spring 2007 when were collected vegetations from lakes Pangarati and Reconstruction.

Fig. 1. Images during collecting vegetation from Pangarati Lake - Cladophora glomerata

Fig. 2. Vegetation Recontruction Lake – Combined vegetation with Elodea

By collecting vegetations from analysed lakes it may be observed that the populations is formed by types Achnanthes, Ceratoneis, Cocconeis, Cymbella, Diatoma, Fragilaria, Gomphonema, Navicula, Nitzschia, Rhoicosphaenia, Synedr and realise almost a green carpet under the free surface of lakes. Beside this diatomee there are and micro algae Oscillatoria, Phormidium and Spirogyra

4. Implementation of barriers

As solution of diminishing the growth vegetations were realised for the first time in Romania some barriers, to be placed into the bottom of the lake, into area of waters having deep between 2-4 m, the principal zone where the vegetation is growing. Each barrier covers a surface around 72 m^2.

Barriers are formed by opaque materials, placed on bottom of lakes, over vegetation at the beginning of growing, March-April. In Fig.3 is presented an image with barriers before implementing into the Pangarati Lake.

Fig. 3. Image with barriers before implementation into the lakes

The barriers were realised as modulated solution to be easier to me manipulated, transported from one lake to another and to be installed. From the other country experience there were made some orifices to permit the evacuation of formed gases during vegetation destroying. The material must be elastic but do not be deformed during time. The orifices must be small enough not to let light to enter till vegetation and to let it to grows through orifices (in time will destroy the barrier) but large enough to let gases to be evacuated at the lake surface.

The solution is efficient due to the fact that it may be used since the beginning of the biologic cycle especially for Elodeea Canadensis. The solution was tested also in cases of groaned vegetations with very good results.

At the corners of the barriers are placed bags full of sand and rocks to keep the barrier exactly into the same position no matter flow rate into the channels.

Fig. 4. Picture during implementation into Lake Pangarati

In Fig.3 may be observed a small amount of water placed over the barrier. Due to this fact the barrier practically flows on water surface and it is easy to be transported to final location.

Fig. 5. Images during barriers anchoring

To be easier there are necessary at least two people; one to keep fixed the barriers and the other to put the anchor at the corners. It's very important that the barriers will rest necessary time till next move into the same position no matter flow rates (to be sure may be putted extra anchor to borders).

The barriers rest into the same places 2-3 weeks, but after each week a control of the barrier was made. Even from the first visit we realised that appeared changes of the colour of water where the barrier was placed, due to destroyed vegetation. During month May-June the barriers may rest 3-4 weeks; during months July-October it is necessary that the barrier rest at least 1 month (the vegetation already have been grown and it is necessary a long time to destroy it). On the other hand till then was enough time to be developed all types of vegetations founded (elodea is destroyed in 3-4 weeks) and needed a long period.

5. Experimental results

After the time passed even from the arrival at the barriers place it was observed that the colour of the water was changed. The anchors have been moved and the barrier took away, till next location. It appears like a clean portion on the water surface. The barriers were in good conditions, proper to other locations.

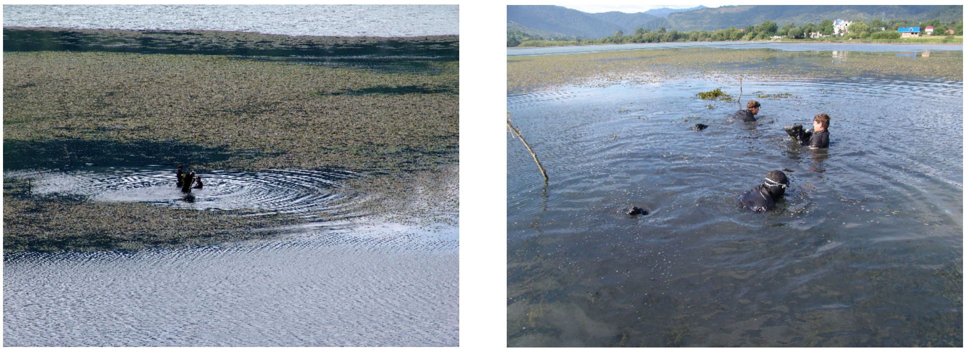

Fig. 6. Images proving the effect of barrier

In images from Fig.6 it's evident to explain the effect of barriers. The places were the barrier was placed rest as a small amount of water free of vegetation. The scuba divers team try to collect vegetation from places where the barriers where placed, but as it is shown into pictures from Fig. 7 and Fig. 8 it was impossible. Even if it was green the roots were all destroyed. At the border of the barrier the vegetation was only partial destroyed, Fig.7, but under them it was practically no vegetation, Fig. 8.

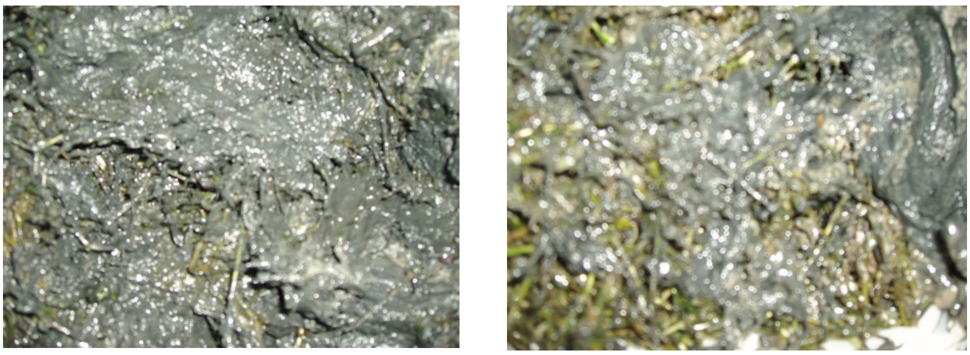

Fig. 7. Vegetation collected at the border of barriers; all roots are destroyed

Under the barriers there is a sucking bad breath smelling like a real bank material into decay. The bank of the central area is more compacted then that one from barrier borders. In to this one there is a supplementary amount of water.

Fig. 7. The bank from central part of barriers

5. Conclusions

It was realised and implemented a solution of current exploit methodology able to ensure the necessary flows downstream, with the efficient training of the sediments “liberated” from the vegetation. A methodology of exploitation also in critical regime will be developed as a request of an integrated management system. The proposed solution is ecological and no affects the quality of waters an important aspect due to the fact that generally from those lakes are realised alimentations with water for population and animals.

It was tested during a spring-summer, from April to October. The barriers were moved from one location to another at the beginning after 3 weeks and after that each month. In places were barrier were installed the vegetation did not grow after replacement of the barrier. The experiment were realised during summer of 2007. Into 2008 the barrier were installed into another places. The same results were registered. Into year 2008 was checked the places were the barriers were placed a year ago; the vegetation grows smaller and has no “power” compared with vegetation leaved free.

R E F E R E N C E S

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