HISTORICAL BASINS SEDIMENTS

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ABSTRACT

Modifications of small water reservoirs in the past focused primarily on addressing issues of capacity and stability of the reservoir capture. By the impact of changes in the use of reservoir surroundings, by acceleration of the erosion processes on the adjecent land and non-periodical maintenance of the capture leads to morphological changes in the reservoir, which causes changes in the in the reduced flowage of the basin and thus in changes of the flood protection degree of adjacent land. This reduces the accumulation part of the basin and subsequently its economic use in fish rearing
Bottom sediments of dams are products of erosion of agricultural and forest soils, the main flow of the river basin and tributaries connected to the dam or a system of dams. They have the basic properties of surface layers of soil erosion

KEY WORDS: bottom sediment, subsidence, the origin of the bottom sediments, dam, water reservoir

1. INTRODUCTION

Unique technical design in water management contributed to the greatest expansion of mining and the most glorious period in history of Banska Stiavnica in the first half of 18th century when it was the third largest city in Hungary. In the years 1740-1760 14 tons of gold and 475 tons of silver was produced in the area. The first university of mining was established here as well especially due to ingenious utilization of water resources.

It was Matej Kornel Hell and especially Samuel Mikovini with his student Jozef Karol Hell junior who resolved the problem of drawing water from flooded mines. Samuel Mikovini, an excellent mathematician, cartographer and geodesist came to Banska Stiavnica in 1735 delegated by the emperor Charles VI and designed and built most of the reservoirs which outlasted to the present. He filled up these reservoirs by means of dozens of kilometres of collecting channels in relatively small area without any rivers. His system of head-water channels and a specific concept of interconnecting the reservoirs by tunnels were also ingenious.

The basis of this water-management framework was the interconnection of the reservoirs, utilization of rainfall water often from greater area than offered the river-basin and its transmit to the reservoirs. This means that we can speak of the most accomplished water

utilization framework of the 18th century. No other system of this kind was able to accumulate greater amount of rainfall water than the one of Banska Stiavnica.

Rainfall water brought erosive material from the surroundings which subsided on the bottom of the reservoirs during decades.

In general sediments besides their chemical influence change the function of a reservoir by reducing its volume from the bottom and by changing its area from the sides.

2. MATERIAL AND METHODS

The reservoirs in Banská Štiavnica – so called „tajchy" – are historically the oldest and most influenced ones by sediments. Today their maintenance is in the competence of Slovak water-management enterprise (Slovenský vodohospodársky podnik, š. p., Odštepný závod Povodie Hrona). In the present the reconstruction of water outlets and dam fortification in the reservoirs of Velká Kolpašská nádrž and Malá Kolpašská nádrž are being finalized.
The reconstruction works on Belianska reservoir, Rozgrund and others have already been finished and the project will continue. We can clearly observe changes in the attitude to revitalization of the reservoir system.

The Kolpašské tajchy complex has been under reconstruction since 2008 prebieha rekonštrukcia Kolpašských tajchov. In the past the comlex originally included three reservoirs: Veľký and Malý Kolpašský tajch a Rybník. Veľký and Malý Kolpašský tajch are situated in the vicinity of Banský Studenec village. Rybník was located near the nowaday railway station in Banská Štiavnica. All three reservoirs helped system of stúp in two valleys first in Rybnická dolina and later in Mestská dolina.

Water from these reservoirs together with water from the reservoirs of piarská skupina supported system of stúp in Antolská dolina. Water from Veľký Kolpašský tajch and Malý Kolpašský tajch passed through a ditch part of which created an interesting aquaduct. Since the second half of the 19th century water from the reservoirs was used for the needs of smeltery and ore finishing workshop in Banská Štiavnica as well.

Veľký Kolpašský tajch was built from in the year 1730. According to the budget of construction from april 16th apríla 1730 the expenses had to be 90 000 gold coins that had to be paid from the future profit. As early as the works on the dam had finished, its insufficient quality became evident. Water leaked out and even some ruptures appeared. Samuel Mikovíni prepared the reconstruction project in 1735 and rebuilt it.

In the following years continual reconstruction works cost great amounts of money. It was possible that Mikovíni wasn't allowed to design the reconstruction project as he wished because none of the other dams he projected ever needed bigger modifications.

The volume of Veľký Kolpašský tajch in 1855 was 798 900m^3, volume of Malý Kolpašský tajch 107 400m^3. Maximum depth of the first one was 13,5m, the second one 6,6m. Veľký Kolpašský tajch has the dam crest lenght of 182,1m, width 20,9m and height 14,2m, flooded area was 10,2 ha , volume of water in the reservoir was 799 thousandm3.

According to present measurings the area of the reservoir is 8,742 ha which is almost 1,5 ha less than in the original documents.

Malý Kolpašský tajch has and Veľký Kolpašský tajch have a common dam while their height rates are identical. The first mentioned was built in 1763. It has the dam crest lenght of 79,9 m, width 15,2 m and height 6,8 m, flooded area is 1,0 ha, volume of water in the reservoir is i 107 thousand m3. (Lichner, 1997).

3. RESULTS AND DISCUSSION

System of ditches that supplies both reservoirs brings deposits from surrounding areas caused by erosion. Soils there are shallow to medium deep, mostly kambizeme vzniknuté na vulkanitoch, tvoriacich materskú horninu. The summary is in the chart 1.

Table 1 Banský Studenec – soils in the surrounding areas of Veľký a Malý Kolpašský tajch (from:www.podnemapy.sk)

BPEJ	Popis pôdnej jednotky	Zrnitosť	Hĺbka pôdy
1081682	KM – Kambizeme na vulkanických horninách na výrazných svahoch stredne ťažké až ťažké	Stredne ťažké hlinité	Stredné 30 – 60 cm
1077462	KM – Kambizeme plytké na vulkanických horninách stredne ťažké až ťažké	Stredne ťažké hlinité	Stredné 30 – 60 cm
1081885	KM – Kambizeme na vulkanických horninách na výrazných svahoch stredne ťažké až ťažké	Stredne ťažké hlinito piesoč	Stredné 30 – 60 cm
1077465	KM – Kambizeme plytké na vulkanických horninách stredne ťažké až ťažké	Stredne ťažké hlinito piesoč	Stredné 30 – 60 cm
1061442	KM – Kambizeme typické na na zvetralinách vulkanických hornín, stredne ťažké	Stredne ťažké hlinité	Plytké do 30 cm
0981682	KM – Kambizeme na vulkanických horninách na výrazných svahoch stredne ťažké až ťažké	Stredne ťažké hlinité	Stredné 30 – 60 cm

Soil qualities significantly affect qualities of sediments in Kolpašské tajchy. Chemical characteristics of sediments can be evaluated through relatively complicated reactions between individual stages , especially between water solution and coloid part of the sediments. We use the same characteristics to describe soils.

Basic characteristics of sediments include
- soil reaction
- absorption capacity and the nature of sorption complex
- organic ratio (humus content).

After sampling we performed three analyses mentioned above, at first for the samples taken at Malý Kolpašský tajch.
One of the most important qualities of soil is its pH value. Soil reaction influences solubility of substances in soils and their efficiency for living organisms, accessibility of nutrients, adsorption and desorption of cations, biochemical reactions, soil structure andthereby physical characteristics. Following great complexity of relations in soil we

distinguish active and interchanging soil reaction. The pH value is expressed Hodnotenie by means of extensive scale USDA.

Table 2 Evaluation of soil by the soil reaction (USDA)

pH/H_2O	Rating
<3,5	very sour
3,5-4,4	extremely acidic
4,5-5,0	very strongly acid
5,1-5,5	strongly acidic
6,1-6,5	slightly sour
6,6-7,3	neutral
7,4-7,8	slightly alkaline
7,9-8,4	moderately alkaline
8,5-9,0	strongly alkaline
>9,0	very strongly alkaline

We made a pH analysis of the samples taken in 2008 in SPU laboratories. The results are displayed in the following chart:

Table 3: Results of measured values pH v KCl a H2O

KCl		H_2O	
Sample	pH	Sample	pH
1	3,05	1	3,82
2	2,86	2	4,02
3	3,19	3	3,81
4	2,8	4	4,25
5	3,4	5	3,9
6	2,1	6	4
7	2,44	7	3,79
8	3,24	8	3,58
9	2,9	9	3,63
10	2,37	10	3,8
11	3,3	11	4
12	2,88	12	4,1
13	3,325	13	3,6
14	2,8	14	3,69
15	3	15	3,69
16	3,375	16	4,3
17	2	17	4,53
18	2,8	18	4,2
19	3,18	19	4,6
20	3,2	20	4,15

The analyses show that samples from all the sampling places are characterized as acidic or extremely acidic soil.

We do not know the cause of this. One of the possible reasons could be acidic rains in the locality where we measured pH value of rainfall – in melting snow the value was pH 5,29. Certain substances which cause acidity of the rainfall might accumulate in the reservoir and during water evaporation their concentration and overall value change.

Proportion of organic content (humus) is the indicator of agricultural land fertility, the content of humic substances. In the case of sediments i tis is an indicator of contained organic matter which has come into the sediment rather from dead planktonic organisms from dead and decomposition of other dead organic matter. The average humus content as an indicator of Cox in the soil are shown in Table 4 (Sánka 2001).

Table 4. Rating humus content in soils (Sánka 2001).

The content of humus in%	Stock humus
< 0.5	extremely low
0,5 – 1,0	very low
1,0 – 2,0	low
2,0 – 3,0	medium
3,0 – 5,0	good
> 5,0	very good

The content of humus (organic substance) is a very important parameter affecting the basic features and functions of soil. I tis determined by setting of oxidizable organic carbon (COX) and multiplying by a conversion factor of 1.724 for humus. This calculation is based on the assumption that humus contains 58% carbon.

Table 5. Evaluation of the humus content in the sediment samples collected from Malý Kolpašský tajch.

sample number	carbon content results in the average (%)	humus content conversion factor of 1.724
1	10,8753	18,749
2	10,1477	17,4946
3	10,1515	17,5011
4	5,679	9,7905
5	10,1812	17,7356
6	9,4237	16,2464
7	8,5225	14,6927
8	9,1858	15,9316
9	7,8377	13,5121
10	8,0829	13,9349
11	5,734	9,884
12	0,9003	1,5521
13	7,3925	12,7446
14	9,2411	15,9316
15	10,4346	17,9892
16	8,0744	13,9202
17	8,3317	14,3638
18	9,8091	16,9108
19	8,8131	15,1937
20	10,1117	17,4325
21	1,4312	2,4674
22	2,1375	3,685
23	4,4481	7,6685
24	3,2819	5,6579

Obtained values indicate an extremely high content of organic matter. It is caused by the residue after planktonic organisms from the reservoir. More detailed surveys of sediments clearly show their layered arrangement, where the layers of lighter minerals alternate the ones with darker minerals.
The proportion of dead microorganisms in the total volume of sediments is significant. Places with a lower content of organic matter were always on in the steeper the bank, where the sediment consisted of material from the erosion of reservoir shores.

When trying to determine the volume of sediment, first we need to determine their thickness in different sections. Given the condition of the sediments - their great humidity and our technical possibilities and we estimated the thickness of the layer in the upper part at about 0.50 to 0.60 m. At the bottom the layer thickness gradually increased to about 2.5 m. With the area of 6,130 m2 and the average thickness of 1.55 m the volume of sediments would be at least 9501 m3. Even the reservoir area surface is smaller than the literature indicates, and so we estimate that the present volume of the reservoir is around 60,000 m3 of water.

Part of the sediment was removed and taken away but most flooded again after the reconsruction works had finished. Their chemical characteristics woul probably affect the quality of the intercepted water.

In the future it is necessary for the reconstruction of other reservoirs to compare obtained values and to evaluate the possibility of adverse changes in their characteristics.

4. CONCLUSIONS

The work was to evaluate the formation and qualities of historical sediments of water reservoirs in Banská Štiavnica. In present time Kolpašské Tajchy in Banský Studenec are under reconstruction. During maintenance works after deletion of the reservoirs they become available for exploration of sediments. After determining of their deposit and their amount, samples were taken for mechanical and chemical analysis. After their evaluation, we found out that their qualities are significantly influenced by their resources and operation. Interesting It is not only extreme soil reaction which is interesting but also a high content of organic matter. And also their large volume, despite the fact that water flows in only by means of rain ditches.

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