

EVALUATION OF CHEMISTRY OF WATER RUNNING FROM THE CATCHMENTS ČERVÍK AND MALÁ RÁZTOKA IN THE MORAVIAN - SILESIAN BESKIDS DURING THE FLOOD WAVE IN JULY 1997

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Problem

On the catchments Červík A, Červík B and Malá Ráztoka in the Moravian - Silesian Beskids the long - term hydrological research has been carried out (Chlebek, Jařabáč 1995).

Observation of chemistry of precipitational water taken from the measuring spillways is a part of this research.

In July 1997 this measurement was hit by the flood caused by extraordinary rain as well as by extraordinary flow wave. From 5th to 8th of July 198 mm of water with the daily maximum 205 mm on the 6th of July fell in the catchment Malá Ráztoka; in the same period the precipitational sum 340 mm and highest daily precipitation 139,6 mm were measured in the catchment Červík (Chlebek, Jařabáč 1997).

This contribution deals with the influence of high water flows on the content of dissolved substances and suspended sediments in the torrents of the above mentioned catchments.

Methods

The observed forested catchments are covered by stands of different mensurational values (parameters). Spruce stands to the age of 40 years are prevailing in the catchment Červík A, area of which is 88,2 ha (in the altitude 650 m to 854 m). On the catchment Červík B with the area of 84,3 ha in the altitude ranging from 650 m to 960 m, older and mature stands with spruce prevalence (75%) are still existing. In the last 30 years the original beech stands on more than 80% of the area were regenerated also mainly by spruce (56% composition) on the catchment Malá Ráztoka which area of 208 ha is situated into the elevation from 602 m to 1084 m. The detailed information is presented by Chlebek, Jařabáč (1995).

The analysis of water samples was done by the chemical laboratory FGMRI in JiloviřtĚ -Strnady according to the instructions used for the international program EU/ICP Forests -observation of state and changes of forest ecosystems on the level II.

Results

The results of water analysis taken on the measuring spillways of the catchments Červík A, Červík B and Malá Ráztoka during the flood situation in July 1997 together with results acquired in the late June and early August are presented in table 1.

Table 1. Concentrations of dissolved substances on the catchments in Beskids during the flood wave in July 1997

Catchment	Date of sampling	Flow l/s	pH	mg.l ⁻¹																
				Cox	K	Na	Mg	Ca	Cu	Zn	Mn	Fe	Al	NH ₄ ⁺	Cl ⁻	F	NO ₃ ⁻	SO ₄ ²⁻	P	
Červík A	97-06-30	8,8	6,77	5,04	1,21	2,66	2,44	6,22	0,004	0,008	0,003	0,021	0,044	0,158	1,39	0,06	0,84	18,08	<0.01	
	97-07-07	1213,0	6,02	17,40	1,73	1,03	1,06	4,54	0,004	0,017	0,036	1,027	1,055	0,078	5,18	0,05	1,03	11,73	<0.01	
	97-07-08	655,0	6,08	6,36	1,05	1,01	1,16	3,19	0,002	0,019	0,012	0,095	0,165	0,555	1,02	0,06	0,45	12,67	<0.01	
	97-07-10	200,0	6,17	8,40	1,05	0,93	1,20	3,37	0,001	0,008	0,008	0,039	0,083	0,914	0,88	0,05	0,43	12,74	<0.01	
	97-08-04	5,6	6,46	2,28	1,15	1,65	2,26	6,13	0,004	0,004	0,002	0,021	0,027	0,072	1,92	0,05	0,24	15,49	<0.01	
Červík B	97-06-30	4,6	6,73	5,76	1,51	2,79	2,89	5,30	0,003	0,016	0,008	0,024	0,046	0,266	2,01	0,11	3,09	23,01	0,03	
	97-07-07	926,0	6,66	15,60	1,53	1,44	1,96	4,02	0,003	0,047	0,184	1,022	0,523	0,979	2,17	0,06	3,57	18,58	0,03	
	97-07-08	446,0	5,96	26,28	1,14	1,30	1,86	3,86	0,001	0,044	0,111	0,187	0,279	0,664	1,46	0,08	3,30	17,94	<0.01	
	97-07-10	160,0	5,89	6,12	1,22	1,42	2,10	4,01	0,002	0,036	0,071	0,039	0,188	0,727	1,39	0,08	3,48	20,64	<0.01	
	97-08-04	3,1	6,42	2,16	1,29	2,31	2,50	5,24	0,004	0,021	0,010	0,013	0,043	0,145	2,53	0,09	1,86	21,88	0,04	
Malá Ráztoka	97-06-30	25,0	6,69	5,64	0,91	2,36	1,78	12,61	0,010	0,013	0,002	0,226	0,016	0,298	1,62	0,08	6,15	19,09	0,88	
	97-07-06	1000,0	6,37	5,52	0,84	1,07	0,77	6,58	0,002	0,005	0,001	0,068	0,087	0,702	1,30	0,06	4,71	12,34	0,72	
	97-07-06	4760,0	6,44	11,10	1,10	1,17	1,00	7,44	0,002	0,012	0,026	0,639	0,528	0,925	0,97	0,05	4,28	13,98	0,03	
	97-07-06	1810,0	6,52	6,72	0,78	1,32	1,07	7,65	<0.001	0,017	0,004	0,108	0,104	0,694	1,07	0,07	4,83	13,18	<0.01	
	97-07-07	6000,0	6,54	18,60	1,44	1,37	1,32	8,36	0,003	0,017	0,057	1,295	1,053	0,726	1,09	0,06	3,97	14,20	0,01	
	97-07-08	2560,0	6,57	2,64	0,72	1,78	0,95	6,90	0,001	0,027	0,002	0,042	0,051		0,90	0,04	3,57	14,93	<0.01	
	97-07-10	400,0	6,58	2,28	0,73	1,74	1,24	10,10	0,001	0,009	<0.001	0,021	0,034	0,590	1,24	0,05	3,71	16,63	<0.01	
	97-08-04	14,3	6,36	1,80	0,85	1,84	1,74	13,02	0,004	0,005	0,001	0,006	0,012	0,249	2,40	0,06	3,28	17,76	<0.01	

On the catchment Červík A torrent water contained the highest concentrations of ions H⁺, K, Mn, Fe, Al, Cl⁻, NO₃⁻, C_{ox} during the highest observed flow in July 7, 1997. All flood water samples showed lower pH and lower concentrations of Na, Mg, Ca and SO₄²⁻ and higher contents of Mn, Fe, Al, NH₄⁺ and C_{ox} than was the average of water samples for the years 1994 to 1996 (table 2).

The highest contents of Mn, Fe, Al, NH₄⁺ and total P were found in the water taken from the torrent on Červík B during the flow culmination (July 7, 1997). In all flood samples (July 7 to 10, 1997) lower concentrations of Na, Mg, Ca and SO₄²⁻ than during lower flows were found (table 2).

Table 2. Average values of concentrations dissolved substances in torrent waters in the Beskids and limit values of concentrations in the years 1994-1996 (mg.l⁻¹)

	pH	C _{ox}	Na	K	Mg	Ca	Zn	Mn	Fe	Al	NO ₃ ⁻	F	Cl	SO ₄ ²⁻	PO ₄ ³⁻	Cu	NH ₄ ⁺
Červík A																	
min	5,90	1,30	1,06	0,80	1,57	4,50	0,001	0,001	0,001	0,001	0,10	0,001	0,50	14,10	0,010	0,001	0,001
max	7,40	15,12	2,90	1,43	3,10	7,80	0,096	0,020	0,074	0,260	3,10	0,340	3,32	39,10	0,140	0,010	1,190
average	6,85	3,35	1,99	1,12	2,44	6,40	0,022	0,005	0,023	0,038	1,16	0,077	1,91	18,00	0,059	0,004	0,219
Červík B																	
min	5,30	0,50	1,29	0,90	1,90	3,80	0,011	0,001	0,001	0,001	0,10	0,008	0,70	8,10	-	0,001	0,010
max	7,40	66,00	4,07	1,53	3,20	7,17	0,084	0,112	0,122	0,210	8,60	0,380	4,59	37,10	-	0,015	3,850
average	6,54	6,96	2,36	1,14	2,75	5,73	0,042	0,015	0,016	0,048	2,98	0,108	2,67	21,90	0,081	0,004	0,262
Malá Ráztoka																	
min	5,80	0,36	0,80	0,50	0,60	3,10	0,002	0,001	0,001	0,010	0,60	0,002	0,70	8,90	0,010	0,001	0,010
max	7,60	17,52	2,78	1,36	2,30	16,20	0,310	0,049	0,098	0,140	16,50	0,380	6,90	27,00	0,100	0,022	1,520
average	6,90	3,50	1,90	0,78	1,78	12,12	0,032	0,006	0,009	0,019	4,94	0,068	2,50	19,04	0,07	0,004	0,261

In the catchment Malá Ráztoka water taking was done in July 6, thus before the culmination of flood wave. Its analysis show that pH of water gradually decreased and content of P increased during the flow rising. The highest growths of concentrations of organic substances (C_{ox}), K, Fe, Mn and Al, overreaching the values found out in years 1994 to 1996 (table 2), are connected with the maximal flow. Concentrations of Na, Mg, Ca and SO₄²⁻ were of below-average values. On all observed catchments the concentrations of NO₃⁻, F⁻ and Cu in the torrent water did not overreach the average values found out in the years 1994 to 1996 (tables 1 and 2).

Intensity of soil erosion in the catchments is represented by sediment amount presented in table 3. It is higher on the catchment Červík than on this one on Malá Ráztoka. It is also obvious that soils with regenerated young forest stands on the catchment Červík A are more resistant than the soils under mature stands of the catchment Červík B.

Table 3. Amount of suspended sediments in flood water taken from the measuring catchments

Catchment	Date of sampling	Specific flow q	Amount of sediments	Concentrations of organic substances in water
		Ls ⁻¹ .km ⁻²	kg.m ⁻³	mg.l ⁻¹
Červík A	97-07-07	1378	1,165	29,93
Červík B	97-07-07	1102	6,242	26,83
M. Ráztoka	97-07-06	2311	4,189	19,09
M. Ráztoka	97-07-07	2913	6,514	33,99
U vodárny	97-07-06	266	2,257	75,34

Conclusion

The different chemistry of water running into the resources in the observed catchments during the year can be caused by variable chemistry of precipitational water but the principal cause is the different interaction between running-off water and soil environment as well as soil mantle.

Possibility to substitute protons for cations, reflected in increment of pH of running-off water and of concentrations of cations Na, Mg, Ca, influences the flow rate. The increased contents of humus substances (C_{ox}) and metals (Fe, Mn and Al) cause their leaching from humus horizons at direct water running-off. At the beginning of flood wave also higher concentrations of K and P were observed in the water.

The greater resistance of soil against erosion at Malá Ráztoka is enabled by greater texture of soil mantle, parent rock and soil in comparison with the catchment Červík. Lower soil erosion on the catchment Červík A than on this one at Červík B, can be explained by existence of ground layer (grassing-up) on the catchment A that reaches the streambed of torrents. On the catchment Červík B the riversides are strengthened mainly by spruce roots because the herb layer is not developed on the full area in closed stands.

The mature stands catch the greater amount of heterogeneous substances from the air which is also the cause higher average concentrations of H ions (lower pH), metals (Zn, Mn, Al), SO_4^{2-} and F^- in the torrent water of the catchment Červík B.

References

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