HYDROCHEMICAL CHARACTERISTICS OF SPRING THAW FRESHET OF THE UPPER WIEPRZ RIVER BASIN IN YEAR 2006 (THE ROZTOCZE REGION)

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Introduction

Water is the most dynamic component of the geographical environment with the ability to dissolve and transport various substances. The effects of energy and matter transportation are best evidenced by research carried out on rivers. Forecasting the changes in river water chemistry in extreme situation (freshets and low waters) has been attracting more and more interest for the past few years, due to the necessity to assess the potential hazards to waters used for consumptive and economic purposes as well as due to the environmental requirements.

Scope of research and methods

The tests of the physical-chemical properties of waters of the Wieprz river during thaw freshets were carried out in the Guciów profile that closes the basin which covers area of 300.3 km^2. The land use structure of the basin is dominated by farmland at 60.2% (of which 79.4% is covered by arable lands, and 20.6% by meadows and pastures) and 33.3% - woodland, and less than 5% is built-up area. The main groundwater reservoir feeding the river is formed in cracked carbonate rocks of the Upper Cretaceous: opokas and gezas. The covering formations consist of sand sediments, with various genesis, and loesses.

The climatic and hydrogeological conditions and economic use of the waters determined the average specific runoff on the Wieprz in Guciów profile in the years 1995-2006 on the level 1.30 $m^3 \cdot s^{-1}$, which corresponds to a specific runoff 4.3 $dm^3 \cdot s^{-1} \cdot km^{-2}$ and 136.2 mm runoff index (Stępniewska, 2007). In the total runoff, the underground feeding formed 80%, half of which was direct river bed drainage and the other half was fed from the springs (Michalczyk, 2004). In the seasonal approach, the highest flows of the Wieprz occur in March and April and the lowest in December. The surface runoffs reach the river bed far more often in the period of thaw freshets than in the period of rain ones.

Physical and chemical testing of freshet waters was carried out on samples taken from the Wieprz river every morning. The water temperature, its reaction and specific electrolytic conductance were measured directly in the river. Directly after sampling, the suspension and alkalinity of the water were determined at the laboratory of the Roztocze Scientific Station of UMCS [Maria Curie-Skłodowska University] Lublin, in Guciów. The other indexes were determined at the laboratory of the UMCS Department of Hydrography: the total organic carbon,

biochemical and chemical oxygen demand and orthophosphates, using the ionic chromatography method: Ca, Mg, Na, K, NH_4, Sr, Li, F, Cl, SO_4, NO_2, NO_3, and Br. For the analysis of the hydrographical freshet course, the tests were made on: rain waters, waters flowing down the slopes and spring waters.

Freshet course

The thaw freshet in the upper Wieprz started in late March and was related to the melting process of snow retained from the winter falls. The data from the precipitation monitoring stations located within the Wieprz basin indicate that over 50 mm of water was accumulated in the snow cover. During the freshet lasting about 2 weeks, the discharge in the Wieprz increased from 0.73 $m^3 \cdot s^{-1}$ to 8.70 $m^3 \cdot s^{-1}$ at the time of the freshet culmination, while in the end of the freshet the discharges dropped down to approx. 1 $m^3 \cdot s^{-1}$. The field observations indicate that the episodic streams on the slopes lasted several days. During the first few days, the water flowed rapidly down the frozen surface and occurred in the river directly after the thaw had started.

At the time of the underground feeding, the hydrochemical condition of the Wieprz river waters in the Guciów profile was characterized by high stability. The rapid quantitative and qualitative changes took place during the surface runoff. Tested the physical and chemical indexes presented varied dynamics of concentration changes, as well as in terms of reaction to the inflow of waters from the surface runoff. The relation between the concentration of indexes tested and the water discharge was determined by the correlation coefficient value: water reaction (-0.78), specific electrolytic conductance of the water (-0.92), total hardness (-0.92), alkalinity (-0.92), calcium (-0.89), magnesium (-0.88), sodium (-0.81), strontium (-0.87), silica (-0.81), chlorides (-0.87), sulphates (-0.83), fluorides (-0.59). Some significant positive correlations connected with flow increase were recorded for: potassium (0.73), nitrates (0.71), nitrites (0.58) organic carbon (0.62), as well as chemical (0.63) and biochemical (0.62) oxygen demand. A step and multi-directional reaction during the thaw freshet was recorded in the cases of ammonia (0.34) and orthophosphate ions (0.13).

Conclusions

The tests carried out show that groundwaters sampled from the springs and the waters sampled from the river during the sole underground feeding had a similar and fairly stable basic physical and chemical composition. However, the waters flowing down the slopes contained far fewer dissolved carbonates with frequently higher content of anthropogenic substances. The physical and chemical composition of the river waters during the freshet depended on the share of surface runoff in the total runoff and on the freshet phase. The content of indexes resulting from dissolution of minerals of natural origin (carbonates in particular) dropped during the freshet. The indexes can be used for the assessment of the genetic division of the waters flowing down the river bed. The indexes that grew during the freshet or those with reaction described by the hysteresis effect suggest that their value was largely formed by the anthropogenic factor (both in time and space). Therefore, the use of the indexes to assess hydrograph distribution of water is restricted.

References

Michalczyk Z., 2004: *Charakterystyka stosunków wodnych.* In: Świeca A. (ed.): *Przyrodnicze uwarunkowania dynamiki obiegu wody i natężenia transportu fluwialnego w zlewni górnego Wieprza.* Wyd. UMCS, Lublin: 50-64.

Stępniewska S., 2007: *Zmienność odpływu górnego Wieprza.* In: Michalczyk Z. (ed.), *Obieg wody w środowisku naturalnym i przekształconym.* Badania hydrograficzne w poznawaniu środowiska, vol. 8. Wyd. UMCS, Lublin: 513-520.