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## Osobliwości składu chemicznego wody stawów położonych na gipsach — Peculiarities of the chemical composition of water in ponds situated on gypsum

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Surface waters in Poland belong to the carbonate and calcium type, with a comparatively small content of sulphates and chlorides as well as of sodium, potassium, and magnesium (Stangenberg 1958). If the influence of geological formations in the river basins on the chemical composition of the water is taken into account, it might be supposed that the proportions of the components and especially of anions would be different in a region in which gypsum rocks are present.

The largest area of gypsum in Poland is located in the region of the Nida basin, on the left bank of the lower course of the Nida river. This area lies in the triangle formed by the towns: Busko, Pińczów, and Nowy Korczyn. Thin layers of gypsum lying on formations of the Cretaceous epoch form not very high cone shaped elevations which decompose rapidly. The phenomena typical for gypsum karst, unique in Poland (Flis 1954), occur here and on gypsum hills many associations of steppe and steppe-and-forest plants grow. Also the presence of sulphide-and-brine springs in Busko and eastwards in Solec (spas) is connected with gypsum in this area.

This area is characterized by hydrography typical for the karst. Besides numerous funnels, hollows from which water does not flow away, and caves (Kowalski 1954), there are to be found small underground lakes with outward holes and many springs at the foot of upland gypsum areas from which water does not flow away (Gąsiorowski 1925, Malicki 1947). All this area is drained by the Maskalis stream, 22 km long and falling into the Nida river below Wiślica, and by tributaries flowing in from the right bank. The basin of the stream covers 146.6 km<sup>2</sup>, and the amount of water does not exceed 10 l/sec. in periods of drought.

Ponds of the State Fish Farm in Górkki (near Wiślica) are located in the lower course of the Maskalis stream; in the spring they are flooded

with water from this stream. In June 1963 water was taken for chemical analysis from two ponds (Żaczki Lisie and Jastrzębiec), from the Maskalis stream (near where it flows into the ponds), and from the Nida river (near Wiślica).

The chemical composition of the water of the Nida river is quite different from that of the Maskalis stream and of the ponds (Tables I, II;

Tab. I

Ionic composition of the water of the Nida river, Maskalis stream, and ponds

	unit	HCO <sub>3</sub> <sup>-</sup>	SO <sub>4</sub> <sup>-2</sup>	Cl <sup>-</sup>	Ca <sup>++</sup>	Mg <sup>++</sup>	Na <sup>+</sup>	K <sup>+</sup>
Nida river	mg/l	241,0	23,3	12,2	77,9	6,1	7,6	2,1
	me-%	82,6	10,1	7,2	81,4	10,5	6,9	1,1
Maskalis stream	mg/l	274,6	257,0	148,0	172,2	12,6	96,0	9,1
	me-%	32,1	38,2	29,7	61,2	7,4	29,7	1,7
Zaczki Lisie pond	mg/l	161,1	244,8	76,0	137,2	11,7	96,0	8,4
	me-%	26,7	51,6	21,7	65,5	9,2	23,3	2,0
Jastrzębiec pond	mg/l	123,3	245,4	51,7	120,8	8,7	41,0	6,0
	me-%	23,5	59,5	17,0	69,4	8,2	20,5	1,8

Fig. 1). The ionic composition of water of the Nida river does not deviate from the usual water composition of rivers (slightly polluted with industrial wastes), lakes and ponds in Poland. Among anions bicarbonates form 82%, and among cations calcium dominates (81%). The content of sulphates, chlorides, magnesium, sodium, and potassium is small (2.1 mg K/l). Thus it is a classic case of carbonates and calcium waters.

In the water of the Maskalis stream sulphates (38%) dominate over bicarbonates; similarly as in the Nida river calcium is the dominating cation. Though the relative calcium content in the water of the stream is smaller (61%), than in that of the Nida river, its absolute calcium content

Tab. II

Some physical and chemical conditions of the water of the Maskalis stream and ponds

	pH	O <sub>2</sub>		KMnO <sub>4</sub> cons. mg O <sub>2</sub> /l	PO <sub>4</sub> mg/l	Fe mg/l
		mg/l	%			
Maskalis stream	7,2	4,00	43,5	9,8	0,45	0,44
Żaczki Lisie pond	7,3	3,68	41,4	13,0	0,22	0,20
Jastrzębiec pond	8,4	8,96	103,2	15,2	0	0,10

is larger (172.2 mg Ca/l) as the result of a comparatively large sodium content. The large content of sulphates, chlorides, and sodium in water of the Maskalis stream is due to the influx of mineral waters rich in these components from the spa in Busko and to the fact that the stream flows through gypsum formations. According to an analysis by the Sanitary Epidemiological Station in Busko, the water of the stream near its springs (Szczaworyż near Busko) contains few sulphates and chlorides but many



bicarbonates, so it is the same type as the water of the Nida river. The springs of the Maskalis stream are situated outside the gypsum area, at the foot of an elevation (Garb Pińczowsko-Wójczański) formed of cretaceous rocks rich in calcium carbonate.

More considerable differences in proportions of anions appeared in the water of the ponds as compared with that in the Nida river. In the ponds a strong precipitation of carbonates occurred and by that very fact their

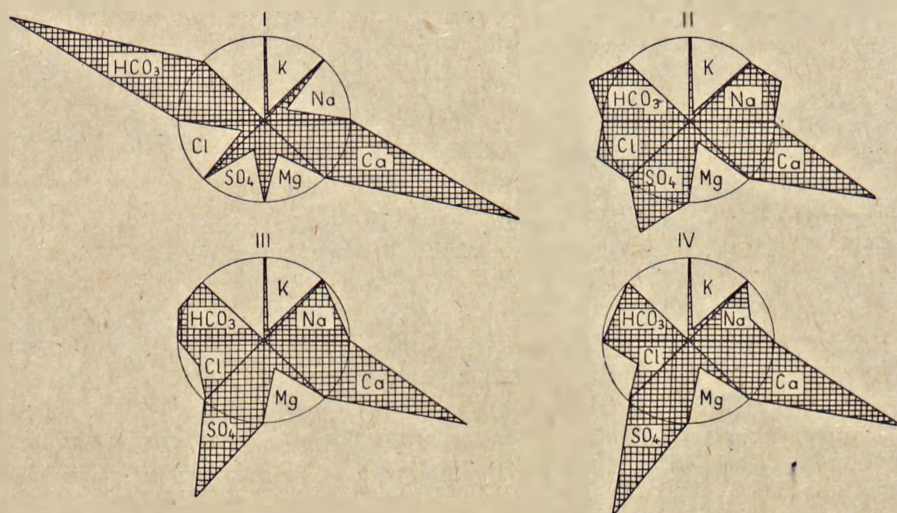


Fig. 1. Comparison of ion equivalent chemical composition of the water of the Nida river (I), of the Maskalis stream (II) and of the ponds Zaczki Lisie (III), Jastrzębiec (IV)

share in relative ionic composition decreased to 24% while that of sulphates increased to 60%. The large content of sulphates in the water of the ponds decreased only imperceptibly in comparison with that of the stream. The more luxuriant was the development of plants in the ponds, the bigger was the precipitation of carbonates, therefore the carbonate hardness was the lowest (Fig. 2) in the Jastrzębiec pond where the development of phytoplankton was the most vigorous (basic reaction of water, high oxygen content, and large  $O_2$  consumption, Table II). As the calcium content in the water of the ponds decreased the sodium content also diminished, therefore the calcium share in relative ionic composition was larger, in spite of a smaller content of this component.

Figure 1 shows clearly that the water in the Maskalis stream, and even more that in the ponds, assumes a sulphates-and-calcium character, rarely found in Poland.

The present note based on a single analysis of the water aims at calling the attention to a subregion of the Małopolska Upland which is very interesting in terms of its hydrochemistry.



Fig. 2. Carbonate (1) and noncarbonate (2) hardness (in German degrees) of the water of the Nida river (I), of the Maskalis stream (II) and of the ponds Zaczek Lisie (III), Jastrzębiec (IV)

#### STRESZCZENIE

W doniesieniu przedstawiono skład jonowy wody rzeki Nidy oraz potoku i stawów (w Górkach k. Wiślicy) położonych na gipsach. Wyniki analizy chemicznej, zebrane w tab. I, II i ryc. 1, 2, wskazują na różny typ porównywanych wód. Woda rzeki Nidy należy do typu węglanowo-wapniowego, natomiast woda potoku Maskalis, a jeszcze bardziej stawów do typu siarczanowo-wapniowego, rzadko w Polsce spotykanego.

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