ASSESSMENT OF THE GROUNDWATER SOURCES QUALITY IN THE KOŠICE REGION, SLOVAKIA

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Abstract: *Water from underground sources is most suitable for drinking purposes. In order to use groundwater as a drinking source, it must meet the criteria laid down by legislative standards and regularly monitored by the Slovak Hydrometeorological Institute. The work is aimed at assessing the quality of drinking water from sources of groundwater in the Košice region. We studied and subsequently evaluated the quality of 5 water samples. The studied samples came from the surroundings of Gelnica, Spišská Nová Ves and Košice. In the work the particular examinations of selected indicators of drinking water are presented. The content of nitrates, phosphates, sulphates and ammonium compounds was determined using a Palintest photometer and the temperature, pH and conductivity by Hanna Combo measuring instrument. No exceedance of the limit values of individual indicators was found in selected samples. The samples examined meet the criteria set by the legislation for selected indicators. It would be appropriate to repeat and monitor individual indicators in the future. In the case of over-limit values, it would be ideal to create a water treatment plan to achieve water quality that is intended for drinking purposes.*

Key words: *groundwater, Košice region, nitrates, phosphates, sulphates, ammonium, temperature, pH, conductivity*

1 INTRODUCTION

The best quality drinking water supplies are surface waters, which together with groundwater form the main reservoirs of drinking water. They are minimally exposed to the external environment and almost not contaminated. Groundwater is the least demanding for the possible treatment of drinking water. We have a large number of drinking water sources in the Slovak Republic, but their positioning in the territory is unfavourable. Bratislava, Nitra, and Trnava regions are supplied by groundwater, the remaining regions (Trenčín, Žilina, Banská Bystrica, Prešov, and Košice regions) are partly supplied from surface water. Sources of drinking water in the Slovak Republic are 18% of surface water and 82% of groundwater. There is one of the largest reservoirs of drinking water in Central Europe in Žitný ostrov area. It has a high quality drinking water that could supply about 14 million people [1].

Groundwater is located beneath the surface in the saturation zone and in direct contact with the soil bed or soil, including the groundwater serving as transport medium and concentrating ground heat from the rock environment. Groundwater remains groundwater even after uncover, natural overflow of its geological cover, or mining activity [2].

With regard to groundwater, the following terms can be defined [3]:

- The useable groundwater source is the total average annual inflow to the body of groundwater, reduced by the long-term annual effluent required to achieve ecological quality objectives in surface water.
- Groundwater status means a complete statement of the status of a body of groundwater determined by its chemical or quantitative status, whichever is worse.
- A quantitative state is a statement that determines to what extent the body of groundwater is influenced by direct and indirect abstraction.
- Good groundwater status is achieved when the quantitative and chemical status of groundwater is at least "good".
- Groundwater collector means a subsurface layer or rocks that have sufficient permeability and porosity to allow significant amounts of groundwater to be collected.
- Groundwater body means a bounded volume of groundwater within groundwater collectors.

In accordance with Directive 2006/118/EC of the European Parliament and of the Council, which mainly refers to the protection of groundwater, groundwater is a rare source of natural resources and should therefore be protected from chemical pollution. It is also the largest body of freshwater in the European Union and the main source of drinking water in several regions. Likewise, this directive states that groundwater is being used for the abstraction of drinking water, so it must be protected in particular in order to avoid deterioration in its quality [3].

In low-income countries groundwater sources often spread diarrheal disease if they are microbiologically polluted [4]. Other source of potential groundwater pollution and health risk, not only in low-income countries, may be heavy metals from the peri-urban and urban-industrial activities [5]. In many studies [6,7] GIS functionalities are used to deal with multiple sources, identify vulnerability levels, assess all contamination sources in the area, and provide a risk-based ranking of the contamination sources.

2 METHODS

Water samples were taken from locations in the Košice region. In the samples, the following indicators were determined:

- pH, temperature, conductivity, particle (Hanna Combo multimeter),
- SO_4^{2-}, PO_4^{3-} , NO_3^-, NH_4^+ (photometer Palintest).

Samples were taken from the following locations in Košice region:

- Alpinka,
- Zlatá Idka,
- Švedlár,
- Jaklovce,
- Košice-Pereš.

3 EXPERIMENTAL VERIFICATION

For the ammonium cations and phosphates indicators, their presence was not detected in the samples examined.

The limit for sulphates is 250 $mg.l^{-1}$. Table 1 shows the measured values in the samples. The limit laid down by law was not exceeded in individual samples.

Tab. 1 Mass concentration of SO_4^{2-} in the samples.

Alpinka	9
Zlatá Idka	48
Švedlár	36
Jaklovce	29
Košice-Pereš	47

Due to increasingly soil fertilization as well as leakage of waste water from cesspools, nitrates became one of the most serious threats of all groundwater sources. According to the Government Regulation the highest nitrate limit is set at 50 $mg.l^{-1}$ for adults. For the preparation of a diet for infants up to 6 months, the maximum limit is 10 $mg.l^{-1}$ [8]. Table 2 shows the values of the measured concentrations.

Tab. 2 Mass concentration of $N\text{-}NO_3^-$ and NO_3^- in the samples.

	$N\text{-}NO_3^-$	NO_3^-
Alpinka	1.80	7.92
Zlatá Idka	0.38	1.70
Švedlár	0.78	3.47
Jaklovce	6.20	27.30
Košice-Pereš	8,40	37.00

None of the samples tested exceeded the highest nitrates limit (50 $mg.l^{-1}$), but according to the data in Table 2, we can notice that water samples from “Jaklovce” and “Košice-Pereš” are not suitable for preparation of a diet for infants. In these samples, there is the risk of the so-called "Blue Infant Disease".

Table 3 shows the measured values of the temperature, pH, and water conductivity of the samples.

Tab. 3 Measured values of the temperature, pH, and water conductivity

	Temperature [°C]	*pH*	*Conductivity [$\mu S.cm^{-1}$]*
Alpinka	11.3	7.47	346
Zlatá Idka	10.4	7.65	472
Švedlár	12.8	7.24	512
Jaklovce	9.9	7.39	489
Košice-Pereš	13.2	7.83	503

According to the Government Regulation [2] these three indicators belong to the group that adversely affect the quality of drinking water. All three indicators meet limit values according to the Government Regulation.

4 CONCLUSION

This study assessed the quality of underground water resources in the Košice region in five sampling points in selected locations (Alpinka, Zlatá Idka, Švedlár, Jaklovce, Košice-Pereš). In selected samples, the limit values of the monitored indicators were not exceeded. The samples examined meet the criteria set by the legislation for selected indicators.

It would be appropriate to repeat and monitor the individual indicators in the future, if necessary by adding additional indicators, especially with regard to microbiological parameters.

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