

Hydrogeochemical characteristic of thermal waters in Bańska Niżna

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Thermal waters belong to the greatest treasures of Podhale. They are used not only in heat engineering but also in recreation, medicine and rehabilitation (Kępińska 2004, 2009, Tomaszewska 2009). It is also known that thermal waters are treated and used for drinking or commercial purposes (Bujakowski & Tomaszewska 2007, Tomaszewska 2009, 2011, Tomaszewska & Bodzek 2013). Thermal waters in Bańska Niżna are exploited by PEC Geotermia Podhalańska S.A. Company. Commercial use of these waters began in 1993, when the system based on geothermal doublet, supplied heat to several houses (Ślimak & Wartak 2009). Currently, the exploitation is made by using three wells: Bańska IG-1 well, Bańska PGP-1 well and Bańska PGP-3 well.

Hydrogeochemical characteristic of thermal waters in Bańska Niżna was based on researches concerning the state of those waters, which was being carried out every two weeks between December 2013 and August 2015. Field research was based on measurements of non-stable parameters – pH, electrical conductivity γ_{25} and the temperature on the flow. The results of field measurements were supplemented with archival data: water temperature at the well head, pressure and well discharge.

The samples for laboratory tests were taken by the author of this work in accordance with the standard ISO 5667-11:2004. The chemical composition analysis of thermal waters was carried out by accredited Hydrogeochemical Laboratory of the Department of Hydrogeology and Engineering Geology AGH in Kraków (certificate

of Polish Centre of Accreditation No. AB 1050). This analysis included measurements of concentration of 45 indicators. On the basis of the results of the research, the hydrogeochemical type of thermal waters in Bańska Niżna was defined as sulfate-chloride-sodium-calcium type (according to the classification by Shchukarev–Priklonskiy (Priklonski & Łaptiew 1955)).

The medium values of the basic parameters of analyzed wells, estimated on the basis of data from 2013–2015, are as follows:

- Bańska IG-1 well: pH 6.63, γ_{25} 3.48 mS/cm, temperature at the well head 78.5°C, pressure 11.8 ba, well discharge 58.1 m³/h, mineralization 2522.8 mg/dm³;
- Bańska PGP-1: pH 6.69, γ_{25} 3.39 mS/cm, temperature at the well head 85.9°C, pressure 14.4 ba, well discharge 317.3 m³/h, mineralization 2533.6 mg/dm³;
- Bańska PGP-3: pH 6.72, γ_{25} 3.43 mS/cm, temperature at the well head 85.0°C, pressure 14.0 ba, well discharge 221.3 m³/h, mineralization 2514.3 mg/dm³.

The database from the years 2013–2015 was supplemented by archival results of chemical composition analyzes. On that basis, the assessment of the thermal waters chemical composition stability in Bańska Niżna was prepared, according to the scheme presented in work (Kmieciak & Korzec 2015). It is especially important because physical parameters and chemical composition of geothermal waters can be change during the long-term exploitation. According to Polish law,

confirm stability of the physico-chemical parameters is necessary because using these waters in medicine (Dz.U. 2011, nr 163, poz. 981 art. 5).

Moreover, the hydrogeochemical model of formation of those waters was defined.

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