

Possibility of Using Waters from the Closed Coal Mines of the Upper Silesian Coal Basin (Poland) as the Resources of the Potentially Medicinal Waters

Irena Pluta ^{a)}, Jacek Jackowicz-Korczyński ^{b)}

^{a)}Central Mining Institute, Department of Water Protection, Plac Gwarków 1 40-166 Katowice, Poland
e-mail i.pluta@gig.katowice.pl Tel/fax: +48 032 259 22 46

^{b)}State Mining Authority, Department of Environmental Protection and Deposit Management,
ul. Poniatowskiego 31 40-956 Katowice Poland, e-mail osg@wug.gov.pl tel/fax: +48 32 736 17 32

Abstract

Some ground waters of the Upper Silesian Coal Basin are used as medicinal waters. Actually the waters from the Miocene (Badenian) and the Carboniferous formations in Dębowiec, Zabłocie and Goczałkowice are pumped. This paper presents the analysis of the possibility of the utilization of the mine waters from the closed or abandoned coal mines of the Upper Silesian Coal Basin in medical therapy as potentially medicinal waters based on: analytical data of pharmacodynamic parameters of mine waters flowing from the closed or abandoned coal mines, according to the Polish law regulations.

Key words: mine waters, medicinal waters, Polish law regulations

Introduction

Groundwater of the Upper Silesian Coal Basin (USCB) is characterised by differential chemical composition (their mineralization degree ranges from several hundred mg/dm³ to more than 200 g/dm³), which results in variation of the vertical and horizontal hydrogeochemical zoning (Rózkowski et al. 2004, Pluta 2005). When their chemical composition complies with the required quality of water intended for human consumption these may be used as drinking water or for production of spring waters, table waters or mineral waters of natural origin. In such cases in order to assess the possibility of using a given mine water it is necessary to take into account: the quality requirements regarding potable water set out in the *Order of 29 March 2007 on the quality of water intended for human consumption by the Minister of Health (Statute Journal No. 61 item 417)*, the sanitary conditions and requirements regarding the hygienic conditions in processing and marketing natural mineral waters and mineral spring waters as stated in the *Order of 29 April 2004 on natural mineral waters, natural spring waters and table waters by the Minister of Health (Statute Journal No. 120 item 1256 with further amendments)* and the requirements concerning concentrations of the pharmacodynamic parameters.

It is also possible to use the mine waters of the USCB as medicinal waters. The new regulations concerning the classification of medicinal waters and the draining of mine waters from closed or abandoned coal mines in the USCB that have been brought into force lately give some opportunities for using the waters from old workings and other cavities for medicinal purposes. Preliminary studies of the mine waters present in some of the closed or abandoned mines has been performed in order to indicate the possibilities of using them as medicinal waters.

Using of the mine waters of the USCB for medicinal purposes

Groundwater of the Upper Silesian Coal Basin have been used for medicinal purposes since the last century. This concerns several waters that are taken from the Miocene, (Badenian), the Carboniferous and the Devonian formations located in the south part of the coal basin (Dowgiałło et al., 1969; Paczyński, Płochniewski, 1996). These were taken through boreholes in Dębowiec, Zabłocie, Drogomyśl and Kokoszyce and were mainly used for brine bath purposes. At present the brine is taken from the Miocene formation in Dębowiec and some geological work is performed in Zabłocie. The waters from Drogomyśl and in Kokoszyce are currently not used (Madeyski et al. 1979). The waters from the Carboniferous formations were taken for medicinal purposes in Jastrzębie, Moszczenica and Goczałkowice. The intakes in Jastrzębie and in Moszczenica were put out of service as a consequence of the coal mining operations performed in that area. At present, waters from the Carboniferous formations are only used for medicinal purposes in Goczałkowice.

The chemical composition of waters taken for medicinal treatment are characterised by different values of the pharmacodynamic parameters. The values of some of them are presented in Table 1.

Table 1 Values of pharmacodynamic parameters of the medicinal waters

Water from	Pharmacodynamic parameters [mg/dm ³]					
	Mineralization		Iodine ion		Iron ion (II)	
	min	max	min	Max	min	Max
Miocene	32 200	53 200	67	140	2	60
Carboniferous	17 500	78 000	9	26	13	29

It is necessary to emphasise that the variability of the above mentioned parameters in the individual intakes was inconsiderable.

The Polish requirements concerning medicinal waters

According to the regulations in Polish law, medicinal waters are classified as minerals and as such are subject to the *Act of 4 February 1994 entitled Mining and geological law (Statute Journal No. 228 item 1947 with further amendments)*. The qualification features based on which water is included among minerals are defined in the *Order of 14 February 2006*. Groundwater deposits included are brines, medicinal and thermal waters and other deposits of medicinal minerals. Common minerals from some deposits or geological formations are classified as basic minerals by the Cabinet (*Statute Journal No. 32, item 220, with further amendments*). According to this Order, groundwaters which are unpolluted chemically and microbiologically and show natural variation of chemical and physical parameters and satisfy at least one of the conditions presented in Table 2 are rated as medicinal waters.

Table 2 Pharmacodynamic parameters of the medicinal waters

Parametr	Concentration
Mineralization	> 1 000 mg/dm ³
Fe ²⁺	> 10 mg/dm ³
F ⁻	> 2.0 mg/dm ³
I ⁻	> 1mg/dm ³
S ²⁻	> 1mg/dm ³
SiO ₃ ²⁻	> 70 mg/dm ³
Rn	> 74 Bq/dm ³
CO ₂	250-999 mg/dm ³
	> 1 000 mg/dm ³

Medicinal properties of groundwaters have to be confirmed in accordance with the provisions of the Act of 28 July 2005 on spa therapeutics, health resorts and areas under health protection as well as health resort communes (*Statute Journal No. 167, item 1399, with further amendments*) by a unit authorised by the Minister of Health for issuing the required certificates. The units are listed in the *Announcements of 7 July 2007 and 14 January 2008 by the Minister of Health*. The certificate is issued based on documented qualitative investigations performed for at least three years. A detailed list of investigations required for determining the medicinal properties of waters is set out in *Appendix 1 of the Order of 13 April 2006 by the Minister of Health* on the scope of investigations needed for affirming medicinal properties of natural raw materials and therapeutic properties of climate, criteria for assessing them, and specimen certificate to be used as formal confirmation of such properties (*Statute Journal No. 80, item 565*).

Water having the identified pharmacodynamic parameters may be treated as medicinal water after these properties have been confirmed by one of the units authorised by the Minister of Health and the certificate has been issued.

Characteristics of the waters from the closed and abandoned mines

Since 1989 when the coal mining reforms had been commenced in Poland, many coal mines have been closed and abandoned in the USCB. For a period of almost 10-years the gobs, old workings and cavities of these mines have been flooded. When the gobs are filled the waters flow by gravity into the neighbouring workings of active mines or are discharging by pumping at the surface. Analyses of the chemical composition of mine waters stemming from the closed or abandoned mines have been performed. Some of mine waters flowing from the abandoned mines into the active ones by gravity were sampled and analysed in the period 2002 – 2006. Selected pharmacodynamic parameters of these waters are presented in Table 3.

Analyses of mine waters drained by pumping to the surface showed that some of them include pharmacodynamic parameters (iodide ion, iron ion (II)) in quantities exceeding the values characteristic of medicinal waters (Table 2).

Table 3 Selection of pharmacodynamic parameters in waters from the abandoned coal mines

Mine	Pharmacodynamic parameters [mg/dm ³]					
	Mineralization		Iodine ion		Iron ion (II)	
	Min	Max	min	Max	Min	max
K1	102000	112000	40	70	30	60
K2	8000	10000	0.9	1.4	0.5	3.5

Conclusions

Groundwaters of the Upper Silesian Coal Basin have been and are used for therapeutic purposes. They are mainly used for brine baths, in particular those that include iodide and / or iron ions (II). At present the medicinal waters are taken from the Miocene and the Carboniferous formations.

On the basis of our investigations, some waters present in closed or abandoned mines in the Upper Silesian Coal Basin have such mineralization and concentrations of iodide and iron (II) ions that require them to be classified as medicinal waters. Because the range of parameters of the waters in abandoned mines may change as the old mine workings, gobs and cavities are filled in, and as a result of pumping the water to the surface, it is necessary to perform such systematic observations and investigations as are required for medicinal waters under the provisions of the *Order of 13 April 2006 by the Minister of Health* (on the scope of investigations needed for affirming medicinal properties of natural raw materials and therapeutic properties of climate, criteria for assessing them, and specimen certificate to be used as formal confirmation of such properties *Statute Journal No. 80, item 565*).

References

- Dowgiałło J, Karski A, Potocki I (1969) *Geologia surowców balneologicznych*. Wydawnictwa Geologiczne Warszawa: p 176-178
- Madeyski A, Pilich A, Kulikowska (1979) *Ujęcia wód mineralnych i słabo zmineralizowanych w Polsce*. Instytut Balneoklimatyczny Zakład Balneotechniki Warszawa: 32-34, p 139-147
- Paczyński B, Płochniewski Z (1996) *Wody mineralne i lecznicze Polski*. Państwowy Instytut Geologiczny Warszawa: p 63
- Pluta I, (2005) *Wody kopalń Górnośląskiego Zagłębia Węglowego- geneza, zanieczyszczenia i metody oczyszczania*, Prace GIG nr 865: p 169
- Rózkowski A (et al.), (2004) *Środowisko hydrogeochemiczne karbonu produktywnego Górnośląskiego Zagłębia Węglowego*. Wyd. UŚI, Katowice: p174.