

Mine Waters of the Upper Silesian Coal Basin (Poland) in Polish Law Regulations and the European Directives

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Abstract

A specific group of underground waters of the Upper Silesian Coal Basin (USCB) are waters flowing into mine workings of the coal mines. Their chemical compositions were shaped by natural processes occurring in the hydrogeological system and human (mine) activities (anthropopressure). The pollutants in mine waters are of geogenic or anthropogenic origin. Mine waters pumped out from the mine workings may be used as drinking or industrial waters or can flow into streams, rivers as wastes. According to the Polish law regulations the waters pumped out of the mines of the Upper Silesian Coal Basin (USCB) are groundwater and waste waters. This paper presents the criteria of assessing the chemical composition of mine waters based on threshold values of the physical and chemical indexes which are mentioned in:

- Water European Directives,
- Water Law in Poland,
- Orders of Minister of Health and Environment in Poland.

Key words: mine waters, groundwater, waste, Polish and EU regulations

Introduction

The waters pumped out of the mines of the Upper Silesian Coal Basin (USCB) are, according to the Polish law regulations, defined as groundwater and waste waters.

The groundwaters of the USCB are characterised by different chemical compositions which are connected with variations in vertical and horizontal hydrogeochemical zoning. If their chemical composition complies with the requirements concerning potable water quality these may be used as drinking water (*Statute Journal No. 61 item 417 of 2007*) or for production of spring waters, table waters or mineral waters of natural origin (*Statute Journal No. 120 item 1256 of 2004*). It is also possible to use the mine waters of the USCB as medicinal waters under the condition that these fulfil the criteria determined for such waters (*Statute Journal No. 32 item 220 of 2006*). When the waters fulfill the conditions for industrial waters they may be used in various technological processes and in agriculture. Waters pumped out of the mines to the surface waters (rivers) that do not fulfill the requirements set out in the law regulations as described above, are classified as industrial waste waters.

The aim of this paper is to present the for assessing the chemical condition of mine waters treated as groundwater and industrial wastes.

Groundwater

Groundwater in the Upper Silesian Coal Basin occurs in the Quaternary, Tertiary, Triassic, and locally in Jurassic, Permian, Upper Carboniferous, Lower Carboniferous, Devonian and Cambrian formations. Among them there are groundwaters of which the chemical composition and physical state were not changed as result of any anthropopression. These are groundwaters with a natural hydrogeochemical background.

Mine waters

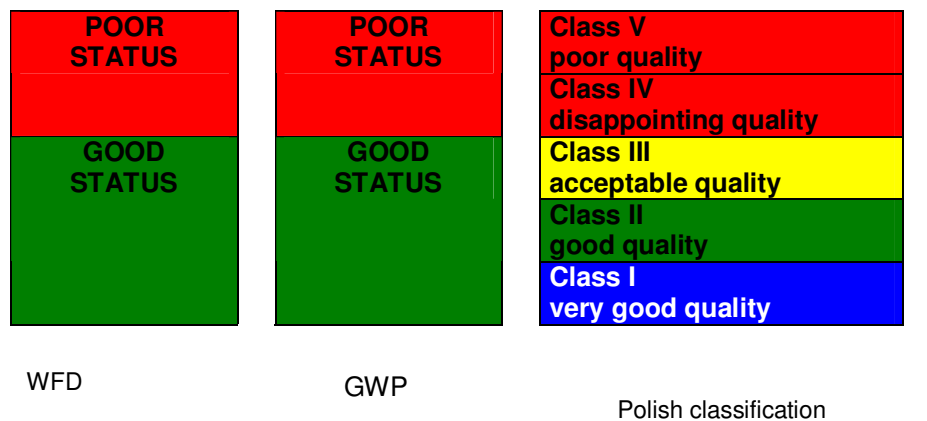
The waters flowing into the mine workings constitute a special group of groundwater of the Upper Silesian Coal Basin. These are natural mine waters that constitute the so-called natural inflow of the underground workings. Their chemical composition is formed by natural hydrogeochemical processes taking place in the hydrogeological system of the USCB. Changes in their chemical composition may be an effect of the mining activities performed (anthropopression). The influence anthropopression may be direct or intermediate and water pollutants may be of anthropogenic or geogenic origin.

Industrial waters (also referred to as technological waters) are often transported into mine workings. These are used in various mine activities: in slushing gobs, for dust suppression when a shearer loader or roadheader cuts and loads coal, for fire fighting purposes etc. Old mine workings are often filled in with industrial wastes along with water. The chemistry of waters flowing into mine workings may become changed during descending or ascending flow through faults, cracks and fissures where the weathering processes of chemical decay (oxidisation) have an important role in the changing of the chemical composition. In general the waters flowing in mine workings are mixtures of natural mine waters (so-called natural inflow) and waters from the mine activities where imported waters are needed. In Project EU FW6 ERMITE (Environmental Regulation of Mine Waters in the European Union) the following definition for mine waters is set out – all waters emanating from active, closed or abandoned surface and underground mines.

Assessment of the chemical composition of groundwater

Assessment of the chemical quality of groundwater is performed by comparing values of concentrations of the physical and chemical components contained in waters with the threshold values set out in the Polish and EU legal regulations (Figure 1).

Figure 1 Assessment of chemical quality of groundwater according to the regulations in Poland and the European Union (quality-colour: poor-red, good-green, very good-blue)



Assessment of quality of mine waters

Mine waters with concentrations of components higher than the threshold values assumed for good quality (Figure 1) are in general industrial waste waters. Assessing pollution of such mine waters should be performed based on a comparison of concentrations of contamination indicators with the threshold values for waste waters given in the *Order of 24 July 2006* on conditions that have to be fulfilled during discharging waste waters to surface waters or soil and on substances particularly hazardous in the natural water environment (*Statute Journal No. 137 item 984 of 2006*).

A detailed analysis of chemical composition of natural mine waters showed that many contamination indicators determined for waste waters (*Statute Journal No. 137 item 984 of 2006*) concern components that do not exist in the mine waters. Thus it was proposed to simplify the procedure of assessing the quality of mine waters classified as industrial wastes which discharged to the surface waters and to soil by taking into account only those contamination indicators that are characteristic of mine waters. Based on an analysis of chemical composition of the mine waters of the USCB the following thirty physicochemical components were selected:

- temperature, pH reaction, suspended solids, general organic carbon (GOC), volatile phenols, surface-active substances – anion ones, substances extractable with the use of petroleum benzene, petroleum substances, volatile aromatic hydrocarbons (VAH), ammonia nitrogen, nitrate nitrogen, nitrite nitrogen, chlorides, sulphates, sodium, potassium, general iron, general phosphorus;

- particularly hazardous substances that should be limited: arsenic, barium, boron, general chrome, zinc, copper, nickel, lead, fluorides:
- particularly harmful substances that should be eliminated: mercury, cadmium, free cyanides.

So, the degree of pollution may be assessed based on the analysis of the chemical composition and by referring the concentrations determined during the analysis to the threshold values of the thirty indexes set out in the Order by the Minister of Environment (*Statute Journal No. 137 item 984 of 2006*).

The quality assessment of the mine waters in Poland described above takes into account those contamination indicators that are in most cases the natural components of groundwaters. According to the Directive of 12 December 2006 on protection of groundwaters against pollution and worsening their condition (*GWP/2006/118/EC*) by the European Parliament and Council these are not pollutants. According to the Directive the term „pollutant” should only be applied to anthropogenic influences. If one assumes that in the case of mine waters the term “pollution” should only be applied to anthropogenic influences then the same contaminating components contained in both natural mine waters and technological waters (e.g. chlorides and sulphates) which become mixed and are pumped together out of mines, would have to be separately identified. Such an approach to the components of natural mine waters and to mine waters polluted anthropogenically would require isolating these two types of waters and working out special regulations for each of them, which is practically unrealisable.

Conclusions

Criteria for assessing the chemical composition of mine waters treated as groundwater and as waste waters based on the threshold values of the physical and chemical indexes of contamination indicators set out in the Polish and EU regulations have been presented taking into account:

- Directive of the European Parliament and of the Council of 23 October 2000 on establishing a framework for Community action in the field of water policy (*WFD/2000/60/EC*),
- Directive by the European Parliament and of the Council of 12 December 2006 on protection of groundwaters from pollution and worsening their condition (*GWP/2006/118/EC*),
- Order by the Minister of Environment of 11 February 2004 on classification for presenting condition of the surface waters and groundwaters, way of monitoring and interpreting the results for presenting condition of the waters (*Statute Journal No. 32, item 284 of 2004*),
- Order by the Minister of Health of 9 March 2007 on the quality of water intended for human consumption (*Statute Journal No. 61, item 417 of 2007*),
- *Directive 98/83/EC* on the quality of water intended for human consumption,
- Order by the Minister of Environment of 24 July 2006 on conditions that should be fulfilled during discharging wastes into waters and soil and on substances particularly detrimental to the natural water environment (*Statute Journal No. 137, item 984 of 2006*).

Having in mind that the basis for assessing pollution of waters is their condition in the natural environment, i.e. the natural hydrogeochemical background, it is proposed that the assessment of the quality of mine waters from the Upper Silesian Coal Basin should be performed taking into account the natural hydrogeochemical background. The background should be determined both in the Polish and the Czech parts of the USCB and assessments of chemical condition or pollution should be based on a comparison of the background values with the threshold values for groundwater or waste waters set out in relevant legal regulations. According to the Directive by the European Parliament and of the Council of 12 December 2006 on protection of groundwater from pollution and worsening their condition (*GWP/2006/118/EC*) in cases where a given uniform occurrence of groundwater is situated in an area divided by the frontiers of several Member States the states should in common continue activities to monitor the chemical composition of waters, determine threshold values used for identifying poor or good quality of water and determine trends of water quality changes in time.