The issues of the self-fill aquifer in the North Nohemian Brown Coal Basin

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Abstract The submitted paper describes the problems of the self-fill aquifer in the central part of the North Bohemian Brown Coal Basin in the Czech republic. The self-fill aquifer create in the interest area a very large antropogenic collector. This collector was create in former times by underground mining of the brown coal. Due to the morphology of the seam floor and interference of her progression by the fracture lines, there are forming a partial depressions. These depressions are successively flooded and they create the reservoires of the self-fill water. In the central part of the North Bohemian Brown Coal Basin was described seven meaningful reservoires: from the west there are Albrechtice, Jiřetín, Chudeřín reservoires, then smaller reservoires Centrum and Viktoria, reservoir in the field Venuše and wide reservoir Kohinoor – Alexandr. The last named is situated in the deepest part of the brown coal basin.

Key Words basin, brown coal, self-fill aquifer, pumping, underground

Introduction

The significant Brown Coal Basins in the Czech Republic are situated in the north-western part of the Czech Republic, in the immediate vicinity of the Krušné Hory Mountains. The biggest basin is the North Bohemian Brown Coal Basin with four active opencast mines and one deep mine. The North Bohemian Brown Coal Basin is further divided in to the three parts: western part, central part (known as Most basin) and the eastern part. [1,2]

The central part of the North Bohemian Brown Coal Basin is situated between the cities Chomutov and Duchcov in the Czech Republic. More than one hundred years of mining of a strong brown coal layer in a number of deep mines from outcrops down to the deepest parts changed the previously almost water proof environment of strata very significantly. Water flew from adjacent water-containing collectors (quaternary, overburden, interdeposit and underlying sand, crystalline complex) into hollowness created in the coal strata by deep mining. In order to ensure safety it was necessary to dewater the stratum for which a number of pumping stations in the deep mines were used. [2,3]

Important pumping sites in the basin

In order to ensure failure free and safe brown coal mining in the central part of the North Bohemian Brown Coal Basin some pumping stations were in operation. Pumping stations in the mine Zdeněk Nejedlý was situated in southeast part of the central part of the basin and collected water from south periphery of the basin. Operation was terminated in 1981 and an average annual pumping was 860 thousand m^3 of mine water. The pumping station in the mine Vítězný Únor was situated in the north of the central part of the basin and collected water from north stratum outcrops. Mine allotment was a flow-through structure from hydrogeological point of view with inflow from north and northwest from stratum outcrops under the Ore Mountains. Operation was terminated in 1985 and an average annual pumping was 800 thousand m^3 of mine water. Pumping station in the mine M.J.Hus was situated in the south of the central part of the basin and collected water from south periphery of the basin. Operation was terminated in 1986 and an average annual pumping was 1 200 thousand m^3 of mine water. Pumping station in the mine Alexander was situated in the deepest section of the central part of the basin (155 m under sea level) at east periphery of the basin and collected water from north stratum outcrops, from flood disturbance and from south from the Bílina region where used to be mining in mines Emerán, Pokrok II and Gorkij. [1] At present there are in this part of the basin only two pumping stations in operation. The first is in the still active deep mine Centrum. The pumping station is situated in the middle of the central part of the basin and collects inflow from west and northwest. Average annual pumping is 990 thousand m^3 of mine water. Second pumping station is in the mine Kohinoor II. It is situated between the former pumping stations Julius III and Alexander and at present it is the deepest pumping station in the basin (90 m under sea level). [4,5]

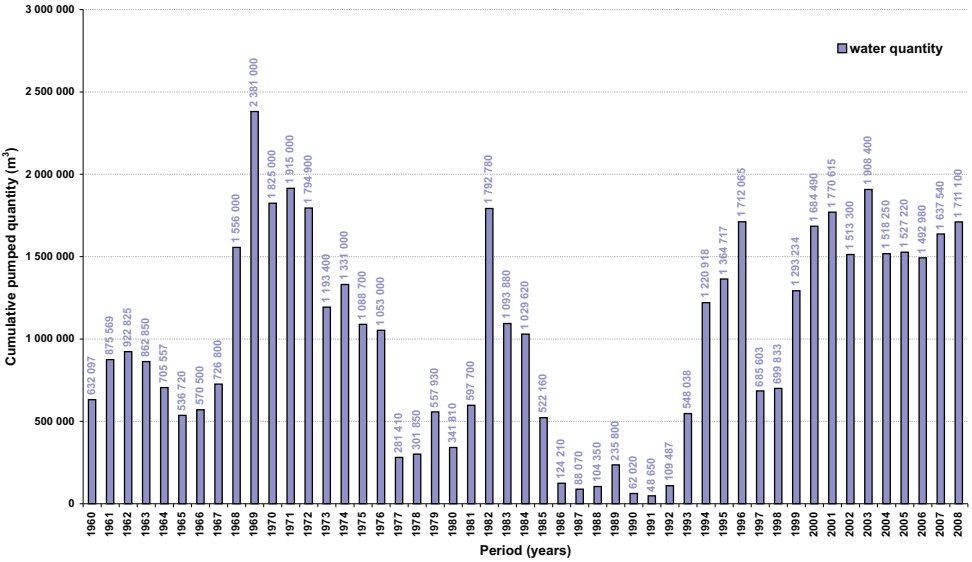

Figure 1 *Pumping volume of water from pumping station Centrum*

Main self-fill water reservoirs

Self-fill water horizon contains secondary mine water, which flows or accumulates in hollow spaces created in the strata by mining. As significant amount of secondary mine water, that had been pumped out for many years in the deep mines in the deepest part of the central depression flows through adjacent hollows, this is predominantly self-fill (self-fill) water. [3,5]

Because in the past there was strata going steeply to outcrops almost along the whole length of central part of the basin adjacent to the mountains and this strata was mined by small deep mines. This resulted in creation of preference routes which route infiltrated water directly to the labyrinth of hollows. Water flows through this labyrinth downwards the coal strata base into central depression. This was proved by communication tests. If, according to the strata morphology, there are partial depressions, there were created permanent reservoirs of self-fill water the size of which is regulated by overflow level towards the deepest sections of self-fill water horizon. With regard to the sub-soil morphology the strata creates a few main depressions in the whole North Bohemian Brown Coal Basin, which match more or less than partial basins. Central part of the basin is almost everywhere deep mined. After termination of deep mining and after stopping pumping mine water in the deep mines, the hollows are filled up with water and so a large self-fill water horizon is created. This horizon will subsequently occupy this whole area. At present some parts are completely dewatered yet. [2,6]

The largest is the reservoir Kohinoor-Alexander. Due to stopping pumping mine water in the mine Kohinoor I in 1965 there was created reservoir of self-fill water Kohinoor. For certain time there was the deepest pumping station in operation in the mine Alexander which lowered the level of self-fill water down to the level -155 m under sea level. In 1997 pumping in the mine Alexander was stopped and so there happened radical change in self-fill water streams because the whole deepest part of the basin began to be filled up to the overflow over „dividing line" between the mines Alexander and Kohinoor I around the level -60 m under sea level. This caused creation of a large reservoir of self-fill water Kohinoor-Alexander. Water line development in this self-fill system, which covers the area from the former mine Pluto to inundation fraction, was monitored from 1997 to 2002 in the pits IV and V of the former mine Kohinoor I. Last measurement (IX/2002) the water line reached the level of -17,9 m under sea level in the pit IV and -10,7 m under sea level in the pit V (III/2002). Due to liquidation of the mine both mines were filled with dirt in 2002. At present there is no place for monitoring water line in this reservoir. [1,3]

Figure 2 *Discovering of the abandoned area*

The Albrechtice reservoir is situated most to the west in flooded hollows of the former deep mine Maršál Koněv. It is morphological structure of the strata, basically copying the morphology of the crystalline complex. Formerly it had an oval shape extended in the direction southwest-southeast with the length related to the stratum base was 30 m at least. The stratum base is at the deepest place of the depression at the level of +40 m above sea level. Water level in hollows of the former mine Maršál Koněv was lowered due to progress of the opencast mine Československé armády towards this area by pumping in the pit VI. At present water flows out of the depression gravitationally to the mine bottom where it is pumped to the main pumping station. The water level of self-fill water in the rest pit of the Albrechtice reservoir varies about +62 m above sea level at present. [6]

The Jiřetín reservoir is created by flooded hollow fields of the mine Centrum and the former deep mine Humboldt in strata depression south of the villages Černice and Horní Jiřetín predisposed most likely by volcanic explosive structure in subsoil. An overflow of it is most likely around the level of +75 m above sea level partly eastwards to the pumping station of the mine Centrum, partly southwards to the drain system under the internal deposit in the rest pit of the former mine Obránců míru. Water level has been monitored here since 2005 in the pit XVIII and at present it is approx. +80 m above sea level. [3,4]

The reservoir Centrum is situated on an upper block mass of Centrum fracture and until 2002 it was dewatered by the mine Julius III. After finishing pumping and subsequent liquidation of the mine it was assumed that water would rise up to +55 m above sea level (overflow to the Viktoria reservoir) based on relation between base configuration and permeability of the fraction Centrum. In 2006 there was started operation of a monitoring bore-hole into the hollows of this mine and at present water level in this bore hole is at +76 m above sea level. [1,2]

Conclusions

The submitted work describes the present state of the self-fill aquifer in the interesting area of North Bohemian Brown Coal Basin. The self-fill aquifer create a very large antropogenic collector, which was created mainly by zhe underground mining of the brown coal. Due to the morphology of the seam floor and interference of her progression by the fracture lines, there are forming a

partial depressions. These depressions are successively flooded and they create the reservoires of the self-fill water. The fluctuation of the water in the self-fill system was in former times considerably influenced by the pumping stations. The pumping stations were situated on the each underground mines. [4]

The flood prognosis of the central part of the brown coal basin becomes from the ideal stage of the water circulation in the self-fill aquifer. But we have to include other factors, such as: punctual geology, detail tectonic lines, methods of the underground mining, active cavities, transmissivity etc. Submitted prognosis is compile on the basis of longtime experiences, suveying results, communication tests. For the more accurately determination of the filling process is necessary to create the digital model of the water fluctuation in the self-fill aquifer. [3,4]

One of the hydrogeological risks is the rising of the water level up to the spot height +225 – +230 m above sea level from the self-fill aquifer. The overflow places are situated close to the coal seam outcrops (the lowest level of the outcrops) in the south border of the basin. [4]

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