

BROWNFIELDS IN UPPER SILESIA COALFIELDS

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*It is an engineering that must repair what a man ruined.
Walery Goetel, Rector of AGH UST (1945-1951).*

ABSTRACT: During the last 13 years production of coal from underground mining was reduced from 200 million tons to around 100 million tons. 15 collieries were completely liquidated, 9 others partly. The process of liquidation for 5 new collieries is to start this year. What is left behind is a devastated economy and environment. This paper presents identification and short description of major social, economic, technical and environmental aspects connected with the revitalization of brownfields in Upper Silesia Coalfields.

1. INTRODUCTION

A long-lasting mining exploitation results in serious degradation of natural environment. As a consequence, brownfields occupy vast areas of a country, used to a relatively small extent only. Therefore, according to the rule of a balanced development, recultivation and revitalisation of these areas are of extreme importance in saving the ecosystem. Post-industrial fields include a series of types of terrain that was degraded in comparison to its original condition due to various utility functions (1)

At the end of 1999 the size of brownfields in Poland was estimated at approximately 5,976 ha, 1,210 ha of which belonged to the Voivodeship of Silesia. A considerable percentage of these areas was created due to mining. Systematic research evaluating possibilities for recultivation and revitalisation of brownfields is a crucial activity allowing for complex solution of problems connected with redevelopment of post-industrial areas. In addition, it is also a problem of implementation of a large number of post-industrial installations located in these

areas, i.e. large-volume buildings, engineering buildings and various types of networks. Due to historical conditions, some of these buildings are of a historic value and remain under conservator's control. Underground Coal Mining in Upper Silesia has over 200 years of history. A lot of objects have a monumental character. A part of mine separated from the 'Makoszowy' mining centre – the GUIDO open-air museum – was incorporated into the Museum of Mining in Zabrze.

Another serious problem of brownfield transformation is connected with split ownership of areas in question. Removing negative effects of former industrial activity is one of the basic tasks of environment protection in the Voivodeship of Silesia. Brownfields are rarely detached from urban areas and they usually constitute a considerable part of these areas. The importance of brownfield revitalisation results not only from the large-scale character of this phenomenon (in central part) but also from the localisation in potentially attractive places, i.e. in the city centres, in the premises of communication lines, in the premises of some attractive reservoirs of nature and landscape. However, the importance of brownfield transformation does not only relate to environmental aspects. It is necessary to carry out a detailed cataloguing of brownfields existing in the Voivodeship of Silesia. The cataloguing should include the following data: type of terrain, characteristics of a former user, size, localisation, legal status (ownership), degree of degradation, density of industrial installations as well as of engineering and large-volume buildings, environment conditions, historic value etc.

Revitalisation of brownfields means not only recultivation in its original meaning but also remodelling of the landscape. The above should be an obligation of a mining entrepreneur. In the case of expired events, when it is impossible to indicate the user, recultivation is a duty of the state budget.

2. BROWNFIELDS - SOCIAL AND ECONOMIC ASPECTS

Another aspect of brownfields is the revitalisation of communities adjacent to mines with all the socio-economic consequences. Population of Silesia was 4,844,008 (March 31st, 2001), 75 % of which in mining regions. Figure 1 shows the unemployment in Upper Silesia Region.

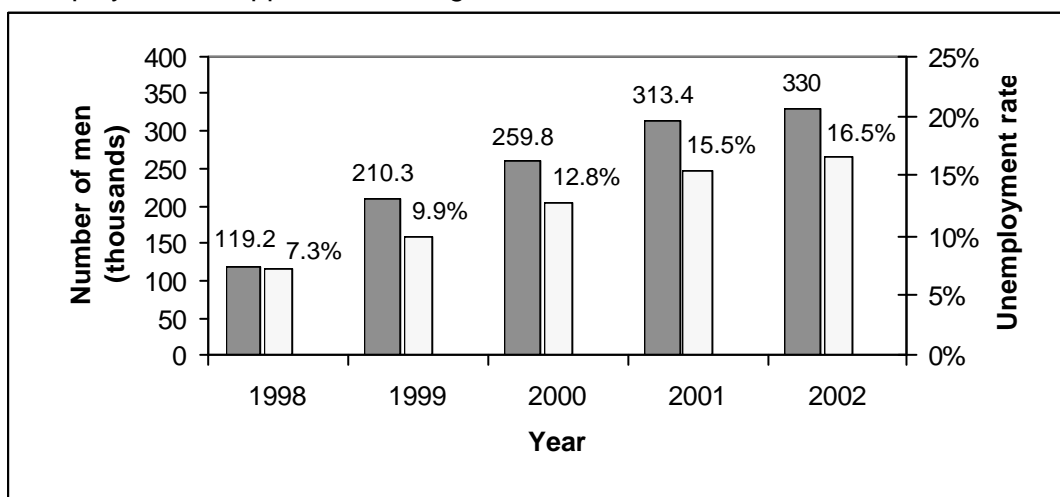


Figure1. Unemployment in Upper Silesia Region.

Fig. 2 presents the rate of dismissals from mining industry in Upper Silesia Region. This is strongly connected with the process of gradual liquidation of underground coal mines (fig.3).

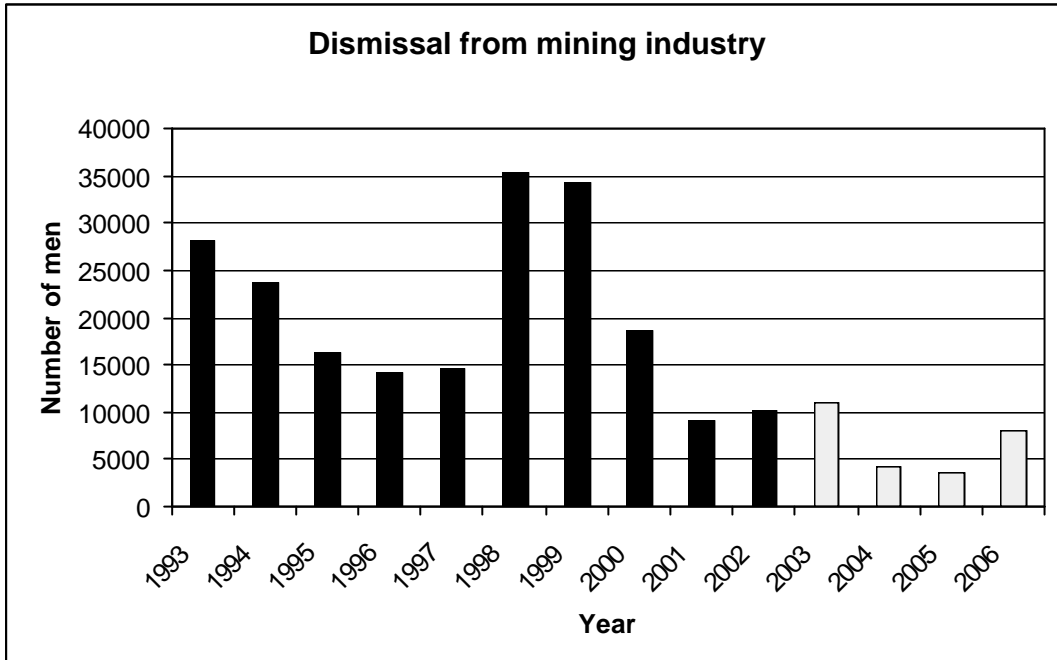


Figure 2. The rate of dismissals from mining industry in Upper Silesia Region.

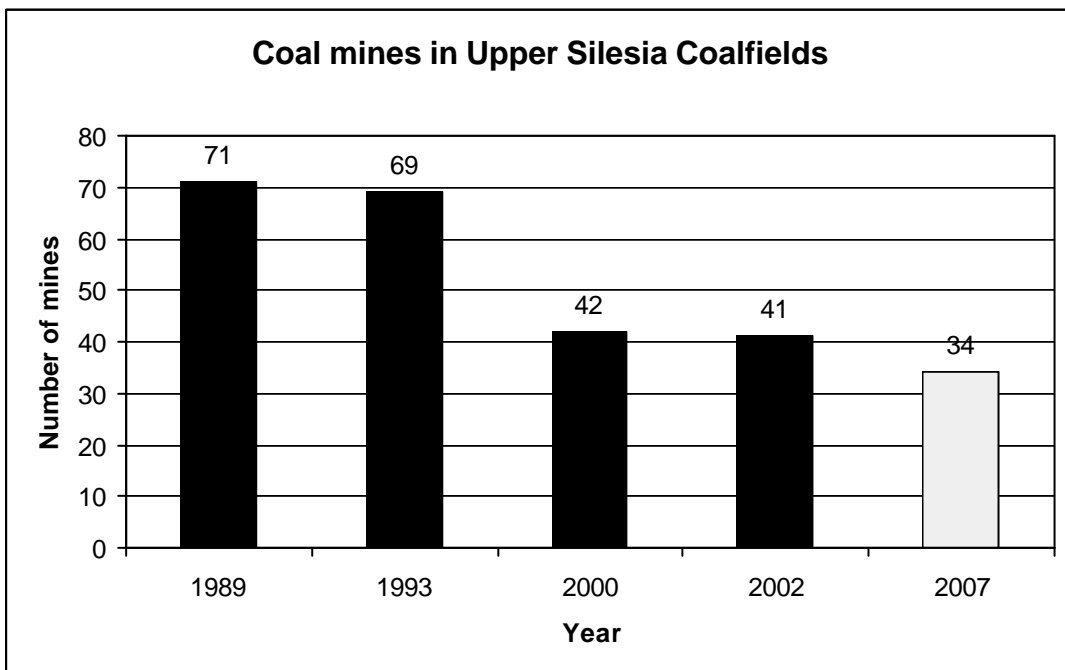


Figure 3. The rate of coal mines liquidation.

The social effects of unemployment in mining families are the following (Szczepanski, 2):

- economic degradation,
- prestige and social degradation (“brownfields in the minds” of former miners),
- useless person complex (such a person is simultaneously susceptible to radical and populist rhetoric).

During last 10 years some 50 thousand miners became beneficiaries of the mining social package (10 thousand euro for permanent dismissal from mining industry). Until 2001 only around 20 % of them found a new job (Martyka et al. 3).

3. BROWNFIELDS – ENVIRONMENTAL ASPECTS

Intensive exploitation of coal resulted in considerable changes in natural environment. Thus the issue of revitalisation of brownfields is of a crucial importance here. The most distinct negative effects of mining activity are the following:

- Salinity of surface waters (excessive salinity of rivers, corrosion of industrial and communal installations)
- Waste production, waste storage, mine waste dumps (storing waste on the surface is the least advantageous solution due to danger of endogenic fires).
- Change of water relations (lowering of ground water level, limiting the flow of surface waters)
- Damage on surface (damage of buildings, communication lines and water courses, etc.)

All the activities should lead to reducing all the inconvenient aspects of mining activity.

3.1. Surface deformations and its redevelopment

Originally, coal extraction used to take place on relatively small depths using room and pillar. The shallow, often not documented, workings – that may cause discontinuous deformations on the surface (e.g. sink holes or irregular ditches) – are the remain of this exploitation. In the region of Upper-Silesia coalfields, more than 1,000 deformations of this type were registered and the area endangered with these deformations amounts to approximately 150 km². There are some registered sinkholes with a diameter of more than 100 m and with a depth exceeding 10 m. (Goszcz, 4).

It is estimated that the surface of the areas suffering from subsidence after coal extraction reaches about 300 km². In some areas the total subsidence exceeded 20 m and they caused irreversible changes in landscape.

Surface subsidence due to mining exploitation may cause damage of buildings and installations on surface (road and railway track repairs, residential building and office building repairs are often necessary). Surface inclinations alongside with the change of groundwater conditions may cause slope stability problems.

A part of land development may be utilized at once or after necessary adaptations. Some objects have to be demolished. Decades of functioning caused the degradation of soil. Several embankments, slag dumps, spoil dumps, coal pulp and other waste materials were placed sometimes straight on the surface. Virgin

soils were penetrated by leached heavy metals, oil-based liquids, sulphates, chlorides etc. This considerably reduces investment activities on these areas. The most common recultivation line is an adaptation for a park, a car park, a playground, a marketplace etc.

3.2. Groundwater conditions

The liquidation of particular coal mines may result in changing the hydro geological conditions in vast areas, especially in the occurrence of uncontrollable flows from the liquidated coal mine to the neighbouring mines, which may considerably change the state of water hazard in these mines (Rogoz and Posylek, 5). Before launching the actual liquidation of a mine, a proper analysis of the consequences of giving up water pumping needs to be carried out (fig.4). Such an analysis should assume both the aspect of water hazard for neighbouring mines and the influence of mine inundation on natural environment and regional economy.

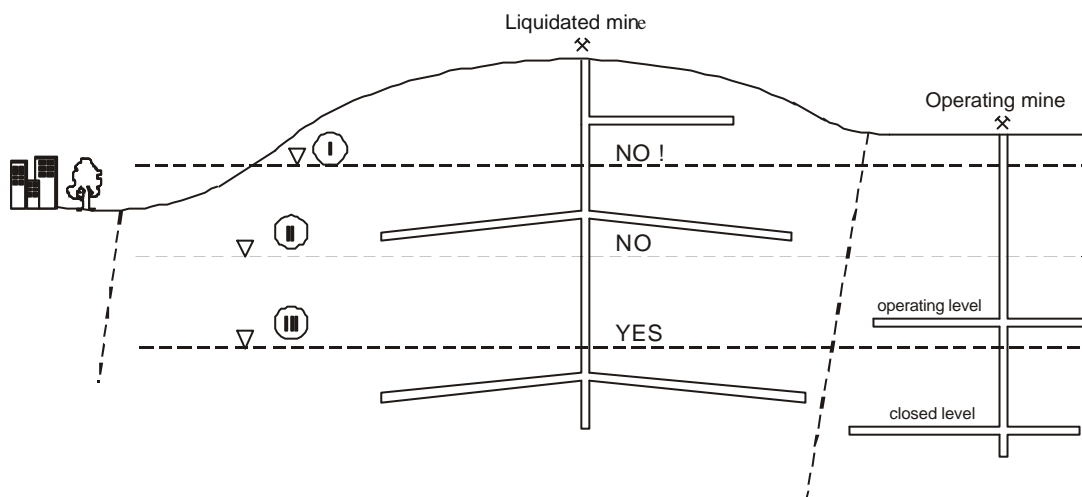


Figure 4. Scheme of consequences of giving up water pumping in liquidated mine

Due to existing underground connections among the mines of Upper Silesia coalfield, giving up water removal in one of the mines may cause the flooding of a neighbouring one. Then, water removal in a liquidated mine should go on until the headings filled with water do not cause any water hazard to neighbouring mines (fig.4). During the liquidation of several mines, it occurred that sustaining stationary pumping station was by no means cause-effective as it required providing for further activity of a mine, employing staff, etc. Now instead, borehole pumps are applied in reinforced shafts or specially made boreholes nowadays.

In the case of unfavourable hydro geological conditions, swamps and overflow lands may occur in the depression areas at the final stage of mine flooding. The above phenomenon may be avoided beforehand by preparing a proper drainage system. As a result of water removal, the groundwater level should rise. Unfortunately, groundwater salination excludes a possibility of transforming an underground mine into a water intake.

3.3. Waste disposal

Possibilities of transforming an underground mine into a waste disposal, mainly power station waste disposal are considered. There has been no precedence of the type in Poland so far. In numerous cases, power station waste is used for mine filling during a process of mine liquidation. It must be concluded that practically there is no possibility to dispose waste. However, there are some possibilities of storing waste for a certain period of time.

3.4. Dumps

There are about 300 dumps in Silesia. For example, the 'Pniówek' coal mine produces 7 thousand tonnes of waste a day, which - in other words - is more than 120 coal wagons. The dumps occupy the area of 3,000 ha. For example the waste dump in Laziska has a height of 90 m, surface of 30 ha and weight of 17 million tonnes. About 60% of dump is burning. The dump is partly extinguished although in some places its temperature varies between 900 and 1,200 degrees centigrade. The commencement of extinguishing process and dump recultivation is planned for 2006.

The waste contains a few per cent of coal and therefore they tend to inflame spontaneously. A disassembly may be considered in connection with using the burnt material as it possesses parameters similar to high quality aggregates. The material not yet burnt might be used for construction of flood banks, filling of liquidated workings and overflow lands. Redevelopment and adaptation of dumps is also possible with reference to the demands of landscape architecture. It might be, for instance, recultivation of dumps into leisure areas, car parks, fairgrounds, golf fields or biological recultivation into forests or meadows.

Fire hazard as well as pollution of underground and surface waters are the most common hazards to environment caused by industrial waste storages in their premises. Both types of hazard are conditioned by the same factors, i.e. atmospheric air and precipitation water leakage through the body of a storage. As opposed to spontaneous inflammations of dumps, which were always in the centre of attention, the problem of water pollution raised some interest only in the last decade of the twentieth century. Solid industrial waste causes serious changes of water quality in the premises of their storage. The changes result from leaching soluble compounds of various degree of contamination from the waste. This pollution – the so-called area pollution – is difficult for monitoring.

3.5. Underground storage

Possibilities of turning closed colliery into underground gas reservoirs are also considered (Twardowski, 6). The works connected with using the workings of liquidated coal mines for obtaining or storing geothermal energy are far more advanced. The temperature conditions in Upper Silesia Coalfields are favourable to such enterprises. Liquidated mines might be used as anthropogenic containers of geothermal waters (created in coal mine goafs) or underground storage of thermal waters (supplied from the surface). Utilizing underground space as a sanatorium or storage of goods is not taken under consideration.

3.6. Gas hazard

In mine workings there are always harmful gases (mostly carbon oxides and methane). In the course of mine dewatering, water ousts gases from the caverns and the gases can be emitted to the air on the surface (i.e. increasing water table acts as a piston and pushes methane to the surface). The forecast amount of methane emission to headings and goafs of a liquidated mine is a function decreasing linearly in time to 15 years after exploitation commencement (Krause, 7).

4. SUMMARY

Never in the history of mining there were so many mines closed down and so many men made redundant in such a short period of time. The entire process is financed by the state budget. During the last 10 years underground mining of coal was reduced by 100 Mt/yr (which means that around 205 thousand workers lost their job). Restructuring of German mining (1965-1998) led to the dismissal of 305 thousand workers and reduction of excavation by 93.2Mt/yr.

Such a tremendous speed of restructuring in Upper Silesia had to cause considerable economic, social and environmental problems. Only the correct inventory of all these problems together with identification of their mutual relations may lead to a successful solution. The full redevelopment of brownfields in Upper Silesia remains a tremendous challenge to engineers, scientists and authorities.

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