Review article

Potential conflicts connected with the recovery of secondary materials from post mining waste dump

Łukasz Gawor

Silesian University of Technology, Akademicka Str. 2a, 44-100 Gliwice, Poland

E-mail address: lukasz.gawor@polsl.pl

ABSTRACT

Coal mine spoil dumping grounds are present in the landscape of every mining region. Although the composition of waste material is in general safe for the environment (sedimentary rocks – sandstones, mudstones and siltstones), there may be up to 10% of coal particles in disposed wastes. The presence of organic material causes self-ignition processes and fire hazards. There is a need and the possibility of the recovery of coal, and which should be conducted according to legal regulations and environmental protection rules. The recovery should also be preceded by a feasibility study, a drilling campaign, laboratory tests and requires different environmental permissions. Recovery processes are connected with the work of a preparation plant, which is usually linked with protests from the local community and potential conflicts. This article presents the most significant hazards to the environment, health and human life connected with the functions associated with the installation of the recovery processes of coal from waste material deposited on the dumps. The methods of reducing these threats are described with regards to legal regulations, particularly law deeds concerning the safe recovery processes and further reclamation and restoration of degraded post-mining dumping grounds. The role and participation of interested community members at the preparation for investment stage as well as the period of realization of the preparation processes is described. The question of re-using and managing the post-mining dumping grounds after completion of the recovery processes is discussed.

KEY WORDS: post-mining waste dumps, recovery of secondary resources, legal regulations, conflicts

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1. Introduction

All over Europe there are dozens of post-industrial areas, where mining wastes are disposed. These are mainly hard coal basins, such as Ruhr Basin in Germany, Belgian Northern and Southern Basin (Campine and Liège), South Wales Basin, Ostrava-Karvina Coalfield in Czech Republic or Upper Silesian Coal Basin (USCB) in southern Poland (GABZDYL, 1994; SCHULZ, 2004; MARTINEC ET AL., 2006; NYSEN & VERMEERSCH, 2010).

Post-mining waste dumping grounds present characteristic signs of industrial activities in the European coal basins and ore-exploitation areas. There are hundreds of such places in different coal basins and in Poland there was an inventory of 226 places, covering a surface area of more than 4000 x 10⁴ m² and collecting more than 700 million

Mg of mining waste (GAWOR, 2014a). After successful reclamation (both technical and biological) these places may be regarded as geotourist attractions. There are different ways of facilitating waste dumps for tourists – one of them can be by creating educational paths, which describe the geological composition of waste material, preparation technologies, ways of reclamation or environmental issues (SCHULZ, 2004; GAWOR ET AL., 2011). Before planning the reclamation processes it is necessary to test the possibilities for the recovery of different raw materials from these dumps. Many of these objects represent anthropogenic secondary resources, whose exploitation is economically justified.

The purpose of this paper is to itemise the potential conflicts connected with recovery of secondary resources from waste material disposed

on these tips. An analysis of the legal regulations concerning the recovery processes is presented. There threats to the environment and local inhabitants connected with the activity of a coal waste preparation plant are described, based on a literature study as well as official documentation and personal communication with the management boards of companies dealing with coal recovery (HANSEL & SCHULZ, 1996; GRAY, 1997; GAWOR, 2014a; SZCZEPAŃSKA & TWARDOWSKA, 2004; ww.haldex.com.pl). A proposal for the complex management of dumping grounds, consisting of the recovery and reclamation processes is given.

2. Recovery of secondary materials from coal mining waste dumps

The recovery of wastes is understood to include all actions based on the use of wastes or leading to the recovery of waste materials or the use of them for the production of energy and not generating hazards to life, health of people or the environment.

The preparation process for the dumping of material is based on the technology of the coal mining preparation plant. The most applied process is called the wet preparation method, which uses a dense medium (magnetite). The segregation processes involve screening into two grain size classes 1-60 mm and 0,25-1 mm. The processes of beneficiation and classification of the material occur in hydrocyclones. The end phase requires dewatering in a centrifuge or chamber filter press. The mobility of an installation, which consists of modules, is an advantage for the preparation process, which may be used in different localities.

The coal mining industry in Poland generates approximately 30 millions Mg of mining wastes per year and it is estimated that each 1 Mg of coal generates 0.4–0.5 Mg of waste material (SZCZEPAŃSKA & TWARDOWSKA, 1999; GAWOR, 2014a). Due to the fact that the amount of coal in the waste material can be up to 10% it can be estimated that the total potential amount of recovered coal from the dumps in USCB will account for more than 45 million Mg (GAWOR, 2013, 2014a).

In the past there were some examples of successful recovery of coal from the dumps in the Upper Silesian Coal Basin – good examples are the Central Mining Waste Dump in Smolnica, and the waste dumps in Buków, Czerwionka and Panewniki (situated between Mikołów and Ruda Śląska).

3. Environmental impacts of wastes disposed on tips

One of the most dangerous environmental impacts of coal mining waste dumps is fire hazards. The lack of compacting of waste material and ignoring rules regarding fire prevention are nowadays the cause of numerous spontaneous combustion events particularly in old coal-mining waste dumps. Coal and pyrite present in waste material undergo intensive oxidization, which leads to self-ignition inside the dump. The fire resulting from waste materials deposited in dumps may be the result of two kinds of processes: exogenous processes and endogenous processes (GAWOR ET AL., 2011; SZCZEPAŃSKA & TWARDOWSKA, 2004).

The temperature of waste rocks rises significantly, which can consequently lead to dump fires. A burning dump may affect its surroundings due to spreading the fire and causing air pollution. Nowadays fires in coal-mining waste dumps still remains a problem, as well as the issue of toxic gas emissions from mine wastes to the atmosphere.

The fire hazards on coal-mining waste dumps are strictly related to the ways of reclamation, e.g. afforestation. The trees make waste material looser and enable access of oxygen to the dump. It results in self-ignition which is a higher grade of hazard (GAWOR, 2011, 2014a; KUNA-GWOŹDZIEWICZ, 2013).

Another important environmental impact of mining wastes is surface water and groundwater pollution. The leaching of chlorides and sulphates is a well known problem of the AMD (Acid Mine Drainage) processes, which occur on dumps. The effect of the AMD processes is a contact of sulphur compound, particularly pyrite FeS_2 with water. Major chemical effects are pH reduction (connected with increased acidity), increase of sulphate, iron, manganese and aluminium contents, oxygen reduction and destruction of the bicarbonate buffering system (STEFANIAK & TWARDOWSKA, 2005).

One of the serious environmental problems connected with the disposal of mining wastes is the danger of mass movements on the slopes (Fig. 1). The old conical dumps are the most susceptible to these processes, which usually start with erosion troughs. The natural erosion processes may be intensified by anthropogenic activities (e.g. illegal mountain-biking on the dumps).

All the environmental hazards mentioned above require activities, which minimise the negative impacts on the environment and to human health and safety. A complex solution may be the environmental friendly recovery of coal from waste material, which will lead to:

- liquidating fire hazards through removal of coal particles from wastes,
- indirect reduction of potential gas and dust emissions,
- protection of surface and underground water due to the reduction of coal and adjacent compounds (e.g. pyrite),
- creating the shape of the dump in the form of a landscape dump, which will reduce the mass movement processes on the slopes.

Fig. 1. Erosion through on the slope of waste dump in Katowice (Ł. Gawor)

4. Legal regulations regarding mining wastes in Poland

The legal regulations regarding mining wastes in Poland include the regulations of environmental protection, geological and mining laws, statutes regulating the management of wastes as well as environmental impact assessments. The directives, statutes, executive deeds, local law acts and standards were analysed. The results of these analyses show that there are comparable law deeds at the level of directives and statutes, but there is a lack of local law acts. When the Polish

and German legal systems are compared, in the Ruhr District there are special local legal acts in the form of guidelines (German: *Richtlinien*), which describe the problems of reclamation and the use of waste dumps in a very detailed way (GAWOR, 2011, 2014a).

The legal regulations in Poland regulate issues connected with coal mine dumping grounds in a very general way. One of the reasons for the non-effective reclamation of waste dumps in Poland is a lack of specific legal regulations concerning mining waste, connected with their negative environmental impacts (e.g. protection of groundwater or fire hazards) and evaluation of reclamation methods. Implementation of the first EU directive concerning mining waste (*Directive 2006/21/EC of the European Parliament and of the Council on the management of waste from the extractive industries*) took place in Poland in 2008. There is, however, a need for creating regulations regarding waste dumps at the level of self-government, i.e. Silesian voivodship. It is necessary to prepare supplements to the legal provisions or new regulations concerning post-mining dumping grounds. It seems to be beneficial to create new regulations in the form of local law deeds (GAWOR, 2014a).

The recovery of coal due to the latest legal regulations in Poland is very important and compulsory. The main rule of managing of wastes in Poland requires environmental compliant recovery if there was no possibility of avoiding origination of wastes (*Ustawa z dnia 14 grudnia 2012 r. o odpadach* – Polish Waste Law).

Recovery processes implemented by their owner are based on preparing wastes for re-use or recycling, and if this is not possible from the technological point of view or not economically justified the wastes should be treated in other recovery processes (*Ustawa z dnia 14 grudnia 2012 r. o odpadach* – Polish Waste Law).

5. Potential conflicts between local communities and industrial entrepreneurs leading to the recovery processes

Preparation for the recovery processes requires cooperation with local communities. Successful and economically justified projects usually concern central waste dumps, which are situated beyond densely inhabited areas (e.g. central mining waste dump in Smolnica, or central waste dump in Przechlebie). Because of the fact, that most central dumps in the area of the Upper Silesian Coal Basin have successfully undergone recovery processes, entrepreneurs have start to look for

new opportunities – also in the places which are in the neighbourhood of highly populated areas.

The functioning of the recovery installation is linked with potential threats to the natural environment of the inhabitants. Negative impacts may be taken into consideration such as:

- negative impacts on atmospheric air (possible dust and gas emissions),
- extending noise limits,
- degradation of the landscape,
- vibration of the bedrock,
- impacts on human health.

According to legal regulations inhabitants who live in the neighbourhood of the dump are described as the interested community. These are local people, legal persons or organizational units not having a legal personality, which may be affected by the consequences of the permit or have an interest in the process of granting permission for the activity of the recovery plant. The local community must be informed about the permitting procedure, the details about institutions responsible for the decisions, and the character of possible decisions. It also has a legal right to give opinions and remarks to suitable institutions before taking decisions. The results of consultations and opinions are taken into consideration during the decision process. When the decision has been taken, a suitable institution will inform the interested community.

The first potential conflict connected with a new investment is the location of the plant. The well-known NIMBY rule (Not In My Backyard) is commonly used to express opposition by the local citizens to locating a project in their neighbourhood, e.g. dump or industrial plant, that is considered unsightly, dangerous, or likely to lead to decreased property values. In the case of the location of a potential preparation plant, firstly (according to the author's opinion), it should be agreed with the community authorities and, secondly, with the local community.

Plenty of new investments concerning industrial plants release fear in the local community connected with different environmental aspects. One of the most often raised problems is sound level. In environmental protection there is a term called "noise pollution" which takes place when there is either an excessive amount of noise or an unpleasant sound that causes temporary disruption in the natural balance. For sure no industrial installation can work without noise, but there should be noticed that the sound level intensity of the operating coal preparation plant (information based on long-term experience), does not exceed

55 dB. This value is the standard permissible noise level for single-family residential buildings in accordance with ordinance permissible noise levels in the environment – Environmental law (*Rozporządzenie w sprawie dopuszczalnych poziomów hałasu w środowisku*). If the noise standards are exceeded, it is possible to construct acoustic barriers and dump the waste material on the inhabited site, and protect it by a natural fence.

Another significant problem is the potential danger of dust pollution. The coal mining wastes preparation plant uses so called "wet technology". All processes use closed water circuit and the end phase is dewatering of sludge. Extended dust emissions, which is connected with heavy transport (trucks, excavators, diggers) is limited by sprinkling of technology and public roads. Heavy transport is also reduced by applying conveyor belts to transport waste material between dump and preparation plant. Extracted coal is mostly transported by railway. That is why the railway connection is one of the most important factors of localization of described installations (Fig. 2).

Fig. 2. Railway enabling reduce of heavy transport (*Ł. Gawor*)

Vibration of the Earth's crust is another potentially negative environmental impact of the activities of a coal preparation plant, but long term experience has shown that there were no such impacts observed during installation work.

Regarding the planned location of the preparation plant in the direct neighbourhood of a coal mine the dump the plant will not interfere with the landscape – it will form part of the existing industrial areas. After exploitation of the dump its volume may be reduced to ca. 15%. There will be positive changes in the landscape – the height and surface of the dump will be reduced (*GAWOR, 2014b*).

6. Conclusions

Recovery of coal from coal mining wastes disposed on tips does not cause serious environmental hazards, due to the application of suitable technology methods ("wet preparation", reduction of heavy transport). The reduction of organic compounds in the wastes results in liquidation of self-ignition and fire hazards. Diminishing of volume of the dump is beneficial for the landscape as well as creating new landforms called dump landscapes. The restoration and reclamation of the site should be planned efficiently and performed according to environmental and legal regulations. The following proposals are suggested for preparing a dialogue with local communities to avoid potential conflicts:

- prepare the merits of each matter for the meeting with local community – investor, experts,
- a meeting with the local inhabitants should be preceded by a meeting with the community authorities,
- emphasising the legal regulations,
- emphasis of positive examples of similar investments (statistical data).

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