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AN ANALYSIS OF DEGRADED POST-MINING AREAS TO BE RE-DEVELOPED – CASE STUDY: SLIME SEPARATORS

7.1 INTRODUCTION

The dynamics of economic transformations in Poland, including mainly the process of transforming the socialist economy into a market one, resulted in a large number of abandoned undeveloped post-mining areas. Many hard coal mining plants could not become profitable, which led to their liquidation. Closed mining plants are often located in town centres or in densely populated districts. They are abandoned or used to a modest extent, and their revitalization would require considerable expenditure. Another problem is related to areas affected by mining activity which are located away from the plant. Such areas could frequently be used in a new way, but: the visual condition is a deterrent preventing any activities, the property status of the areas is not regulated, the areas are largely contaminated and there are facilities difficult to adapt.

Mong the visible effects of mining activity the one which comes to the fore is surface degradation, dependent on the technology of mining and geological conditions. Area subsidence, an effect of underground mining activity, frequently leads to the creation of characteristic elements of industrial and post-industrial landscape – overflow lands or inundated areas, which take up the farmland, woodland or settlement area.

Surface degradation also includes using the area for waste landfills formed as a result of fossil extraction and processing, so-called heaps and slime separators, where coal sludge of insufficient calorific value is stored. Post-mining waste landfills have a strong negative impact on the landscape aesthetics, but most importantly they are a source of harmful substances permeating to water and emissions of gaseous and dust contaminations. Particularly dangerous is the phenomenon of self-ignition, which tends to occur in older heaps, where frequently material containing several dozen percent of coal was dumped [1].

In the article an initial analysis of a selected part of the post-mining area in the south-western district of Rybnik has been conducted. Basic problems hindering the development as well as the assets of the area have been presented.

7.2 INFLUENCE OF MINING ACTIVITY ON THE AREA

Mining activity has negative effects, which may continue for many years after stopping the extraction or which may permanently influence the affected area.

Among the visible effects the one which comes to the fore is physical degradation of the surface, dependent on the type of mining technologies, the intensity of mining as well as the geological form of the deposit.

Surface degradation is reflected in area subsidence, horizontal displacements or slopes. Apart from surface deformations, it directly translates into destruction or damage to buildings located in the degraded area. Area subsidence frequently leads to the formation of characteristic elements of industrial and post-industrial landscape – overflow lands and inundated areas which take up farmland, woodland or settlement land. An overflow land is water accumulation in the lowered part of the area. Partial inundations, on the other hand, lead to excessive water accumulation in soil in the subsided area. Negative effects of partial inundations include mainly: soil degradation, losses in crops and stand of trees, destruction of natural plant community.

Surface degradation also includes the use of an area for storing the waste produced as a result of fossil extraction and processing, so-called heaps and slime separators, where coal sludge of low calorific value is dumped. Post-mining waste landfills have a definitely negative influence on landscape aesthetics, but first of all, they are a source of harmful substances permeating into waters and emissions of gaseous and dust contaminations. Particularly dangerous is the phenomenon of self-ignition, which occurs mostly in older heaps with waste containing large amounts of coal.

Degradation is also reflected in a change of hydrographic conditions. Two groups of factors can be distinguished: factors directly influencing a change of water circulation and a group of factors indirectly contributing to a change in hydrographic conditions. Direct factors include: uptakes and discharges of water, discharges of deep mine waters to water courses, transfer of water between drainage bases as well as drainage and intensive, long-lasting extraction of groundwater. Indirect factors include among others: melioration works, regulation of water courses and their beds development, change in land use. The above described physical effects concern areas situated far away from the immediate vicinity of a mining plant, whereas the area related to mine overground infrastructure can be affected by effects of chemical degradation, which is reflected e.g. in the saturation of land with compounds harmful to human health or life.

7.3 INVESTMENT LIMITATIONS

The process of economic transformations in Poland caused among others the liquidation of many mining plants. Located frequently in or near urban centres, they are potentially good investment areas – they have convenient road and rail connections with an urban centre and are equipped with energy infrastructure. In the immediate vicinity of a former mining plant there are sometimes post-mining buildings with interesting, historical forms, which would be perfect headquarters of various subjects and institutions.

Unfortunately, due to many factors, in the investors' opinion, the disadvantages of post-mining areas outnumber their advantages. Major drawbacks include the lack of complete information on the key features of a given area – "unreasonably" divided area, unclear property situation, soil contamination or underground infrastructure or its chaotic remains, which make building works difficult. As a result, the investors' attention is directed to undeveloped areas, which despite being located far from the centres, are free of troublesome "surprises", legal as well as environmental and building ones. A key to the investor's interest in redevelopment of a post-mining area is providing its detailed analysis, which accurately describes the area's past and the effects of mining activity, the current condition of the area as well as possible directions of its new development.

7.4 CHARACTERISTICS OF THE AREA SUBJECTED TO ANALYSIS

The area selected for analysis is the reclaimed terrain of former slime separators of „Rymer" coal mine in Rybnik-Niedobczyce. Slime separators are used for storing waste produced in the coal refining process. The mined rock is contaminated with so-called gangue, which is next removed in the process of coal refinement in order to increase its energy value. Refining takes place in a water medium and the obtained products are subjected to dehydration; only particulates having a diameter of maximum 1mm get into the water. This suspension is called coal sludge. It is most frequently deposited in ground slime separators, in which particulate matter is separated from water by gravity forces. Water is returned to industrial circulation, whereas dehydrated coal sludge, depending on the percentage content of contaminations, is treated as waste or is sold as fuel. Slime separators are located in the immediate vicinity of former "Rymer" coal mine in Rybnik-Niedobczyce. The area of former „Rymer" coal mine is conventionally designated by the following boundaries:

- from the north – the bed of the Nacyna stream,
- from the east – National Road No. 78,
- from the south – boundary of the town of Rybnik and Radlin,
- from the west – Górnośląska Street in Rybnik.

These boundaries close an area of approximately 2.4 km^2. Mining area is no longer continued in this area and it is removed from the register of mining areas.

Major facilities located in the described area include:

- facilities of the former „Rymer" coal mine
- flotation and maintenance waste landfill „Stożki",
- reclaimed sludge ponds,
- part of the railway line number 158 with Rybnik Rymer station,
- park at the foot of "Stożki" landfill,
- residential development,
- forest grounds.

Fig. 7.1 presents a map of the discussed area with marked facilities.

Fig. 7.1 Map of the former coal mine „Rymer"

a. buildings of former coal mine „Rymer",
b. waste landfill „Stożki",
c. reclaimed sludge ponds,
d. railway station Rybnik-Rymer,
e. park at the foot of „Stożki" landfill,
f. residential development,
g. forest grounds
Source: Own elaboration

7.5 CASE STUDY

Below has been presented a sample evaluation of former sludge separators in terms of their potential to be reused (Tab. 7.1 – Tab. 7.49).

Tab. 7.1 Proper name or short characteristics of an area

Reclaimed slime separators

Tab. 7.2 Code and location

Place:	Commune:	Post-code:	Street, no.:
Rybnik	Rybnik	44-200	Akacjowa

Tab. 7.3 GPS coordinates – extreme points

N 50° 3'48.62"N	E 18°30'41.85"E	S 50° 3'41.22"N	W 18°30'17.94"E

Tab. 7.4 Area size (ha)

7 ha

Tab. 7.5 Numbers of record parcels of the post-industrial area

6710/300, 1791/304, 1794/304, 779/304, 1870/304, 1866/304, 785/304, 1586/304, 1587/303, 1589/304, 2651/304, 1792/303, 1795/303, 778/303, 1869/303, 1865/303, 784/303, 1567/303, 1793/300, 1796/300, 2370/300, 1868/300, 1864/300, 783/300, 2371/300, 1867/300, 1863/300, 1588/300, 1591/300, 2652/300

Tab. 7.6 Structure of ownership

Form of ownership	Share in proprietorship (in surface area percentage)
Treasury	35%
Local government unit (commune, district or province)	65%
State or local government legal persons	0%
Other legal persons	0%
Natural persons	0%

Tab. 7.7 Is the legal status of the area regulated?

Yes	No	No information

Tab. 7.8 Status of reclamation activities (choose one option)

Planned (approved for implementation)		Included in plans (intended for implementation)	
Completed	In progress	None	Other

Tab. 7.9 Immediate intervention required

Yes	No

Tab. 7.10 Utilities supply (networks in the area)

Type	Yes/No	Type	Yes/No
Electrical energy	No	Rain water sewer system	No
Potable water	No	Gas	No
Industrial water	No	Central heating	No
Sanitary sewage system	No	Telecommunications system	No
Combined sewer system	No	Other (what)	No

Tab. 7.11 Local road and rail infrastructure

Road and rail facilities	No. of road/railway	Distance from the area
The nearest existing local, regional or district road	DK 78	10 m
The nearest existing regional, district road – planned or under construction	-	-
The nearest regional or local railway	Railway no. 158	30 m
The nearest regional, local railway station	Rybnik Rymer	300 m

Tab. 7.12 Existence of development

Developed	Undeveloped	No information

Tab. 7.13 Local air pollution emission sources

Emission source neighbourhood	Yes/No
The area is adjacent to a sewage treatment plant, distance of less than 500m	No
The area is adjacent to point air pollution emission source, distance of less than 500m	No
Sewage treatment plant in the area	No
Point air pollution emission source in the area	No

Tab. 7.14 General description of buildings (name, cubature, initial and current form of occupancy, property)

No development

Tab. 7.15 Local transmission lines in the vicinity of the area

Type of infrastructure	Distance from the area
Sanitary sewage collector	100 m
Medium-voltage power line	In the area
Low-voltage power Line	50 m
Medium-pressure gas pipeline	400 m
Low-pressure gas pipeline	-

Tab. 7.16 Inactive waste landfills

Facility	Distance	Remarks on arduousnes
Inactive municipal landfill site	-	-
Inactive industrial landfill site	1500 m	
Mine waters discharge site	100 m	

Tab. 7.17 General internal evaluation of the transport network

Type	General description (degree of development, technical condition)
Road network and car parks	-
Rail infrastructure	-
Other (walking paths, cycle lanes, horse etc.)	-

Tab. 7.18 General types of current area use

Production and service of production	Yes/No	Production and service of production	Yes/No
Services	No	Open waters	No
Housing	No	Agriculture	No
Communication and transport	No	Unused area	No
Recreation in the open air	No	Other (specify)	No
Cultivated green areas or environment protection			Yes

Tab. 7.19 Document specifying the directions of future area development (tick)

Local area development plan	Yes	Land use and development directions plan	No

Tab. 7.20 In terms of service (basic function – „B", complementary function – „x")

Name type of service	B/x/-	Name type of service	B/x/-
Service development	B	Waste management	-
Gas engineering	x	Power engineering	-
Areas with facilities over 2000m^2	x	Telecommunications	-
District heating	x	Sewage system	-
Other (specify)	-	Water distribution systems	-

Tab. 7.21 Activity which contributed to degradation

Name activity	Yes/No	Name activity	Yes/No
Power engineering	No	Industrial waste dumping	No
Metal industry	No	Municipal waste management	Yes
Chemical industry	Yes	Sewage treatment	No
Coke-making industry	No	Cement factory	Yes
Ferrous metallurgy	Yes	Transportation activity	Yes
Non-ferrous metallurgy	No	Underground coal mining	No
Mechanical industry	No	Opencast mining	No
Construction industry	No	Underground ore mining	No
Paper industry	Yes	Aggregate extraction	No
Textile industry	No	Sand extraction	No
Wood industry	No	Rock mining	No
Food processing	No	Peat exploitation	No
Other activity (specify)	No	Other activity (specify)	No

Tab. 7.22 Presence of waste in the area

Type of waste (classification according to the waste law)	Present	Not present	No information available
Hazardous		x	
Municipal	x		
Other than hazardous	x		
Neutral		x	
Additional information about the type and amount of waste			

Tab. 7.23 Is the area contaminated?

Yes	No	No information

Tab. 7.24 What kind of substances cause contamination of the area? Caution! Define one type of predominant substance or more, if it is important.

Type of contaminating substance	Yes/No	No information available (but contamination is highly probable)
Metals	Yes	
Organic compounds (other than pesticides)	No	
Emission of gases	No	
Pesticides	No	
Other (specify)	Yes	

Tab. 7.25 Observed or expected radiological hazard

Yes	No	No data available

Tab. 7.26 Is the analysed area a part of mining area?

Yes	No

Tab. 7.25 Observed or suspected negative impact of contamination present in the area (observed – „O", suspected – „S", unlikely – „U", no information available – „No")

Threatened facility	O/S/U/No	Threatened facility	O/S/U/No
Human health	U	Buildings	U
Potable water resources	U	Nature conservation structures	U
Other water resources	S	Land in the vicinity of the area	U
Terrestrial ecosystem	U	Other (specify)	No

Tab. 7.28 Is the analysed area a part of post-mining area?

Yes	No

Tab. 7.29 Existing area deformations related to mining activity

Continuous	Non-continuous	Not found	No information

Tab. 7.30 Expected area deformations related to mining activity

Yes	No	No information

Tab. 7.31 Facilities in the local register of monuments in the analysed area

Register, facility number	Description	Is the facility entered in the Register of Silesian Province Monuments or KESA?
-	-	-

Tab. 7.32 Legally protected natural structures in the analysed area

Name of facility	Protection category	Number in the register of Provincial Nature Conservation Officer
-	-	-

Tab. 7.33 Additional important information about the area (e.g. occurrence of downslopes over 15%, water holes, shallow underground voids, particularly large parking areas or storage yards, garages, vast scrubland, etc.)

-

Tab. 7.34 Suggested preferences of area development directions in the light of its genesis – scoring

Type of works	Yes/No	Type of works	Yes/No
Production and production service areas	No	Communication and transport areas	No
Service development areas	Yes	Outdoor sport and recreation	No
Residential development	No	Green areas, nature	No

Tab. 7.35 Possibility so multifunctional management (I work-live-rest) in the light of the genesis of the area and its size (only area over 20 ha)

Yes	No

Tab. 7.36 Is natural valuation required in the light of area Genesis?

Yes	No

Tab. 7.37 Is cultural valuation required in the light of area valuation?

Yes	No

Tab. 7.38 Probable need for reclamation due to area genesis (tick if such a need exists and specify the type of works)

Type of works	Yes/No	Type of works	Yes/No
Production and production service areas	No	Communication and transport areas	No
Service development areas	Yes	Outdoor sport and recreation	No
Housing development	No	Green areas, nature	No

Tab. 7.39 Category of mining or post-mining area

Mining area (0, I, II, III, IV, V, not applicable)	Post-mining area (A, B1, B2, B3, C, not applicable)
not applicable	A

Tab. 7.40 GZWP (Central Groundwater Reservoir) and groundwater intake)

Criterion	Yes/No
Existence of groundwater intake	No
Location in a groundwater intake protection zone	No
Location within GZWP	No

Tab. 7.41 Exposure to flooding and partial inundation

Criterion	Yes/No
Location within a hydro-isohypse of 1m below ground level	No
Location within the reach of emergency wave	No
Location within the reach of one-hundred year water	No
Periodically flooded area	No

Tab. 7.42 Forms of Nature protection forms, sanctuaries and ecological corridors

Criterion	Yes/No
Location within a large nature protection form (including NATURE 2000) or ECONET corridor or CORINE sanctuary	No
Existence of an individual nature protection form or CORINE sanctuary	No

Tab. 7.43 Road facilities of supralocal significance

Road facilities	Road number	Distance
The nearest motorway or major road	A1	15 km
The nearest motorway or major road – designed or under construction	-	-
The nearest national Road	78	10 m
The nearest motorway junction	A1 and A4	37 km

Tab. 7.44 Is the area located within a terrain defined as „Environmental resources protection, strengthening of protected areas system and multifunctional development of open areas – preferred economic functions?"

Yes	No

Tab. 7.45 Access to air transport

	Name	Distance
The nearest air port	Katowice Pyrzowice	76 km

Tab. 7.46 Railway facilities of supralocal significance

Railway facilities	Name	Distance
The nearest national railway line	Railway line number 158	30 m
The nearest railway trans-shipment station	Rybnik Towarowy	200 m

Tab. 7.47 Other transport-related facilities of supralocal significance

Facility	Name	Distance
Container terminal		
The nearest river port		
Road border crossing	Chałupki	20 km
Railway border crossing	Chałupki	20 km

Tab. 7.48 Area genesis versus contamination hazard

Due to its genesis, the area belongs to a group of contaminated areas or areas characterised by high probability of contamination	Yes

Tab. 7.49 Area genesis versus health hazard

Due to the area genesis, there is a high potential threat to health of persons staying in it, detailed studies and calculations are recommended	No

CONCLUSIONS

One of the conditions enabling developing an appropriate concept of management of a degraded area is to obtain knowledge about this area through specialist investigations in the legal, ecological, economic as well as social aspect.

The above presented analysis is considerably simplified. A comprehensive area study should among others include a number of specialist investigations determining the substances which contaminate the environment, hazardous substances.

Despite continuous improvement of solutions facilitating the reclamation processes (cluster connections, co-operation networks, information, communication, monitoring platforms, survey studies or environmental audits [7], [8]), data collection (including data generated in the process of co-operation between various level authorities, the enterprise sector and local community related to the area) as well as continuous updating and making this data available is still an issue which has not been completely resolved.

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Abstract: *Economic transformations in Poland in the 1980s among others started the process of liquidation of many mining plants. Areas which until recently were subject to strong influences of mining economy, are now becoming post-mining areas. Degradation of an area, incomplete or scattered information on its legal conditions, its property structure, ecological condition, the existing logistic infrastructure and provision of utilities discourage potential investors from undertaking activities to re-use the area. This article presents an initial analysis of a selected post-mining area, which should make it easier to determine the directions of its future development.*

Key words: *degraded area, post-mining waste landfill, slime separators, re-development*

ANALIZA POGÓRNICZYCH TERENÓW ZDEGRADOWANYCH W CELU PONOWNEGO ZAGOSPODAROWANIA – ANALIZA PRZYPADKU: OSADNIKI MUŁOWE

Streszczenie: *Przeobrażenia gospodarcze w Polsce w latach osiemdziesiątych zapoczątkowały między innymi proces likwidacji wielu zakładów wydobywczych. Tereny, które do niedawna podlegały silnym wpływom gospodarki wydobywczej, stają się terenami pogórniczymi. Zdegradowanie terenu, niepełne lub rozproszone informacje na temat uwarunkowań prawnych terenu, jego struktury własnościowej, stanu ekologicznego, istniejącej infrastruktury logistycznej, uzbrojenia w media, zniechęcają potencjalnych inwestorów do podjęcia działań zmierzających do ponownego wykorzystania terenu. W poniższym artykule przedstawiono wstępną analizę wybranego obszaru pogórniczego, mającą ułatwić formułowanie kierunków jego przyszłego zagospodarowania.*

Słowa kluczowe: *teren zdegradowany, składowisko odpadów pogórniczych, osadniki mułowe, ponowne zagospodarowanie*

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