Smart and Green Mining Regions of EU (REMIX)

Workshop, Peer Reviewand Steering Group Meeting
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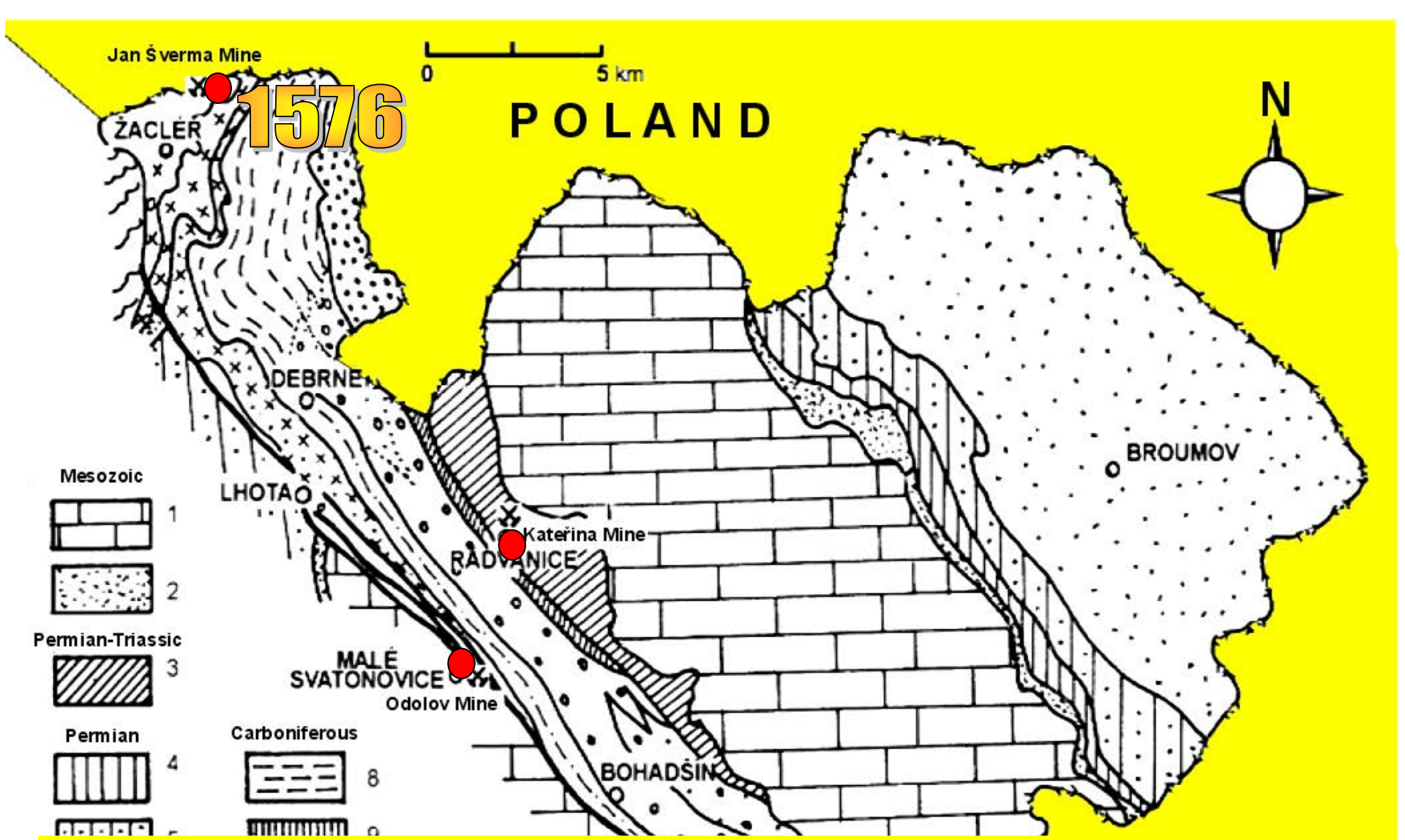
Revitalization of the Allotment of Underground Mine below the Ground and on the Surface – Application to the Jan Šverma Mine in Žacléř, Czech Republic

- ***Z. Adamec*** *Gemec -Union a. s.,*
- ***V. Petroš*** *VSB -Technical University of Ostrava,*
- ***K. Novotný*** *Gemec-Union a. s.,*


Lower Silesian
Coal Basin
Germany
Poland
Prague
Czech Republic
Ostrava
Brno
Vienna
Slovakia
Austria
Massif Central
rpathian
Massif
Pyrenees



1992 -1994 - in the Czech part of the Lower Silesian Basin mining activities were stopped and the mines are under the process of liquidation

The mining claim occupies the area of 9, 25 km^2
The carboniferous strata contains altogether 54 seams
The thickness of the seams reached 0.4 - 4 m
The dips of strata are mainly 20 to 40^o, but in many places is steep dip

The average surface altitude is about 600 m above sea level

Climatic conditions: temperature changes from -30°C to +30°C, about +7° C in annual average

The depth of freezing is about 0.8 m

During closure of Jan Šverma Mine were solved these main tasks:

- to avoid the contamination of mine water all equipment with oils and hydraulic fillings were removed,
- for elimination of sadden surface subsidence it was decided to fulfil all free mining workings with stowing material produced on the basis of power and thermal plant ashes and flotation tailings,
- long-term supervision of hydrogeological situation,
- due to the potential risk of self ignition in the future opencast mining of seam outcrops was used,
- many very old mining openings from the surface have to be found and fulfilled by hydraulic stowing material

In the course of environmentally sound decommissioning, in the years 1993-1994, the following items were removed from the mine:

- 150 tons of machines and equipment with oil and hydraulic fillings,
- 800 m^3 of contaminated rocks,
- 650 litres of oils and hydraulic fillings of mining machines.

As hydraulic stowing material, wastes such as secondary raw materials were used. Secondary raw materials were evaluated by the following three basic criteria:

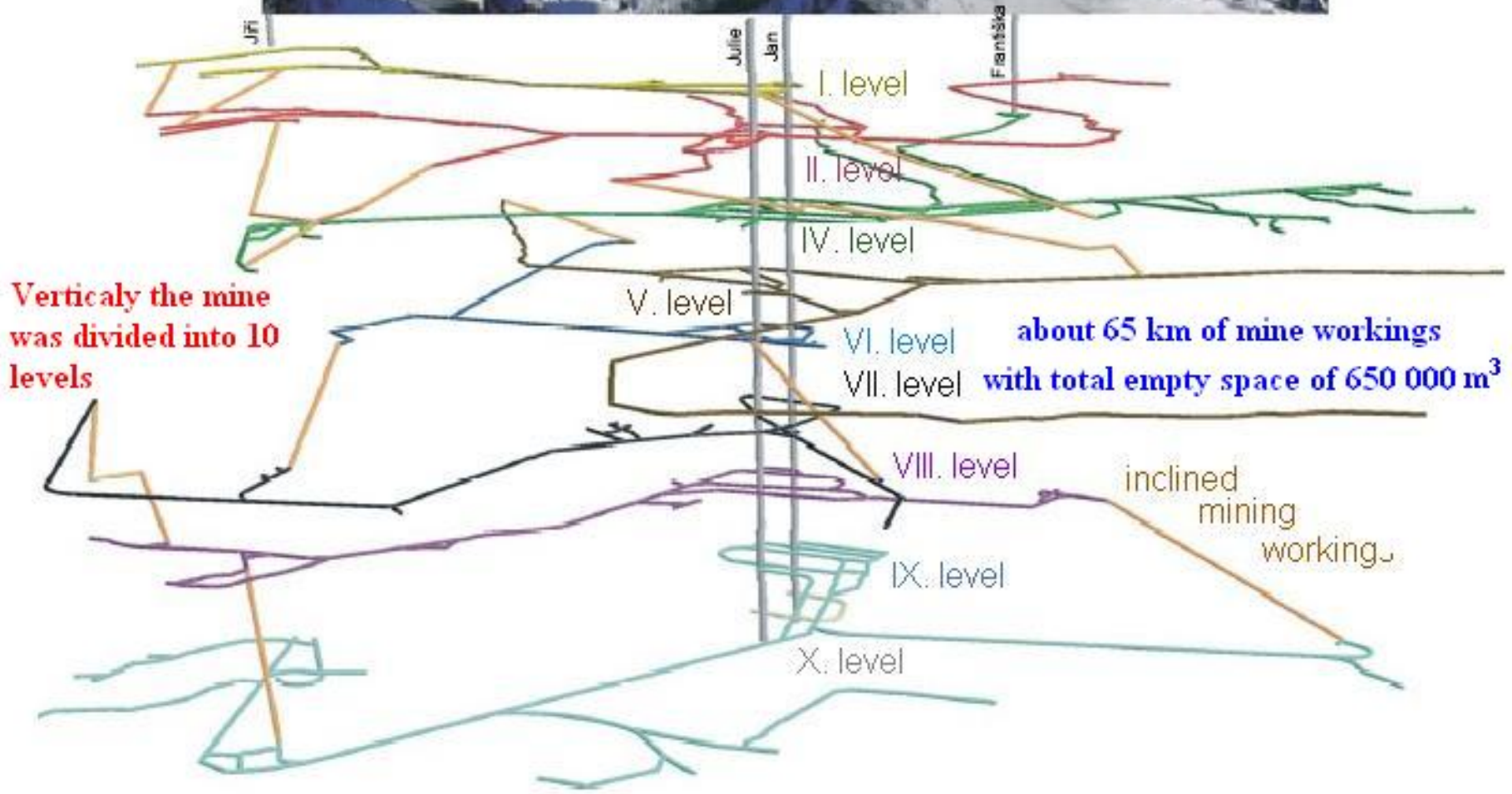
- aqueous leachate,
- ecotoxicological test,
- radioactivity.

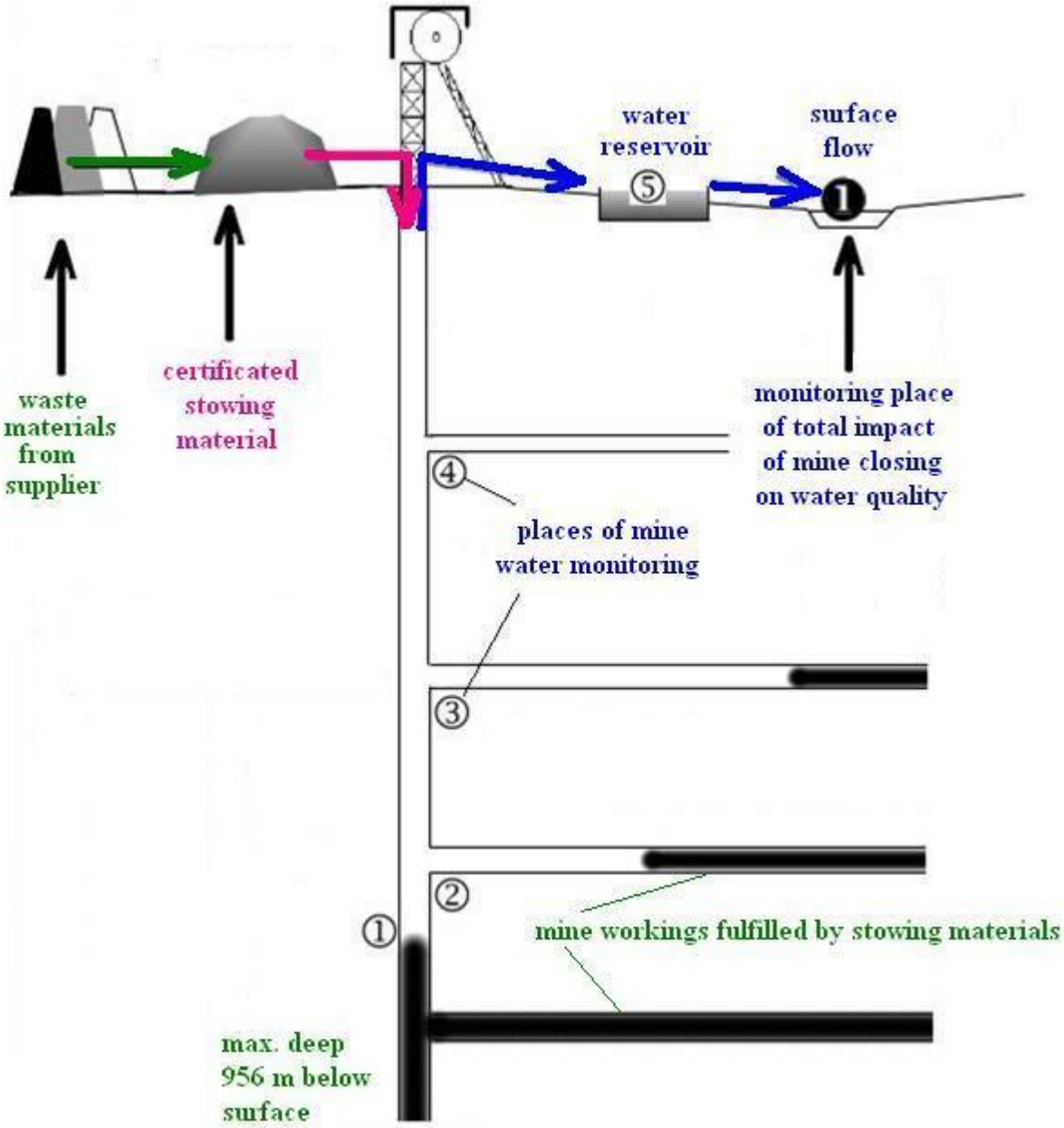
Utilization of secondary raw materials was negotiated by the environmental authorities and hygiene services.

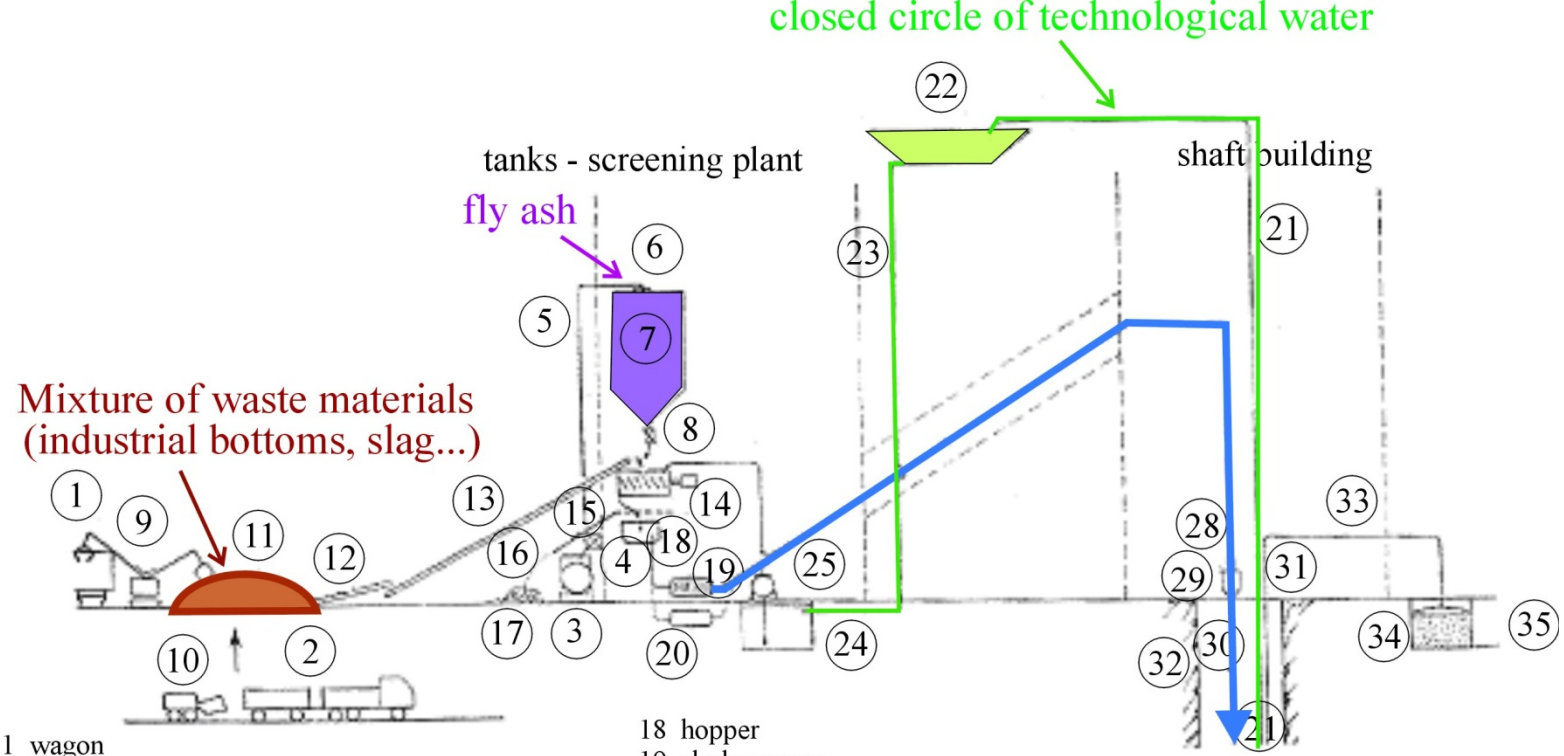
Further explored properties of stowing materials:

- ratio of ashes and flotation tailings,
- minimal water content to ensure hydraulic transport,
- solidification, compressibility, bearing capacity, parkability and chemical composition.

Compositions of secondary raw materials were patented.

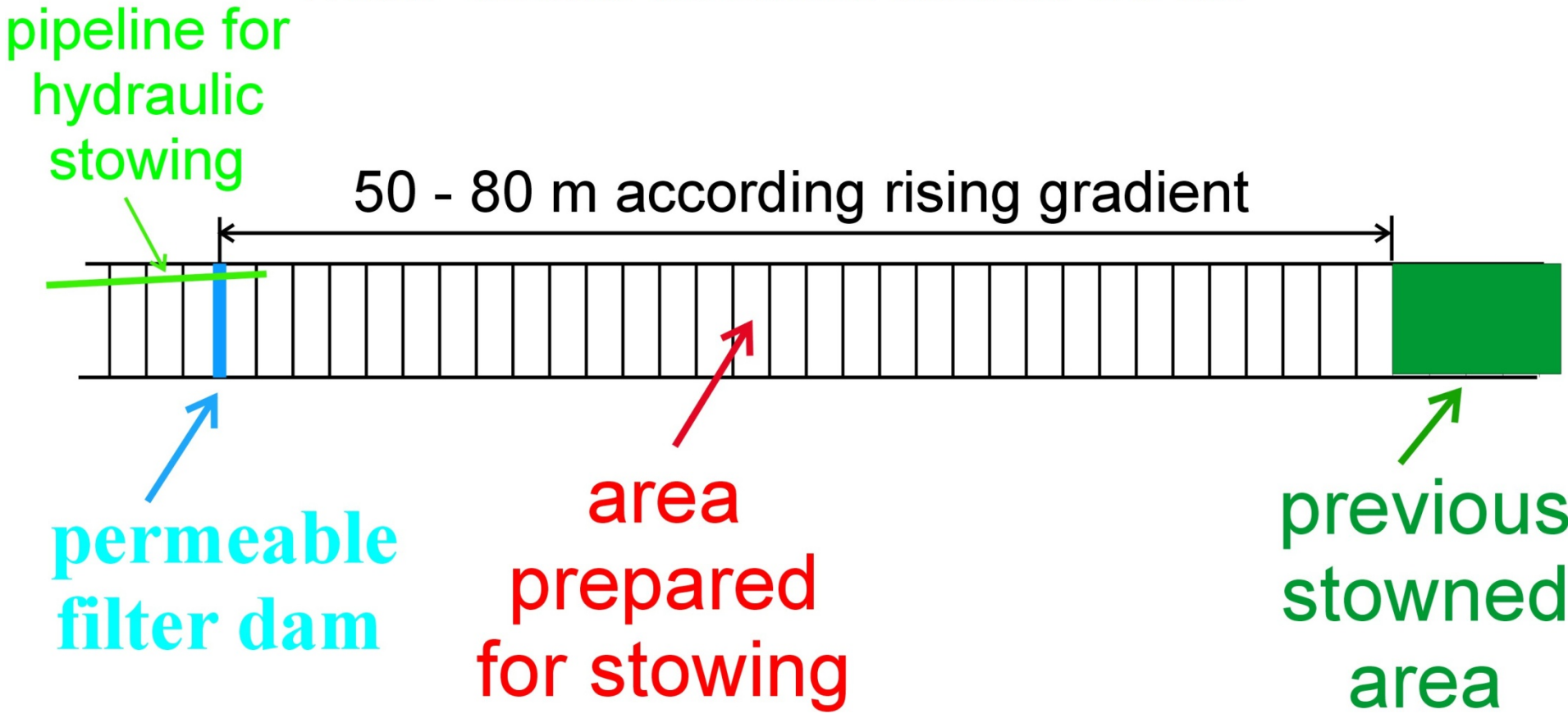

Jiří
Julie
Jan
Františka
I. level
II. level
IV. level
V. level
VI. level
VII. level
VIII. level
IX. level
X. level
Vertically the mine was divided into 10 levels
about 65 km of mine workings with total empty space of 650 000 m3
inclined mining workings


water reservoir
⑤
surface flow
1
waste materials from supplier
certificated stowing material
monitoring place of total impact of mine closing on water quality
④
places of mine water monitoring
③
②
①
mine workings fulfilled by stowing materials
max. deep 956 m below surface

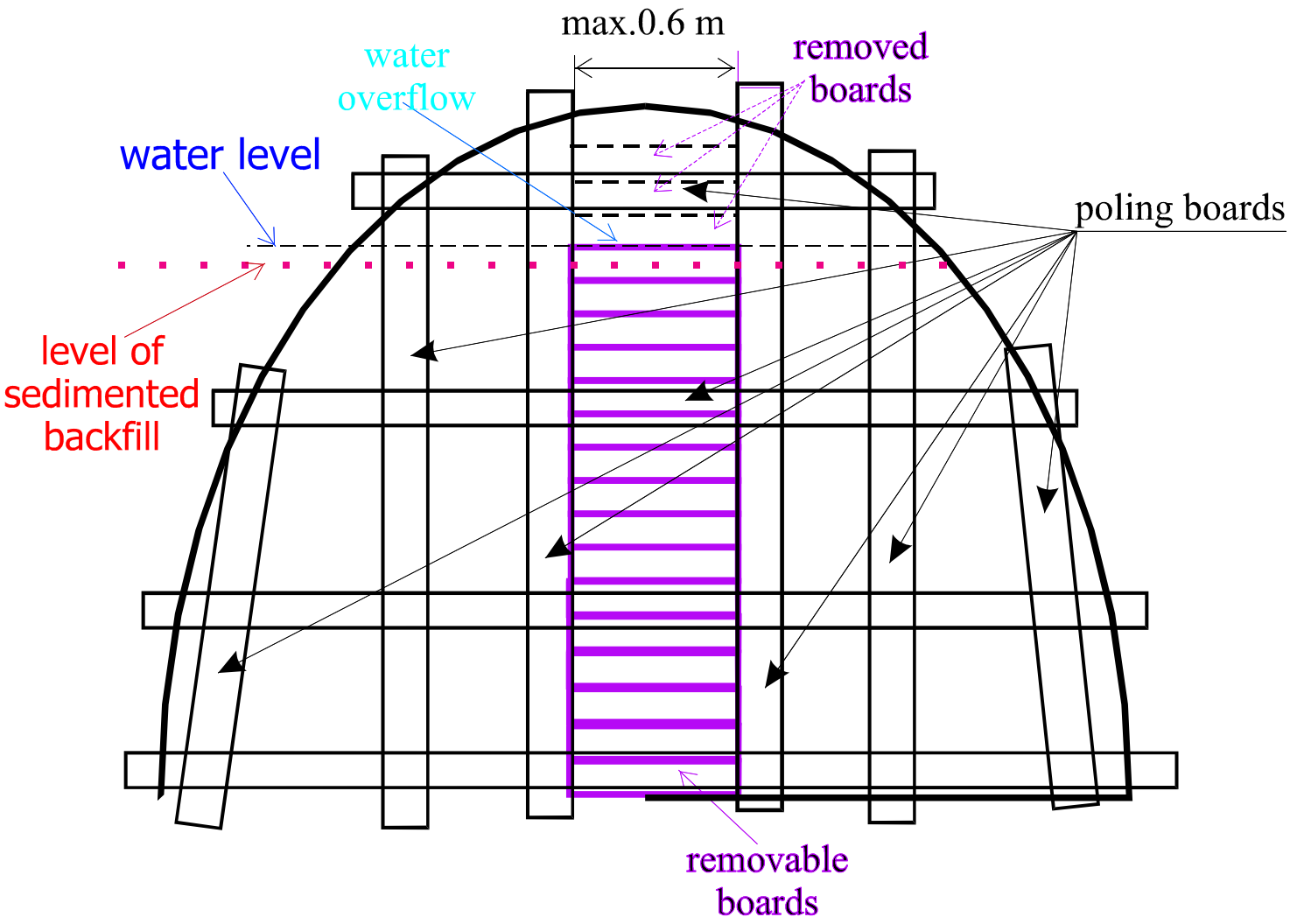


1 wagon
2 automatic set
3 tank car
4 pressure limiting station
5 pipe with pneumatic transport
6 filter
7 dry dust bunker
8 discharge valve of bunker (feed screw)
9 loader IH 411
10 loader UNC
11 ready-to-use stock of waste materials
12 drag conveyer
13 belt conveyer
14 mixer for mixture preparation
15 vibration screen
16 chute
17 storage pile of sieve oversize
18 hopper
19 sludge pump
20 reserve sludge pump
21 technological water lifting pipes
22 compensating water tank
23 gravity pipes into ready-to-use reservoir
24 ready-to-use reservoir
25 former shaft loop haulage system
28 depressiometer sensor of clogged flushing pipes
29 compensating hopper
30 gravity flushing pipes
31 shaft collar
32 shaft
33 mine water lifting pipes
34 wastewater purification plant
35 purified water effluent into a watercourse

Horizontal mine workings method of closure with cross-section about 10 m^2

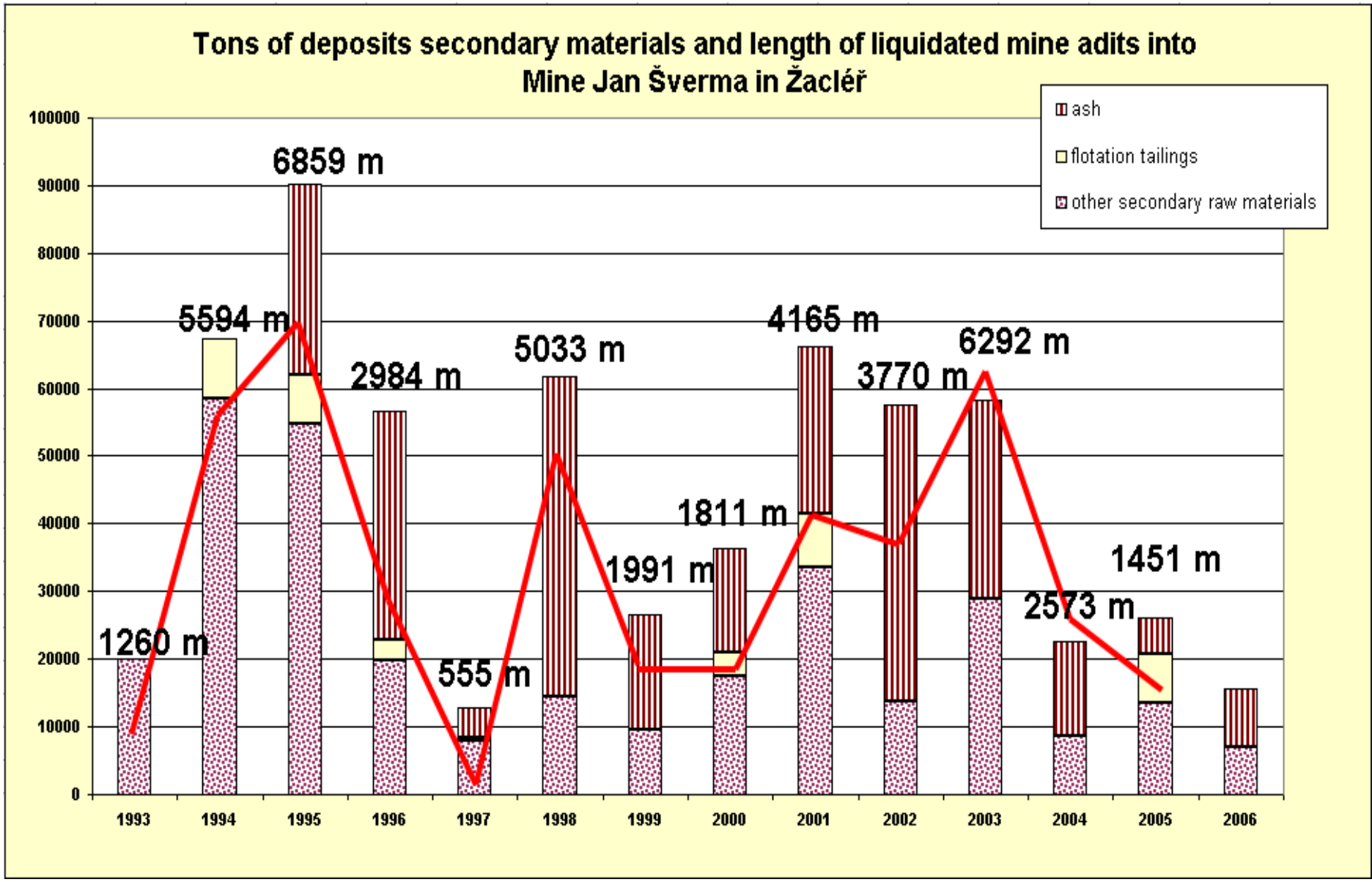


A permeable filter dam construction

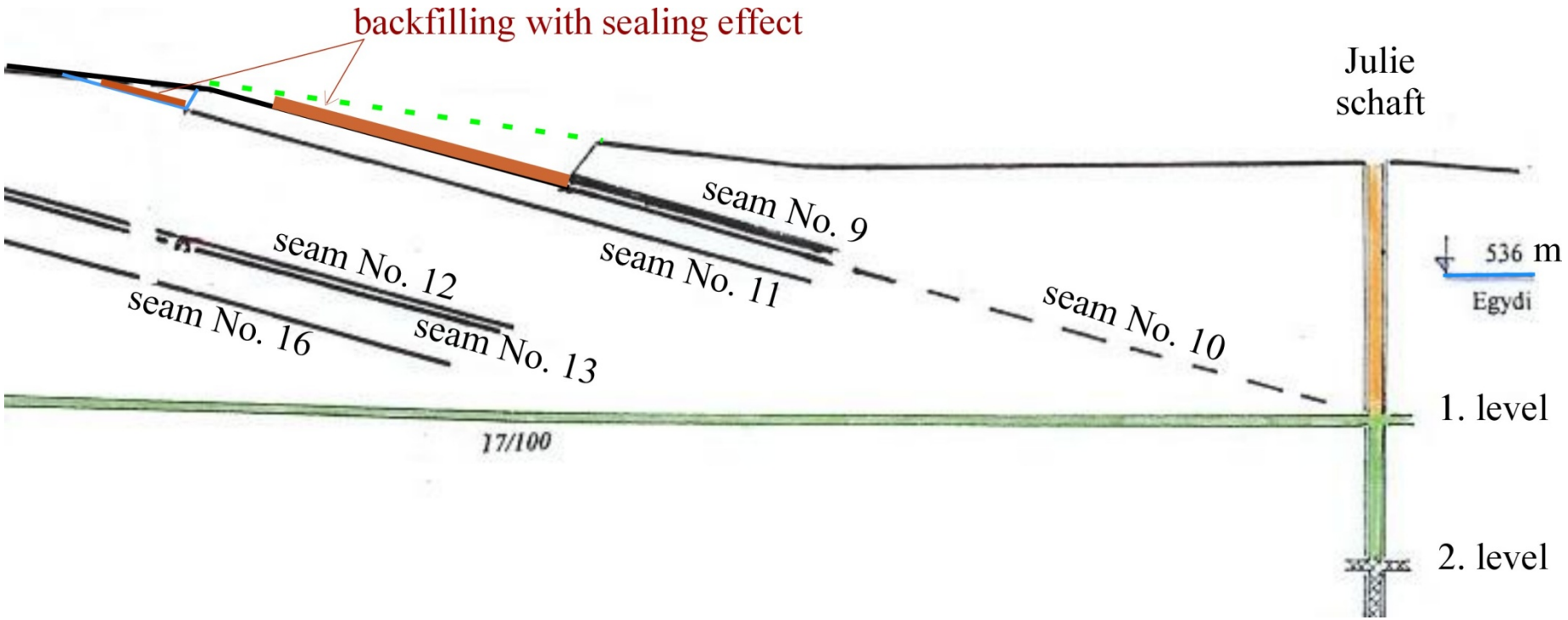


Minimal uniaxial compressive strength of stowing material in horizontal mine workings was 2 MPa.

In shafts and horizontal workings near to the shaft strength of stowing material should be at least 5 MPa.

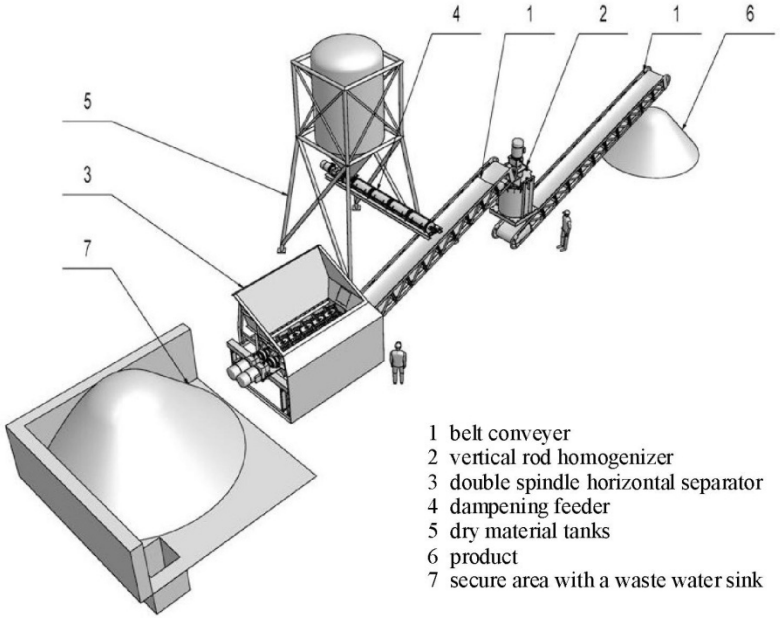

Tons of deposits secondary materials and length of liquidated mine adits into Mine Jan Šverma in Žacléř
ash
flotation tailings
other secondary raw materials
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
1260 m
5594 m
6859 m
2984 m
555 m
5033 m
1991 m
1811 m
4165 m
3770 m
6292 m
2573 m
1451 m
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006

Backfill application to the opencast mining of seam outcrops



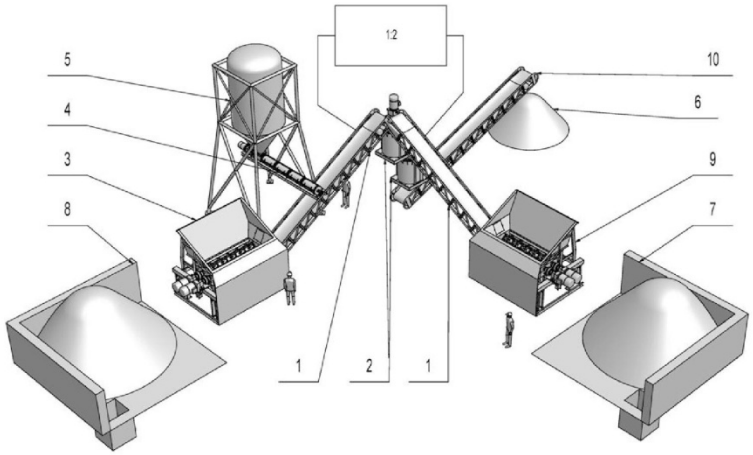
Systems of backfill mixture preparation for opencast mining

A single - line system



1 belt conveyer
2 vertical rod homogenizer
3 double spindle horizontal separator
4 dampening feeder
5 dry material tanks
6 product
7 secure area with a waste water sink

A two - line system



1 conveyer with belt scale
2 vertical rod homogenizer
3 double spindle horizontal separator
4 dampening feeder
5 dry material tanks
6 product
7 area for other material entry
8 secure area with a waste water sink
9 double spindle horizontal separator
10 belt conveyer

The exploitation of the seam was performed by shovel excavators with loading into trucks, overlayers rocks ware breaked up by blasting. Coal, rocks and backfilling materials ware transported by trucks.

Opencast mining was finished by reclamation. Before mining the vegetable soil was stripped and then was returned.

Different plants were sawed to receive the best results

Off-road bike truck was build on waste pile

In the Zacler mining claim, hundreds years ago, **several tens** of development workings were driven from the surface. Sudden subsidence of the surface to these empty workings can be dangerous

The abandoned mine working is marked according Czech mining law

- Several old mine workings were opened during surface mining of seam outcrops. These workings were fulfilled by stowing materials.
- The situation in the closure of old mine workings between the surface and the 1st level of the mine is a long-term issue and will be solved during next several years, supposedly up to 2020.
- The closure of Mine Sverma is finished by reclamation of waste pile and industrial areas with buildings. One part serves as mine museum, but the main part is used for sport and recreation purposes.

The biggest problem after closing of underground mines is enormous volume of open spaces in rock mass.

Water transports of tiny rock particles to these open spaces create new caverns in the rock mass. These caverns, gradually move as up, as may move horizontally. Then follow collapse of the surface.

For monitoring the dangerous caverns yet there is no reliable method.

In the Czech Republic, there have already been several such collapses, for example.:

- **Jáchymov, 1981 — two collapses occur: gas station and 2 months later sudden collapse of the road intersection: Náměstí Republiky – Boženy Němcové**
- **Příbram, 1962 – a cultural house and kitchen of prison. Fortunately, in the night, there were only 2 people, which dead. Size 50x60 m crater created with volume 30 000 m^3 as min.;**
- **Ostrava, playground Bazaly, 1998 – the crater with volume less than the previous was created;**
- **Mine Doubrava, 1998 – a collapse of the upper part of shaft, shaft building and head frame. The crater measuring about 63 × 53 m with volume approximately 65 200 m^3 was created.**

The risk of sudden collapse in the broader area of closed underground mines are long-term – may take several centuries.

The only known method that eliminates the danger of sudden collapse is fulfill mining spaces, how it was implemented in the Mine Jan Šverma Žacléř.

Secondary materials are appropriate to use for purpose of filling material. Unfortunately, in the Czech Republic there are a number of legislative barriers in this use.

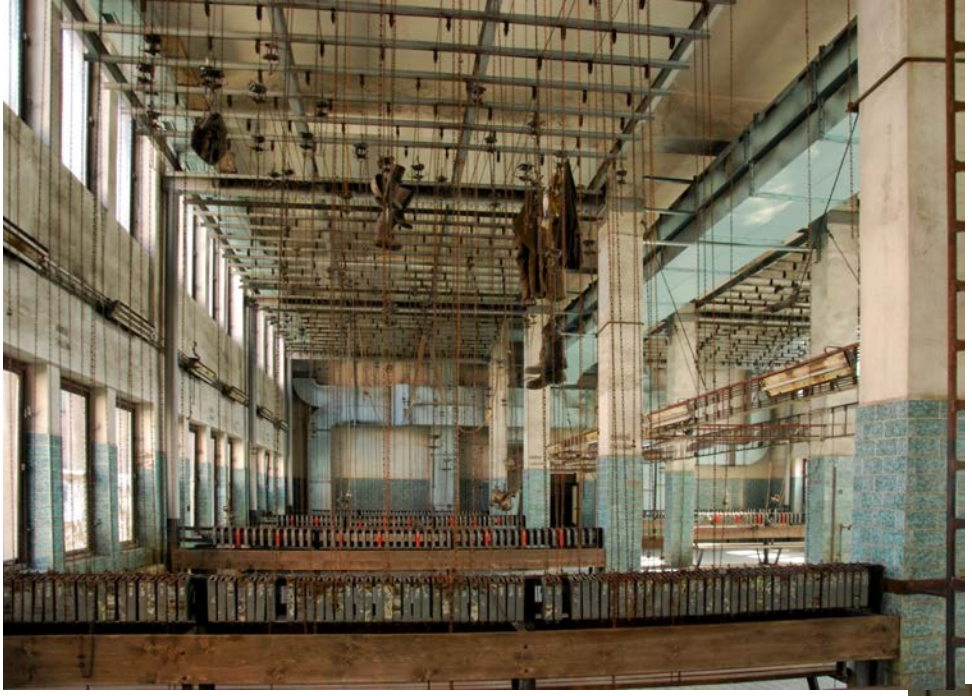
Summary

The chosen method of mine closure has confirmed the correctness of an engineering solution – the filling of empty mine spaces with a hydraulic, incompressible, self-hardening backfill. During more than 24 years of closure operations, the advantages of this method have been proved, namely:

- it was approved, that no harmful substances from stowing material did occurred in the mine water outflow,
- Elimination of occupational hygiene and safety risks,
- The mitigation of dangerous surface subsidence,
- Putting an end to the non-controlled emissions of mine gases,
- Prevention of potential self ignition of coal seams near the surface,
- Protection and a sensitive approach to ecology, environment and so on.

Mine scansion in Žacléř was created from liquidated Mine Jan Šverma in the year 2012

- The most old remembrance of underground coal mining in Czech Republic – first written record about Žacléř region mining is from the year 1570.



Changing room of miners

Endgine room, shaft building, headframe of Jan shaft

Shaft building, headframe, fan and endgine room of Julie shaft,

From the year 2011 is collaboration with Polish partner – Kowary: It was implemented common Czech – Poland project

„Opening of Mine Bohumír and mine scansion Kowary to the public “

From the year 2016 is collaboration with Stara Kopalnia Walbrzych and Nowa Ruda

It is prepared common Czech – Poland project:

Mining remembrance and traditions in Euroregion Glacensis

Thank you for your attention