CENTRAL MINING INSTITUTE

GIG

New techniques of coal seam panels' pre-drainage - based on GasDrain project experience

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Basic facts:

Realisation time: July 2015 – June 2018

Budget: 3.8 mln €

Partners:

GIG (Poland) – project coordinator,

JSW (Poland)

INIG-PIB (Poland),
RWTH (Germany),
INERIS (France),
Imperial College (UK),
HUNOSA (Spain)

Structure of the project :

WP0: Project Coordination and Reporting (GIG)

WP1: Characterisation of Coal Seams and Surrounding Rocks: Field Site Characterisation (RWTH)

WP2: Development of Borehole Stimulation Technologies for Coal and Rock Formations (GIG)

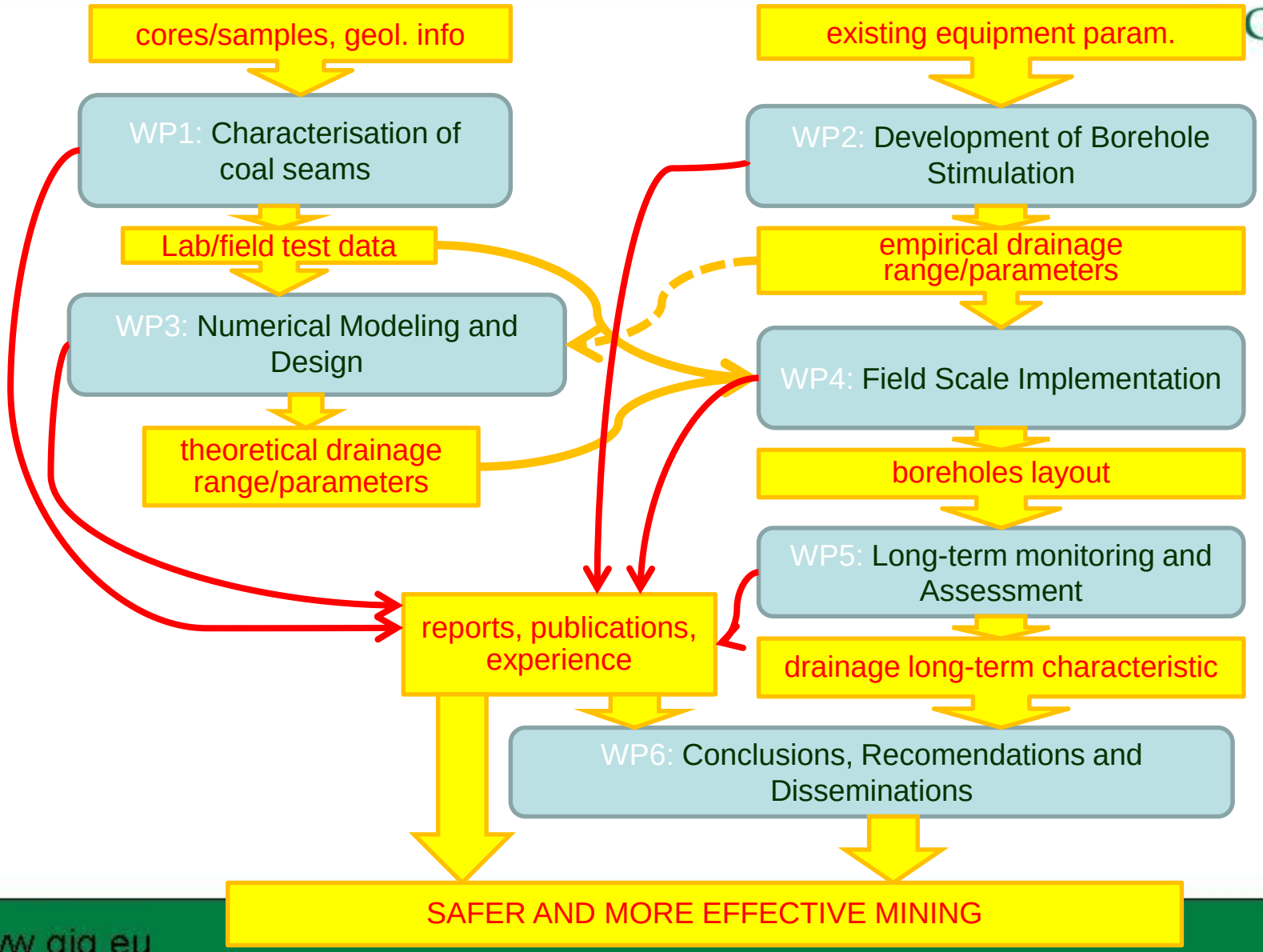
WP3: Numerical Modelling and Design of Field Scale Stimulated Methane Drainage Processes (Imperial College, INIG)

WP4: Field Scale Implementation of Improved Methane Drainage Systems at Mine Sites (JSW SA)

WP5: Long-term Monitoring and Assessment of Improved Methane Drainage Efficiency (GIG)

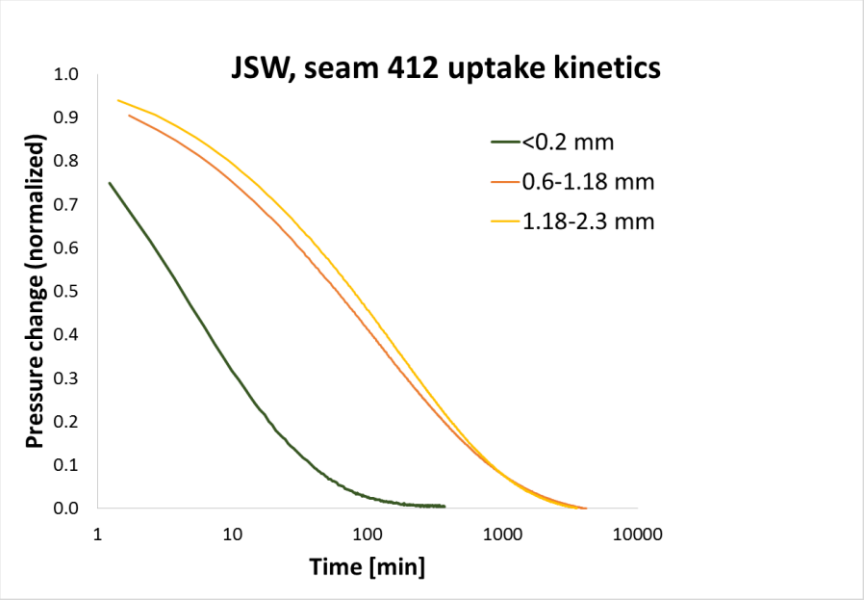
WP6: Conclusions, Recommendations and Dissemination (INERIS)

Imputs and outputs of WPs



Laboratory experiments to define the baseline reservoir properties

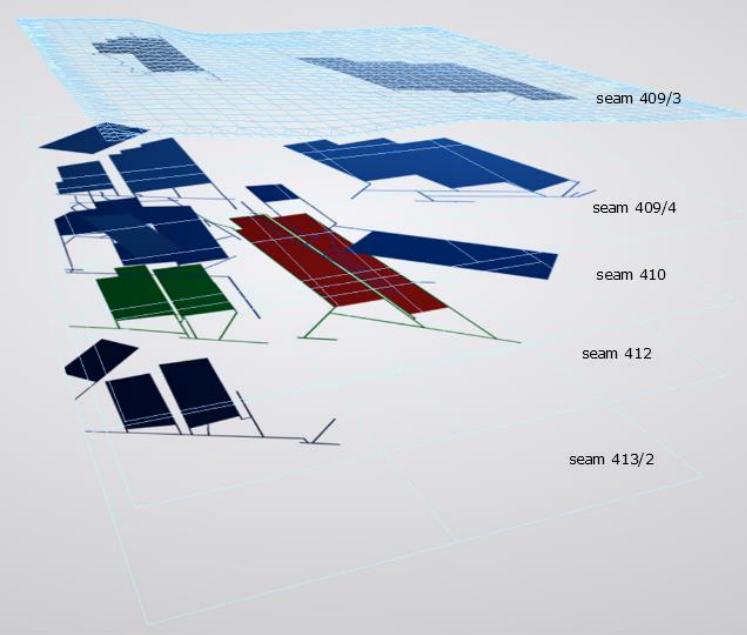
The laboratory experiments aimed at defining the baseline reservoir properties for numerical simulations.
Petrophysical data comprise permeability and porosity.
Physico-chemical data comprise methane sorption isotherms and gas uptake kinetics determined on different particle sizes.
The database is complemented by organic petrological information and petrography of the bedrock samples.



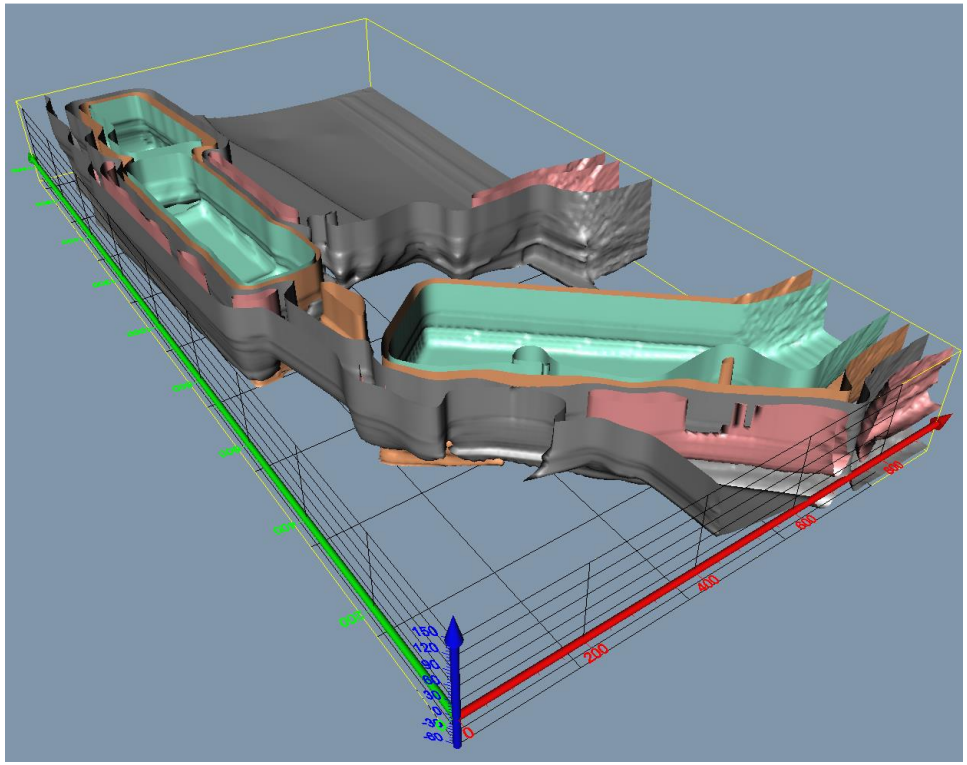
Normalized pressure decline curves for gas uptake by different grain sizes of ZOFIOWKA seam 412 coal (semi-logarithmic plot).

Assessment of the prevailing stress state at different mine layouts

The main objective of this task was to implement both numerical and empirical methods to define the state and magnitude of stresses around working longwall and sublevel caving coal faces at JSW and HUNOSA to assist the initial design of field experiments in the project.



Location of extracted panels in seam 412 and surroundin

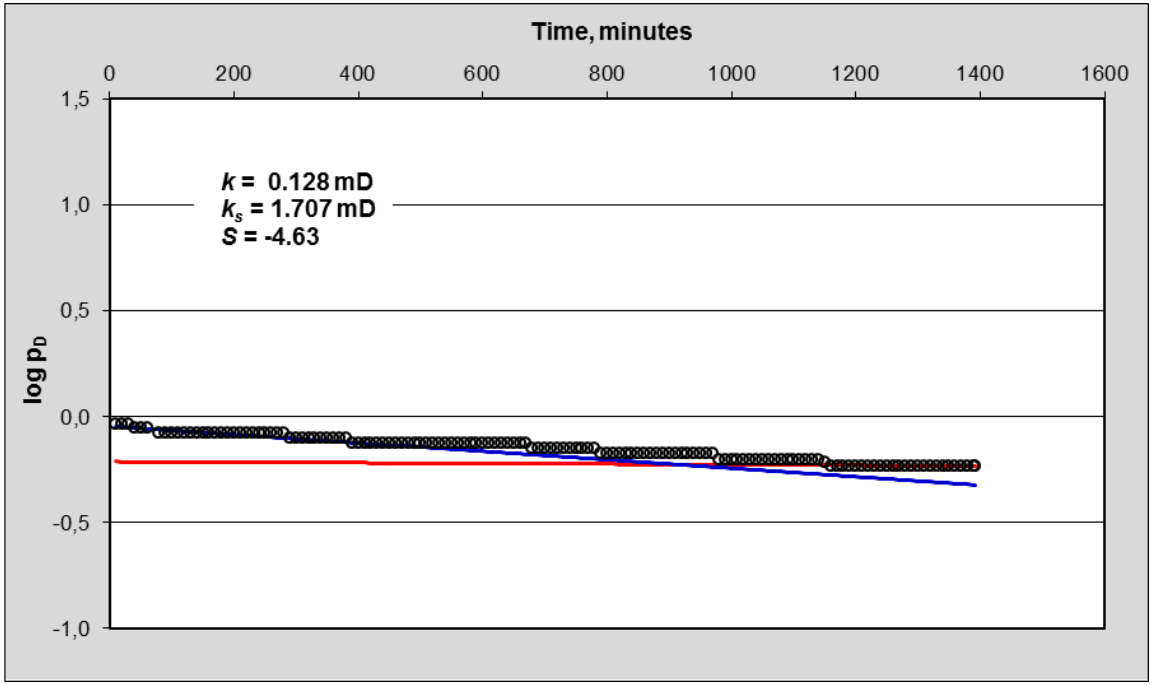


Vertical stress distribution around longwall panel D-2 isosurfaces of 15 MPa (green), 20 MPa (orange), 25 MPa (grey) and 30 MPa (red).

In-situ measurements of coal and surrounding rock properties

This task aimed at drilling and instrumenting a number of boreholes at selected JSW and HUNOSA sites to carry out field experiments to establish the in situ stress and reservoir properties of the coal seams and surrounding rocks that are affected by coal production.

Pressure gauge developed by INiG-PIB



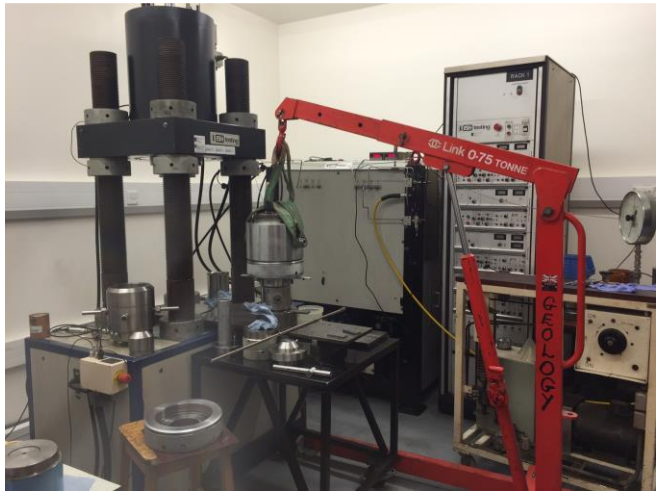
log p_D vs. time curve

Development of the equipment and tools for the stimulation

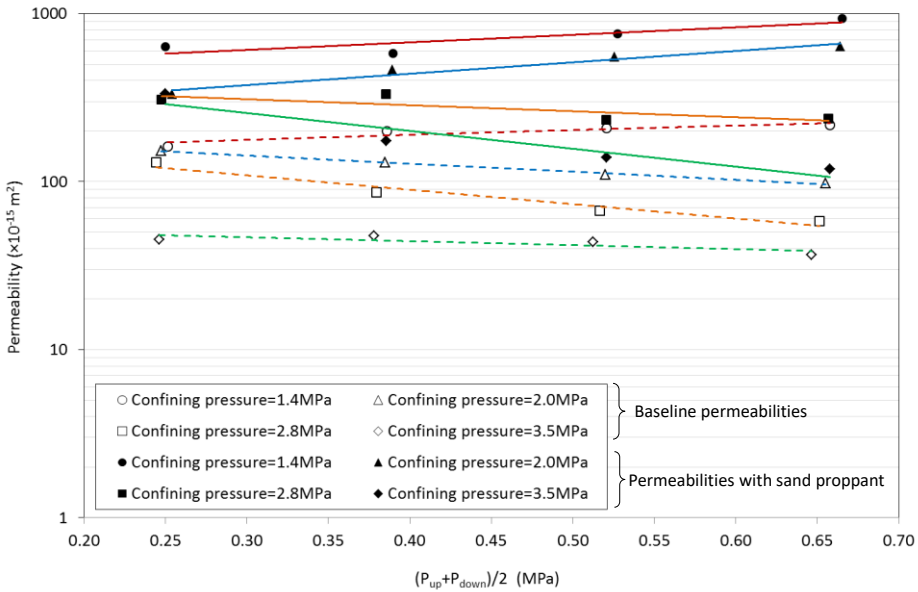
Task 2.1 aimed at the development and construction of the equipment and tools for the hydraulic/mechanical slotting and stimulation by blasting. Due to specific underground coal mine conditions, the equipment had to be designed and manufactured with the required specifications and certifications.

Laboratory investigations into stimulation techniques

Laboratory experiments to characterise fracture growth, frac fluid and proppant behaviour in coal seams



The newly constructed 100mm hollow cylinder testing triaxial cell during pressure testing. Large cell size and weight requires lifting and stabilising tools.

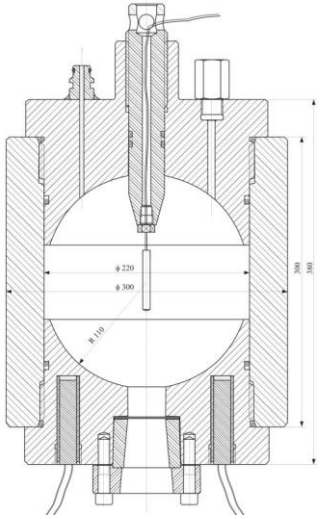


Permeability behaviour of a sand propped fracture in coal comparing baseline (un-propped) and propped N2 permeabilities.

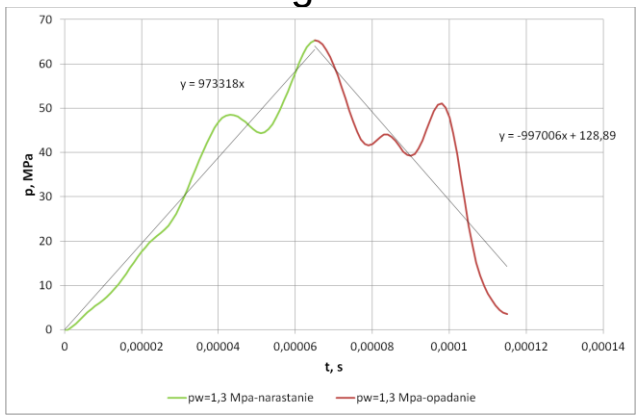
Fractured coal samples treated with 34-40 Mesh sand proppant (left) and InterProp 30/50 ceramic proppant (right).

Laboratory investigations into stimulation techniques

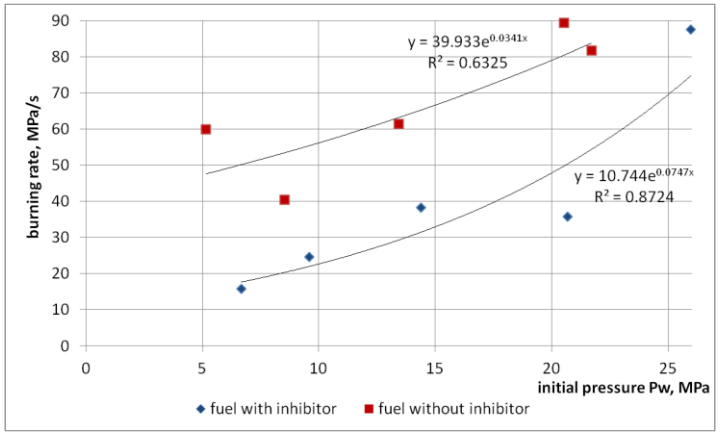
Laboratory experiments to develop new blasting techniques for fracturing coal and rock masses



Test chamber for determining the explosive characteristics.



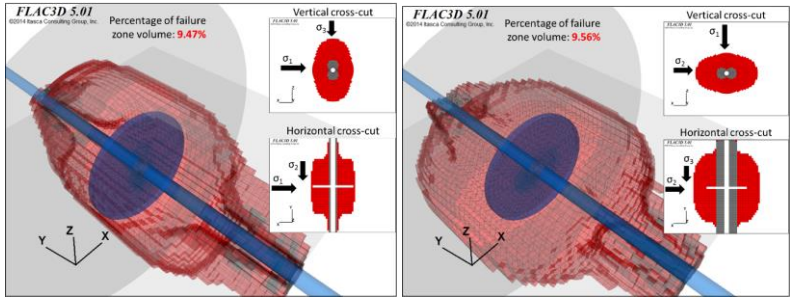
Characteristics of the pressure changes during explosion of the 10 g METANIT SPECJALNY E7H charge (Initial pressure = 1.3 MPa).



Relationship between combustion rate in the intermediate period of the course, and initial pressure for 50% time of pressure increase.

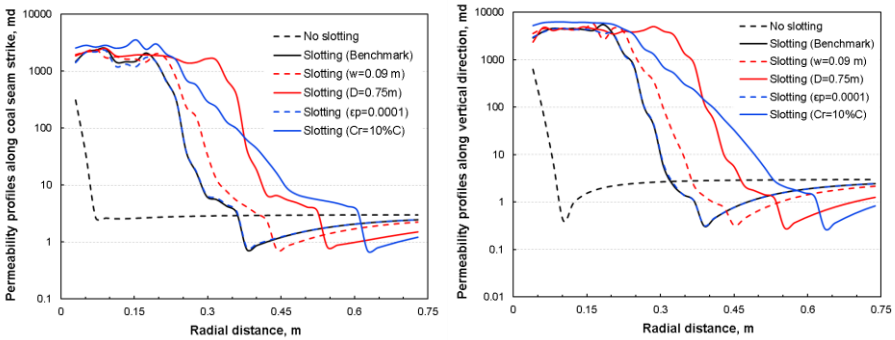
Numerical modeling to assess the performance of stimulated wellbores

Numerical modelling of hydraulic stimulation
Numerical modelling of stress relief and fracturing induced around slotted wellbores
Numerical simulation of cavity completions
Numerical simulation of the use of explosives



(a) **n // σ_2** (b) **n // σ_3**

The effect of varying dip direction and dip angle on failure zone geometry.

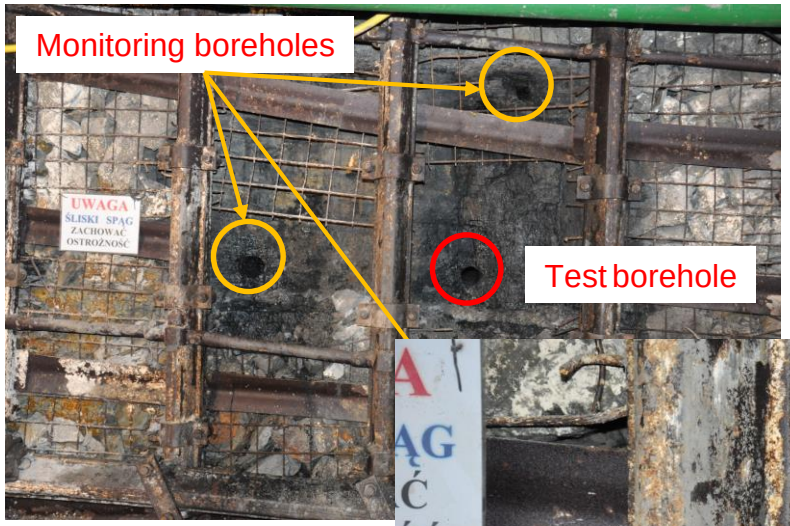


(a) (b)

Permeability profiles along the (a) coal seam strike and (b) vertical direction.

Field testing and development borehole methods

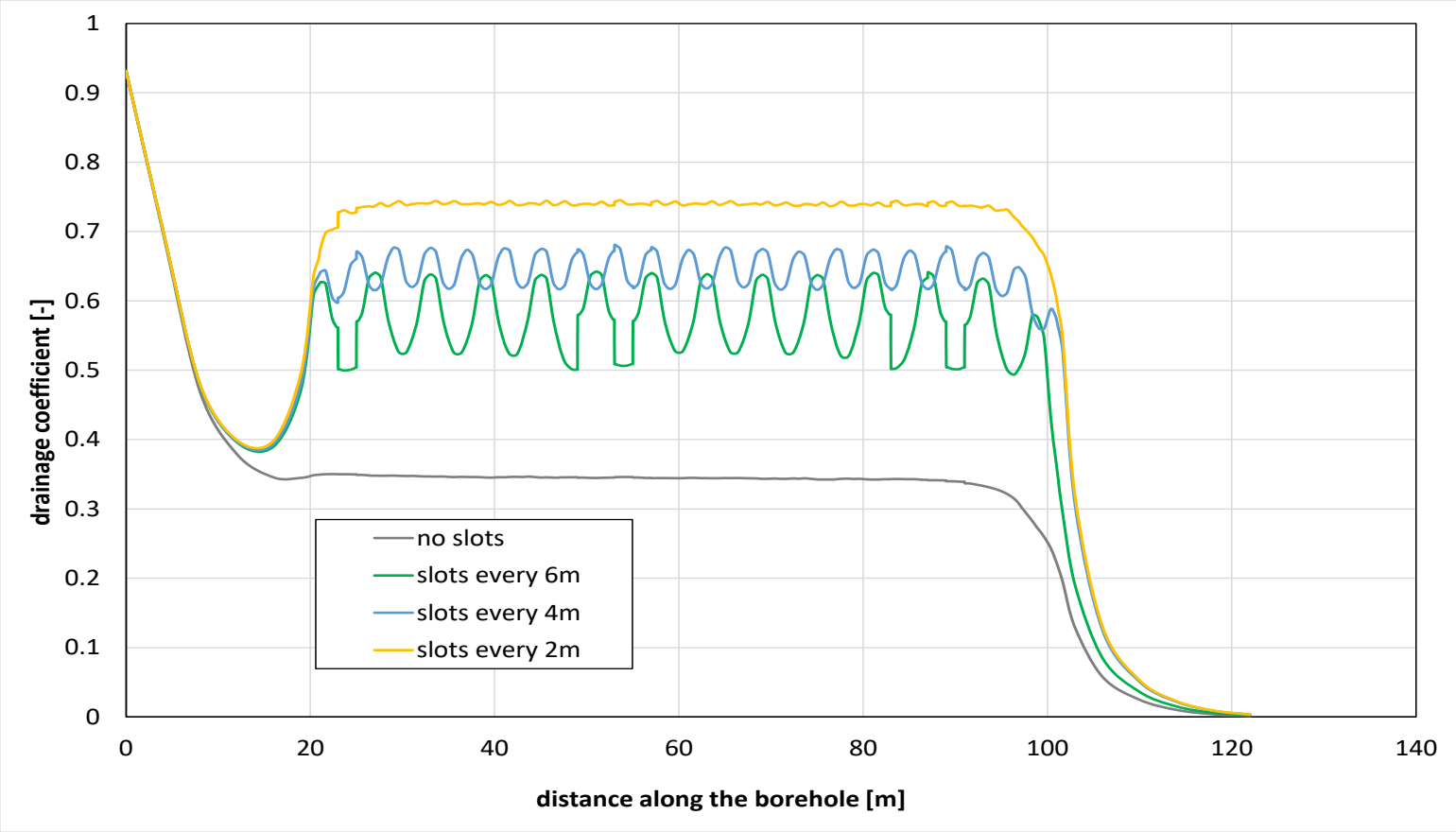
Training of the use of stabilization-turning u



Test boreholes used to inve
hydro slotting

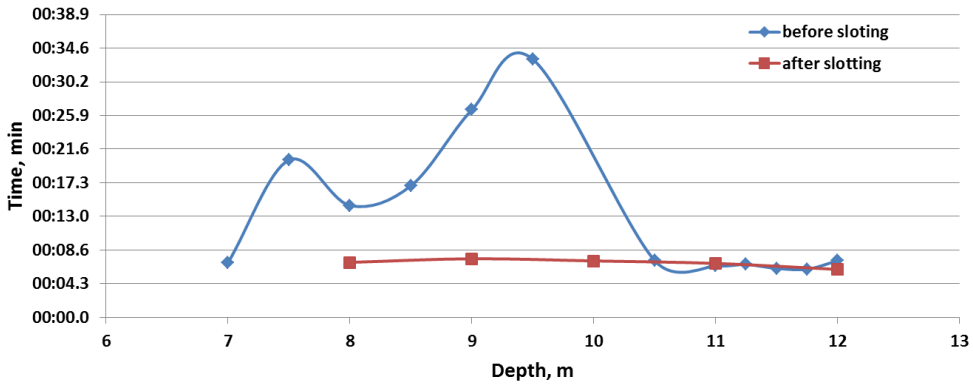
Confirmation of hydro slotting range: water and steam flow from the monitoring borehole.

and gas flow patterns around longwall faces for enhanced methane drainage at JSW mines

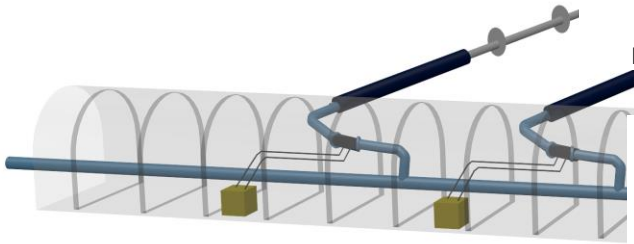


Drainage coefficient in the vertical cross section B-B' parallel to the borehole axis, 107.5 cm from the borehole axis.

Application of large scale stimulated drainage of methane layouts at JSW



Results of aerometric tests in the experimental borehole G180c (2016) before and after slotting

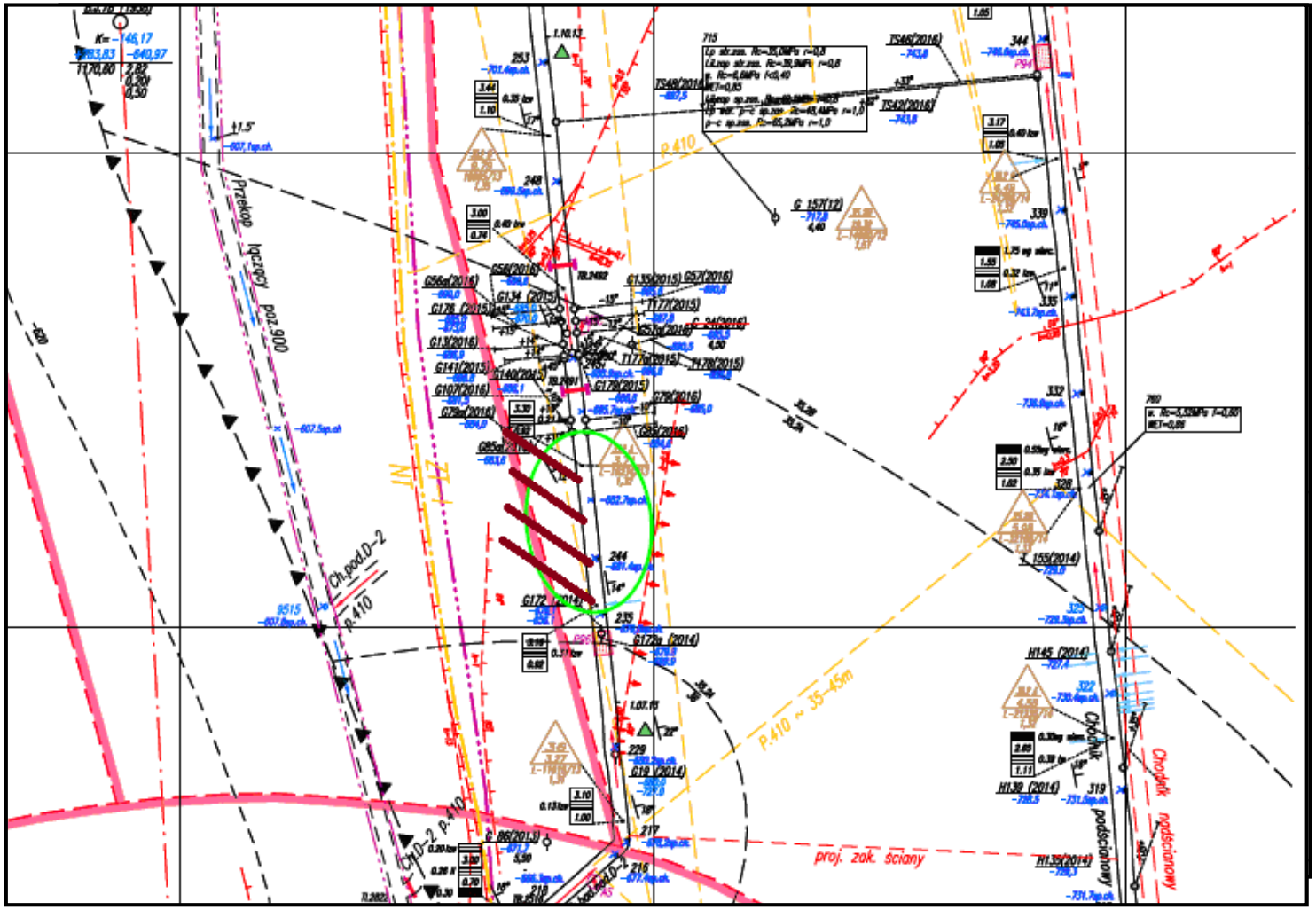


Layout of boreholes wi

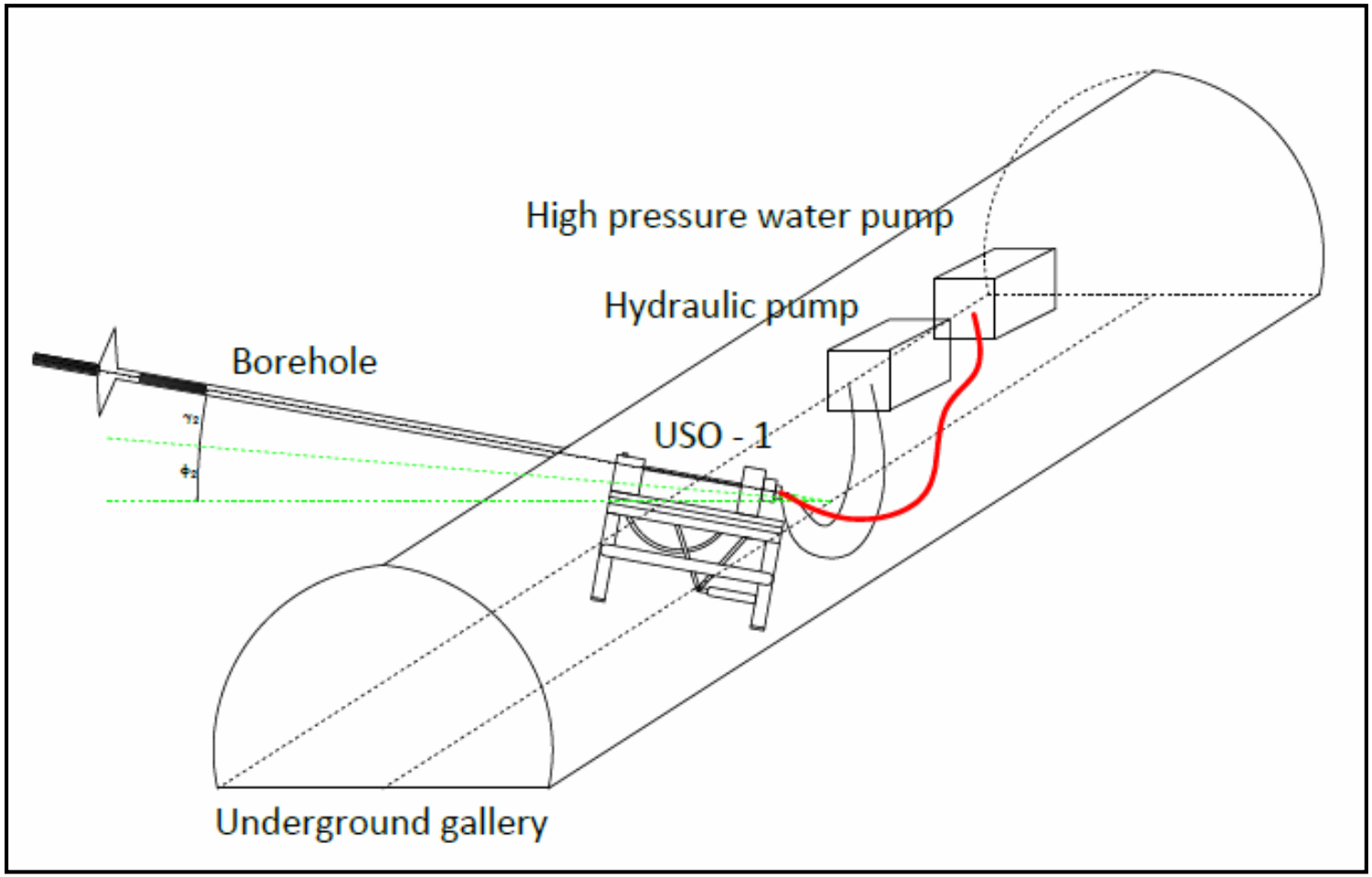
Location of test bore
gate

Exemplary results of methane intake from borehole G180c

Map of the research area



Placement of the machinery underground



Outline of the site test

Outline of the hole in the coal seam

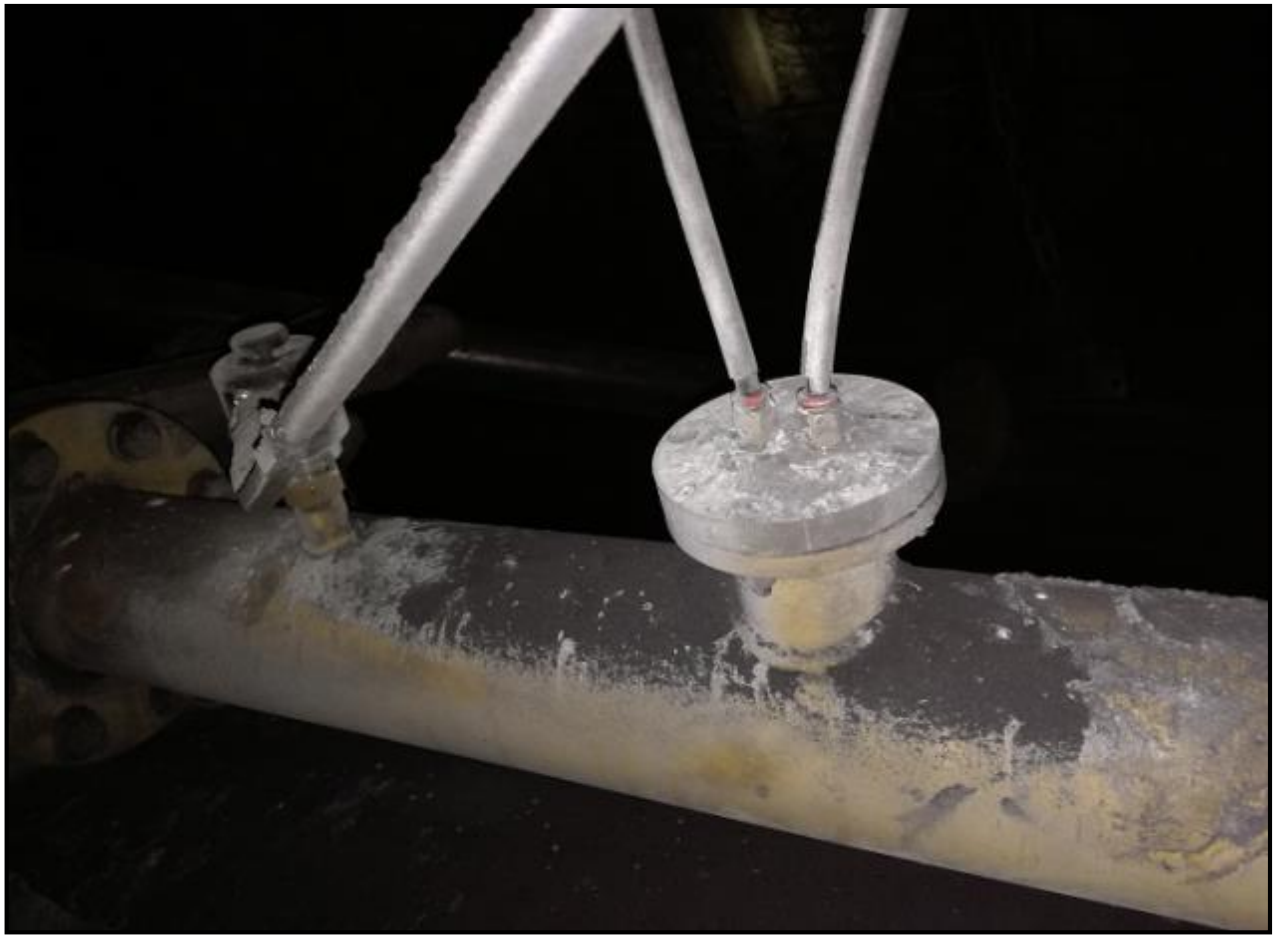
Positioning the USO equipment

Fixing rod elements together

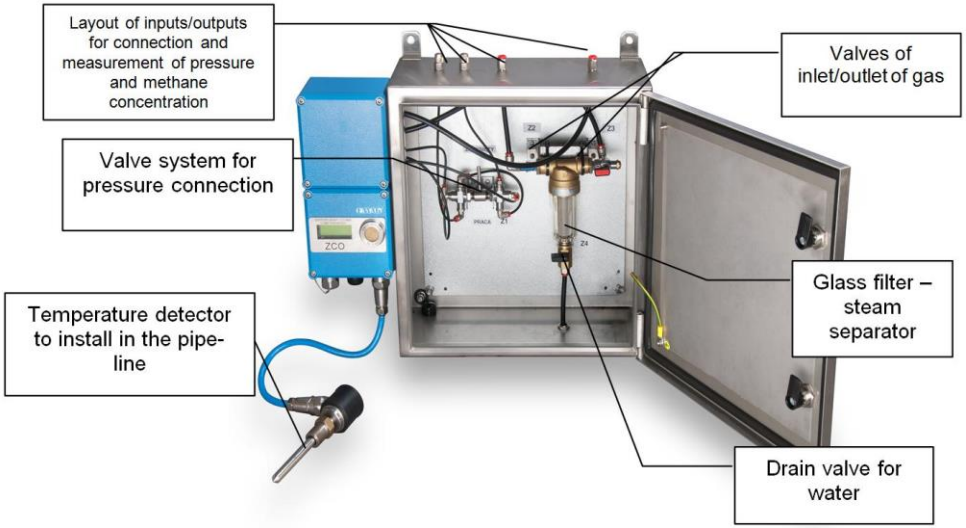
Rod entering into stabilizing pipe

Drainage instalation

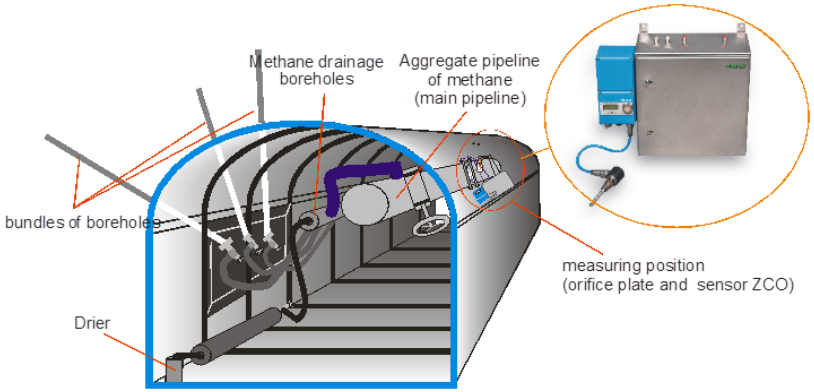
Methane flow sensors on the pipe



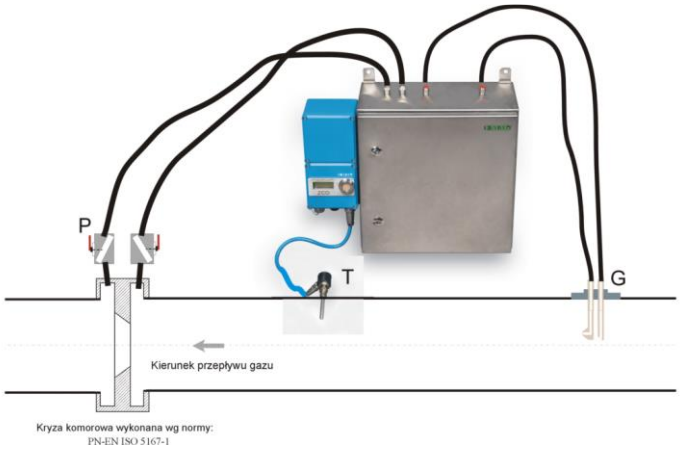
Long-term Monitoring of Improved Methane Drainage Efficiency



Components of integrated methane drainage sensor ZCO



Example of methane drainage system with measuring equipment.



Block diagram of the ZCO sensor adjusted to operation with a measuring orifice plate

Findings and conclusions from Zofiowka tests

Conducted experiments and data obtained during the research in Zofiowka mine enabled the following:

- to confirm the results we came across in EM Barbara
- to confirm the possibility of applying hydroslotting system undergound
- to determine the possible dangers and safety measures
- to discover the most important elements of this technology
- to find solutions to the problems that might appear during operating
- to find the correlation in the parameters in order to optimize the technology

Thank you for your attention