Technic and Results of the Measurement of Gas Content and Permeability of Coal Seams in Underground Mines

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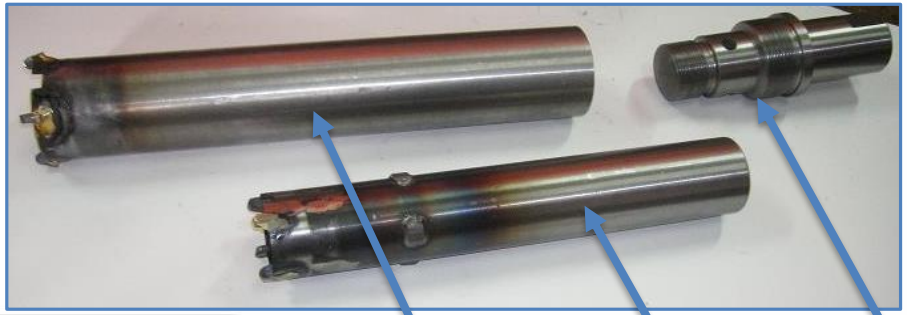
Introduction

- Coal and methane outburst can lead to a sharp increase in the concentration of methane in the mine atmosphere and to the formation of conditions for explosions of methane and coal dust
- Modern geophysical methods could be used for forecasting of hazardous areas applying directly in the coal mines
- These studies may include:
  - collecting coal samples in the mines and determination of gas content of coal seams
  - defining of the filtration properties of coal seams by conducting injection tests in the mines
  - seismoacoustic survey of coal seams from mine workings

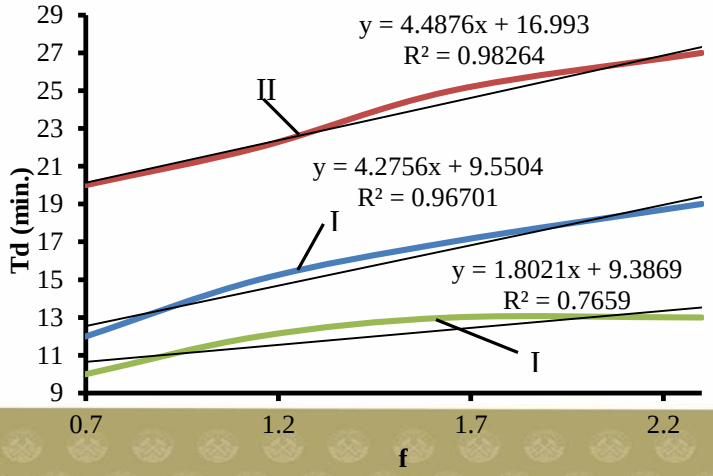
Determination of Residual Gas Content of Coal Seams

Desorption Tests

Open-type Core Samplers



Dependence of a coal sample drilling time (T_d) on a coefficient of coal strength (*f*), for the coal sample obtained in mining conditions from *LFG* grade coal using core samplers of types I-III

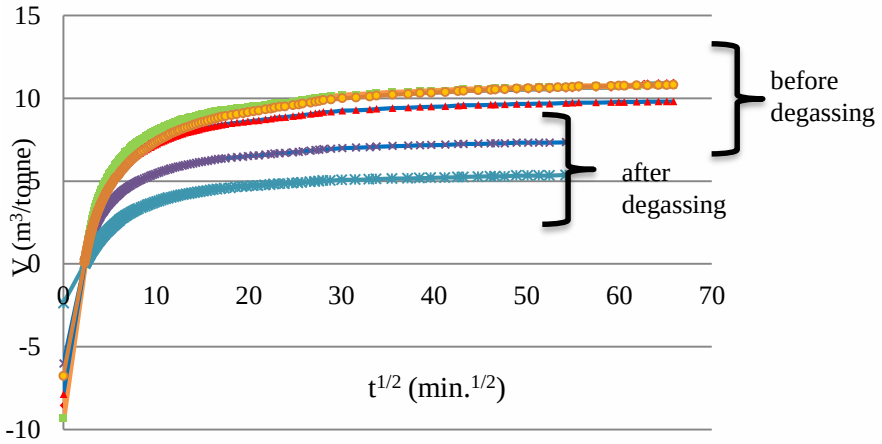


Results of the Tests

Estimate of coal seams degasification efficiency on the basis of direct method

Mine	Coefficient of degasification efficiency	In-situ gas content (m^3/t dry ash free mass)	Residual gas content (m^3/t dry ash free mass)
A	0.9-0.85	9-14	1.2-2.1
B	0.01-0.1	9-11	8.7-8.9
C	0.9-0.6	17-20	2.0-7.6
D	0.9-8.4	18-20	1.0-3.2

Desorption of methane from coal samples of *LFG* grade, selected in mine entries of Kuzbass mines



Effectiveness of coal seams degasification

$$K_d = \frac{c - c'}{c}$$

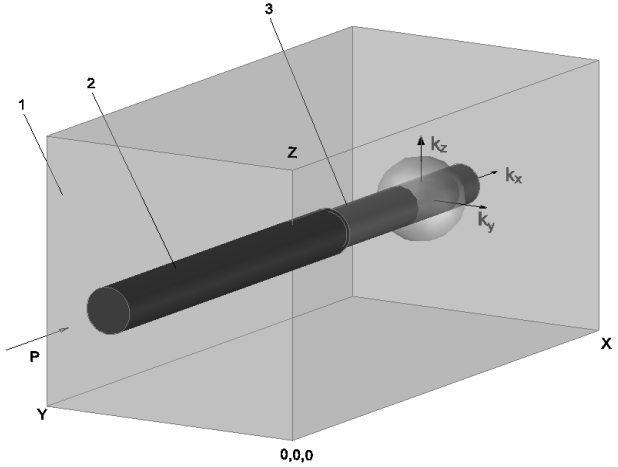
χ_n – in-situ gas content of a coal seam, (m^3/t) ; χ'_n – gas content after coal seam degasification (m^3/t)

Coal Seams Permeability

Methodology and Equipment

- A chamber was designed and manufactured in a form of reinforced rubberized hydraulic hose with a sealed threaded connection on the other side
- A pre-programmed electronic self-contained manometer is placed in the chamber and is connected to a borehole water supply system for recording pressure changes caused by hydrodynamic impacts

Three-dimensional view of coal seam permeability: 1 - coal seam; 2 - casing string; 3 - borehole uncased part



Results

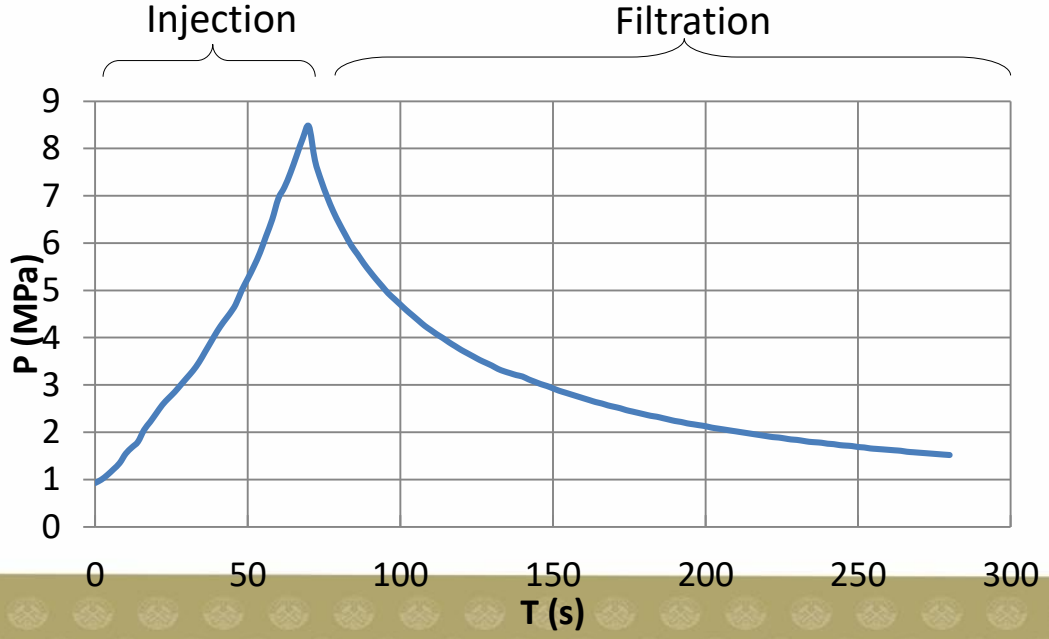
Before Stimulation

k_x = 19.17 mD
k_y = 11.48 mD
k_z = 23.51 mD

After Stimulation

k_x = 73.91 mD
k_y = 30.20 mD
k_z = 4.16 mD

Monitoring injection fall-off test in a borehole drilled from a mine entry



Detection of the Abnormal Tectonic Zones

Seismological Survey in Mines Entries

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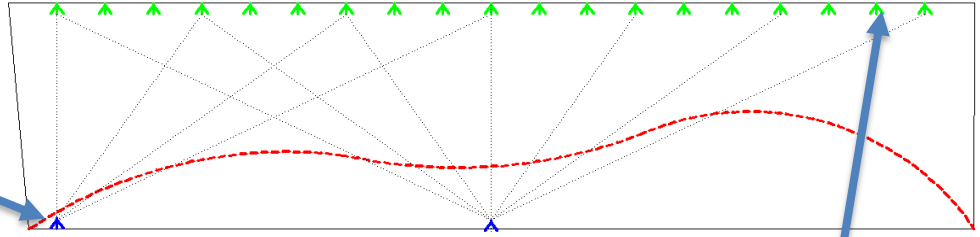
Set of the Seismological Stations

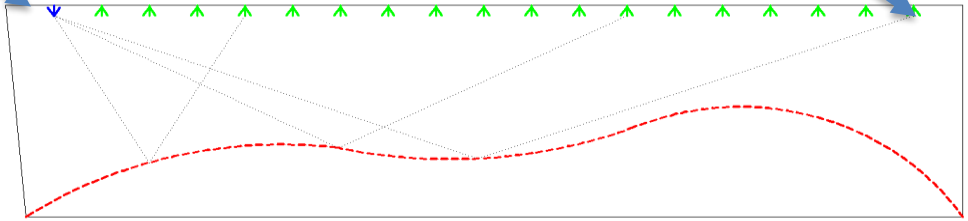
Source of the Signal

Direct and Transmitted Waves

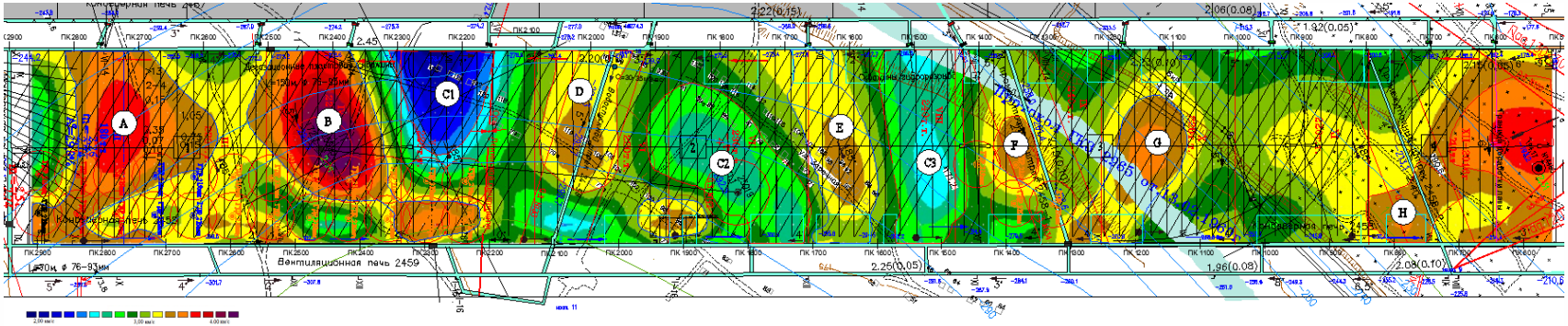


Geophones

Reflected and Refracted Waves



Results



A, B, G - the probable site of substitution of rocks of a direct roof by sandstone; C1, C2, C3 - zone of low speeds, characterized by increased moisture content; D, E, F, G - influence of the entries

Conclusions

- Direct measurements of the gas content and permeability of coal seams along with their seismological survey in underground mines are feasible
- The results of the geophysical measurements could be used for the following:
  - Prediction of the coal and methane outburst
  - Improving degasification systems
  - Increasing efficiency of the ventilations systems
  - Monitoring process of the hydrofracturing of the coal seams