

REGULATORY ASPECTS OF COAL MINE METHANE RECOVERY

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Background

- The success of the methane drainage technique depends on various physical and chemical characteristics, the composition of the different gases, depth, degree of coalification or rank and gas content of coal seams.
- The most important parameters affecting the feasibility of methane drainage are the volume of gas-in-place, porosity, and permeability of the coal seams.
- Coal seams need to be deep enough for adequate reservoir pressure and gas content. However, permeability also decreases with depth. Therefore, the optimal depth of the coal seam is necessary for the drainage of methane.
- Coal rank is an indication of the thermal maturity of coal. High-rank coals have higher methane sorption capacity than the low-rank coals.

- Coal with sufficient permeability is the prerequisite controlling parameter for economic gas flow rate and methane production.
- The permeability of coal is influenced by cleat spacing, which in turn depends on the coal rank and reservoir pressure.
- Coals with well-developed cleats are brittle. In general, cleats are more closely spaced with increasing coal rank, and methane drainage in coal seams having optimal coal rank will be more economical. Therefore, it is necessary to collect core samples of coal and conduct an analysis of the physical and chemical characteristics of coal for assessing the feasibility of the methane drainage technique.
- Designing a methane drainage system could be essential to achieve a relatively high effectiveness of methane drainage. Production of methane drainage boreholes depends on many parameters connected with the methane drainage system. The parameters are the prediction of the methane flow rates from boreholes, the determination of the parameters of extractor pumps and regulation devices located in the methane drainage system, and the selection the diameter of pipes.

Regulatory Aspects of Methane Drainage

- When the coal seam in mines contains methane content of above 8 m^3 per tonne of non-moisture and non-ash coal (dry and ash-free coal), methane drainage is obligatory.
- When the predicted methane emission exceeds $25 \text{ m}^3/\text{min}$, methane drainage is obligatory.
- When intensive ventilation and using additional ventilation devices are insufficient to fight methane threat, a methane drainage system has to be used.
- The in-mine horizontal drilling is suggested for high permeability coal beds ranging from 20 md to 100 md to guarantee its drainage performance.

- When the coal seams have high methane content and low permeability, direct underground-to-inseam methane drainage is not suitable because of safety issues. In this circumstance, the cross-measure boreholes drilled from roadways in roof and floor strata are good options for methane drainage as a rock between the coal seam and the drilling site could guarantee the safety of drilling workers.
- Methane captured by the drainage system has to be transported on the surface by methane drainage pipelines.
- Methane drainage pipelines should not be built in downcast shafts and in excavations with electrical lines.

Regulatory Aspects of Methane pipelines

- The main gas pipelines should be sectionalised so that in the event of rupture in the pipeline, the methane gas in the general body of air gets diluted within the permissible limit.
- Sectionalisation should be accomplished with automatic control valves, which are of spring-loaded type and pneumatic valves that fail close.
- The tracer tubing should be connected to a pneumatic valve on each degasification hole which is activated (fail close) whenever pressure is lost in tracer tubing and also when the automatic control valves on the pipeline are actuated.

- Concentration of methane in drainage pipelines should be higher than 30%.
- Methane drainage pipelines parameters:
 - i. Material: steel, polyethylene
 - ii. Pipeline Diameter: 100 – 500 mm

Regulatory Aspects of Methane and Other Gas Monitoring System

- A proper automatic online or continuous methane monitoring system fitted with audio-visual alarm should be installed along the gas pipelines.
- Methane monitors should be placed at every five hundred meters intervals along the main pipeline in the return airway or at closer intervals, if so required.
- Methane monitors should be interfaced with the electrically actuated valves attached to the tracer tubing.
- Methane monitoring system should be provided with an interrupted power supply arrangement.

- All air that crosses or passes the pipe-line should be monitored by methane monitors.
- When the concentration of methane in mine excavations exceeds the permissible level, the following precautions have to be taken immediately:
 - i. the crew has to be escaped from threatened excavations,
 - ii. all electrical and mechanical devices have to be turn off.
 - iii. entrance to the mine excavations has to be closed.
 - iv. automatic methane monitors have to unplug electric devices.
- Places of measuring concentrations of methane using mobile devices:
 - i. below the roof of excavation (max. 10 cm below)
 - ii. above the mine working support
 - iii. in places of accumulation and methane outflows.

- Places of localisation methane monitors sensors in longwall panel:
 - i. Maximum: 10 m before the longwall face in Maingate road
 - ii. in longwall face: 2 m before the Tailgate road
 - iii. Maximum: 10 m after the longwall face in Tailgate road.
- When concentration of methane above the working support during measurements exceed 5%, the followings have to be taken immediately:
 - i. all activities in excavation have to be stopped,
 - ii. activities should be taken to fight the threat

- Places of localization methane monitor sensors in development headings:
 - i. with forcing auxiliary ventilation: maximum 10 m from the working face
 - ii. with exhausting auxiliary ventilation: maximum 6 m from the working face.
 - iii. at a distance of 10 m to 15 m from the intersection with excavation ventilated by main ventilation system.
- Heading machines (near the cutting head) working in coal seams containing methane content of above 2.5 m^3 per tonne of non-moisture and non-ash coal (dry and ash-free coal) have to be equipped with
 - i. Automatic methane monitor: methane monitor has to unplug electric devices when concentration of methane exceeds 2%.
 - ii. Automatic methane monitor near dust separator has to be used: methane monitor has to unplug electric devices when concentration of methane exceeds 1%.

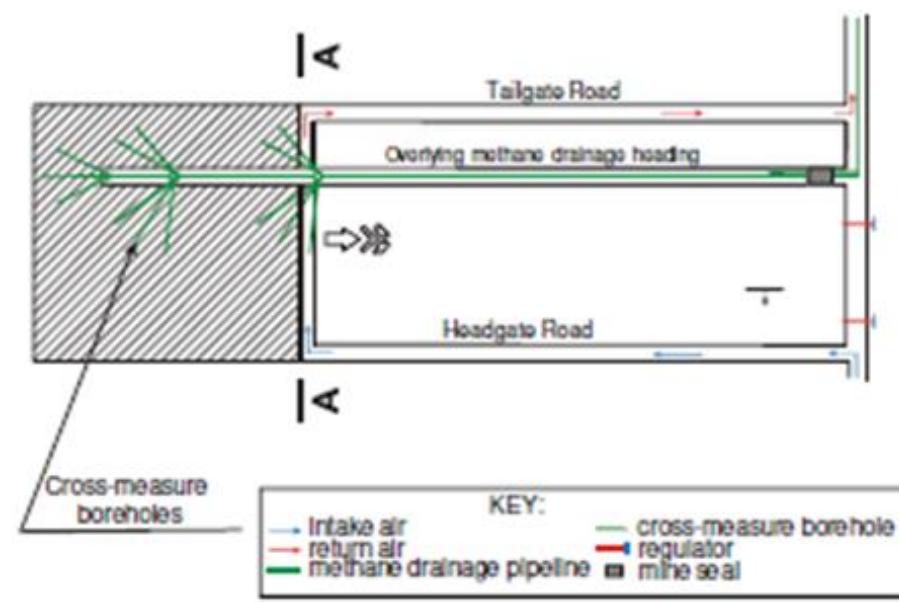
Regulatory Aspects of Drilling Operation and Extraction of Methane from Boreholes

- The drill machine and each of its accessories should be of non-inflammable material and any inflammable material, if used, should be shrouded with substantial metallic covering to render it non-inflammable.
- The drill machine should be provided with an efficient fire extinguisher so placed as to be within easy reach of operator and also with an automatic type of fire detection and suppression system.
- The clear space for drill machine in underground mines should not be less than 0.3 m below the roof or its support and 0.6 m on the sides.

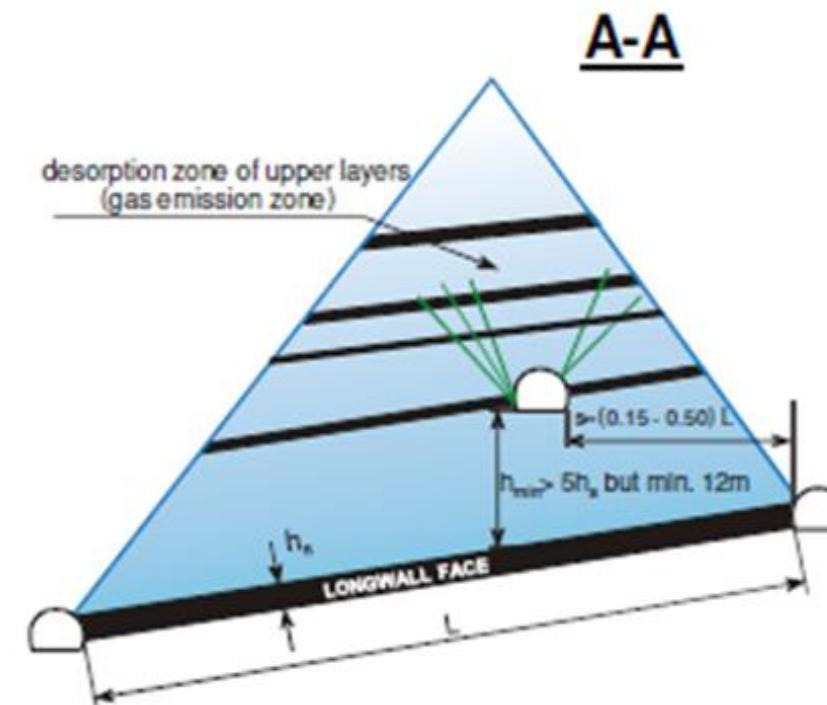
- While drilling for exploration or extraction of methane through boreholes, all precautions and arrangements should be made to ensure that no frictional or open spark occurs inside the borehole containing methane or likely to contain methane which may cause an explosion or blow out in the borehole.
- Collecting samples in the mine from the moment of drilling a borehole at the depth of 3.5 – 4 m until the samples are sealed in the airtight container should not last longer than 120 seconds.
- Methane drainage boreholes parameters:
 - a) Vacuum: 80 – 200 mmHg
 - b) Borehole Diameter: 45 – 95 mm
 - c) Borehole Length: 50 – 100 m
- Extractor pumps unit (types of compressors): rotary screw, rotary vane, Roots

Regulatory Aspects of Methane drainage by an overlaying drainage gallery

- The distance between a mined seam and a drainage heading should not be smaller than five times the thickness of mined seam at the same time not smaller than 12 m.
- Horizontal shift of drainage heading from the edge of a desorption zone from the side of a tail entry should amount to one-third of the longwall width.



*Methane drainage of longwall panel
by an overlying drainage heading*



Regulatory Aspects of Ventilation plan for methane exploration or Extraction Belowground

- A ventilation plan should show
 - a) the general direction of air-current;
 - b) every point where the quantity of air is measured;
 - c) every air-crossing, ventilation door, stopping and every other principal device for the regulation and distribution of air;
 - d) every fire-stopping and its serial number;
 - e) every room used for storing inflammable material;
 - f) the position of fire-fighting equipment;
 - g) every haulage and travelling roadway;
 - h) every auxiliary or booster fan;
 - i) every stone dust barrier;
 - j) position of each exploration and production borehole, and gas transportation pipe lines;

- Air measurement stations should be fixed at each split through which gas transportation pipe line passes in belowground working and air measurement at all such stations should be taken in each shift.
- Whenever the normal ventilation of the mine is disturbed, all methane exploration or extraction activities shall be stopped forthwith and work should not be resumed till the normal ventilation of the mine is restored.
- A coal barrier of not less than 150 m in thickness should be maintained in the same seam from old boreholes and present working of the mine from where exploration or extraction of methane is in progress.