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Method of determining coalbed methane content

Méthode de dosage de la teneur en méthane de houille

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Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 263, *Coalbed methane (CBM)*.

Method of determining coalbed methane content

1 Scope

This International standard provides methodology for measuring coalbed methane content of coal core samples obtained by coring or sidewall coring during well drilling. This standard has to be also applied to drill cuttings samples, if the equipment for the determination of the coalbed methane content according to a respective national standard is not available. The selection of the most appropriate method shall consider the purpose of the test and the possibilities of sampling.

This International standard is applicable for the direct method of measuring coalbed methane content. It includes sample preparation, experimental procedures and calculation methods. Indirect methods of measuring gas content of coal (not included in this International standard) are generally based on either the gas sorption characteristics of coal under defined/specified pressure and temperature conditions.

This International standard includes three types of direct measuring methods: conventional desorption (slow desorption) of core samples, fast desorption of core samples, fast desorption of cuttings or lump samples. The difference among them lies in the time allowed for gas to desorb before final crushing and in sample size and shape.

This International standard is applicable for the determination of the methane content of coal during coal and coalbed methane exploration for the determination of free gas content of low rank coals is included.

Procedure of free gas content determination of low rank coals need to be defined.

All units used and referred to in this International standard are international standard units. Reference temperature is 0 °C (273,15 K) if not stated differently. Reference pressure is 0,1 MPa (1 bar) if not stated differently.

This International standard does not point out all the potential safety hazards associated with its use. The users are responsible for establishing appropriate safety measures and health practices when applying the procedures defined in this standard.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
coalbed gas content
under natural conditions, quantity of gas contained in the unit mass of coal

Note 1 to entry: It is the sum of lost gas, measurable gas and residual gas.

2.2
coalbed methane content
methane content, which is commonly the major component of coalbed gas

Note 1 to entry: The terms “coalbed methane”, “coalbed gas” and “coal seam gas” are frequently used synonymously.

Note 2 to entry: If a component other than methane is the predominant component of coalbed gas this should be stated explicitly.

2.3
Q1 (lost gas)
gas lost from the samples subsequent to its removal from its *in situ* position and prior to its containment in the canister, expressed as volume (at standard conditions) per unit mass of coal

2.4
Q2 (measurable gas)
measurable gas desorbed at atmospheric pressure from the non-pulverized coal sample, expressed as the quantity per unit mass of coal

2.5
Q3 (residual gas)
gas still contained in the coal sample before its pulverisation, expressed as the quantity per unit mass of coal

2.6
conventional desorption (slow desorption)
method of gas determination in which volumetric readings of canister gas content are taken frequently (every 5 min) during the first few (2 to 6) h, followed by hourly measurements for several hours, and then measurements on 24-h intervals until no or very little gas is being desorbed for an extended period of time

2.7
fast desorption
method of gas content determination in which a trend of gas desorbing from the coal sample is not established

Note 1 to entry: Measurements are taken over a period of time typically less than 1 day

2.8
sampling
activity that take some representative part of coal from coalbed

2.9
core sample
cylindrical section of rock (coal) that is usually 5 cm to 10 cm in diameter taken as part of the interval penetrated by a core bit and brought to the surface for geological examination, representative sampling, and laboratory analysis

2.10
cuttings sample
rock (coal) fragments, chips, particles with a size of typically ≤5 mm that break off because of the action of the drill bit and are transported to the surface by the drilling circulation system

2.11
coal lump samples
coal fragments or pieces of coal fragments that break off in the extraction or development process of a coal mine operation, from coal transport or storage or by manual removal from the coal seam or an intact core sample. The size is larger than that of cuttings and smaller than the inner diameter of the canister used for transportation and desorption

2.12
low-rank coal
the coal and rock thermal evolution degree is low, vitrinite of oil-immersed maximum reflectance $R_{v,max} \leq 0{,}65\%$, including lignite and long flame coal

[SOURCE: ISO 11760:2005]

2.13
high-rank coals
coal and rock thermal evolution degree is high, vitrinite of oil-immersed average random reflectance $\overline{R}_r \geq 2{,}0\%$, including anthracite coal

3 Apparatus

3.1 Desorption canister

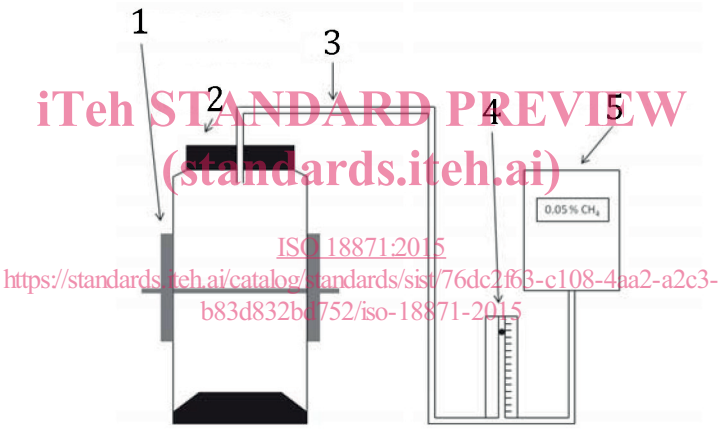
The desorption canister is a sealable container into which the coal samples are placed to determine their gas content. The canister should be designed such that the coal can be transferred into a pressure-tight status as quickly as possible.

Canisters should be easy to handle and fill and should close rapidly to form a gas sealed space.

The material of the canister shall not absorb coalbed gas, or react with drilling fluid and coalbed gas. Therefore, it is recommended to use aluminium alloy, coated aluminium, PVC and/or stainless steel materials.

When using core samples, the canister volume shall be more than 1 000cm^3 with a suitable inner diameter. It should maintain gas tightness up to a pressure of 0,3 MPa.

When using cuttings samples or coal lump samples, the canister volume shall be ≥ 500 cm^3. The ratio of canister volume and sample volume shall be between 70 and 150. The desorption canister shall be equipped with a shut-off valve and a rubber hose to connect it to a gas metering device and gas analyser (Figure 1).



Key

1 squeezing device
2 desorption canister
3 hose
4 flowmeter
5 gas analyser

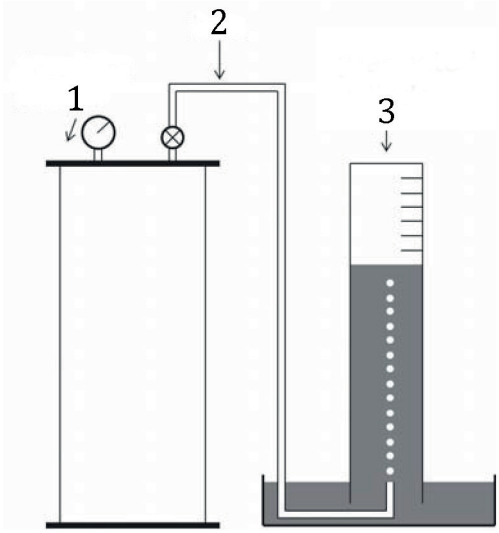
Figure 1 — Desorption canister with connection to gas analyser

3.2 Metering device

The measurement of desorbed gas volumes shall be executed either by the displacement of water (displacement method) or by flushing the crusher head with a defined volume of air and subsequent analysis of the gas composition (flushing method).

For the displacement method, a graduated measuring cylinder (burette) is used. The volume and scale of the measuring cylinder shall be appropriate to the desorption volume. The measuring cylinder and storage reservoir are preferably of glass. Readings of the gas volume are taken at atmospheric pressure by adjusting the liquid levels in the tube and the storage cup. The minimum graduation on the metering scale shall be no more than 10 cm^3. The measuring cylinder is connected at the bottom to a storage

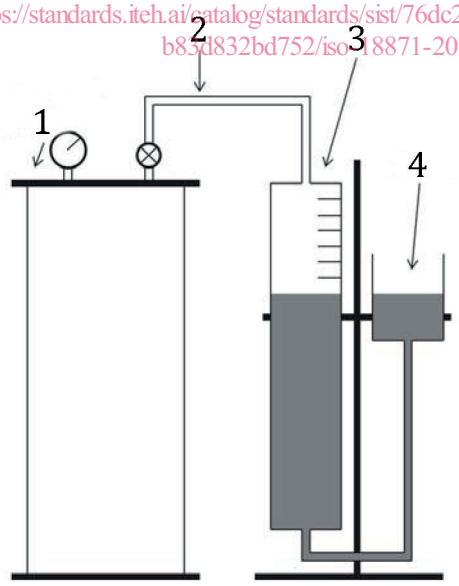
reservoir and at the top to the desorption canister head. The connections shall be made of flexible and gas-tight plastic or rubber.



Key

1 desorption canister
2 hose
3 graduated cylinder

Figure 2 — Desorption canister with graduated cylinder for collection of desorbed gas



Key

1 desorption canister
2 hose
3 burette
4 storage reservoir

Figure 3 — Desorption canister with graduated burette and storage reservoir for pressure equilibration

For the flushing method, a defined volume of air is passed through the crusher headspace and collected in a vessel, preferably of glass. The collecting vessel shall be connected to the gas analyser [see 3.13] by a flexible hose. The connections shall be flexible and gas tight plastic or rubber.

3.3 Thermostat

A water, oil or air thermostat shall be used with a temperature stability and controlling accuracy of ± 1°C.

3.4 Temperature measuring devices

Temperature should be measured with an accuracy of 1°C or better. The temperature range of the measuring devices (thermometer, thermocouple, resistance thermometer) should cover both the ambient temperature and the temperature in the thermostat holding the desorption canisters. Typically this should correspond to a range from 10 °C to 80 °C.

3.5 Barometer

The measurement range of the barometer for metering the ambient pressure should cover the local range of ambient pressure. Scale intervals should be 0,1 kPa.

3.6 Electronic balance (top load)

A precision (accuracy ± 1 %) electric, top-load balance with appropriate capacity is used to weigh empty and filled canisters.

3.7 Standard sieve

The sieve shall be 60 mesh (maximum grain size 2 mm)

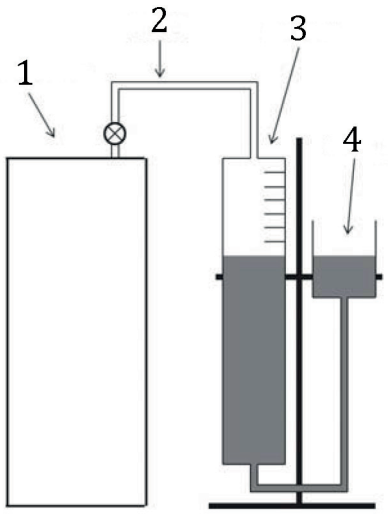
3.8 Coal crusher

A coal crusher is required for pulverization of the coal in order to release all remaining gas rapidly.

For conventional desorption test, samples are completely broken during the residual gas test in the measurement process.

In case of using the displacement method, the crusher shall be gas tight and equipped with an adapter for connecting a rubber or plastic hose to transfer gas to the metering device (Figure 4). The crusher headspace shall be minimized.

In case of using the flushing method, the tightness of the crusher shall be adjusted to the flushing process. The gas being released during crushing shall be mixed with inflowing air completely with all mixed gas being captured in the collecting vessel.



Key

1 coal crusher
2 hose
3 burette
4 storage reservoir

Figure 4 — Coal crusher with graduated burette and storage reservoir for pressure equilibration

3.9 Hose

The hose material shall not adsorb coalbed methane and not react with it.

3.10 Gas-sample bottles

Gas-sample bottles are used for collecting samples for subsequent analysis. The volume of the gas-sample bottle shall not be less than 100 cm^3

3.11 Padding

Cylinders, glass spheres and hollow tubes are used to reduce the void volume of the desorption canister. These should be made of materials not adsorbing coalbed methane and not reacting with coalbed methane.

3.12 Quick connector

Quick connector is a pipe fitting designed for easy and rapid connection and disconnection.

3.13 Gas analyser

The gas analyser shall be equipped with sensors for the main components of the adsorbed gas, at least with a sensor for methane, preferably an infrared sensor. The accuracy of the analyser shall be ± 5 % of the measured value or better.