TECHNICAL REPORT

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Natural gas — Coalbed methane quality designation and the adaptability of actual ISO/TC 193 standards

Gaz naturel — Désignation de la qualité du méthane de houille et applicabilité des normes en vigueur ISO/TC 193

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Foreword

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This document was prepared by Technical Committee ISO/TC 193, *Natural gas*, Subcommittee SC 1, *Analysis of natural gas*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Coalbed Methane (CBM) is an unconventional form of natural gas and refers to methane-rich gases that naturally exist in coal seams and surrounding rocks, see also Reference [31]. It is defined as a methane-rich gas naturally occurring in coal seams (and surrounding rock) typically comprising of 80 % to 95 % methane with lower proportions of ethane, propane, nitrogen and carbon dioxide (see ISO 18875).

At present, CBM is explored and developed in the United States, Canada, Australia, Russia, India, China and a few other countries.

Typical CBM contains 80 % to 95 % or more methane and a small portion of ethane, propane, nitrogen and carbon dioxide, but the composition of coalbed methane varies widely around the world. This document aims to promote communication and coordination among countries and support the smooth progress of unconventional natural gas exploration, development, production and custody transfer.

Natural gas — Coalbed methane quality designation and the adaptability of actual ISO/TC 193 standards

1 Scope

This document surveys the quality designation of CBM all around the world, and analyses whether ISO/TC 193 standards for sampling, test and calculation methods are applicable to CBM.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14532, *Natural gas — Vocabulary*

ISO 18875, *Coalbed methane exploration and development — Terms and definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14532, ISO 18875 and the following apply.

NOTE Specific coalbed methane or coal gas mine terms are given in national documents, such as GB/T 31537[30].

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
normal reference conditions
reference conditions of pressure, temperature, and humidity (state of saturation) equal to 101,325 kPa and 273,15 K for a gas in the dry state

[SOURCE: ISO 14532:2014, 2.6.1.3]

3.2
ISO standard reference conditions
reference conditions of pressure, temperature, and humidity (state of saturation) equal to 101,325 kPa and 288,15 K for a real gas in the dry state

[SOURCE: ISO 14532:2014, 2.6.1.4]

3.3
direct sampling
sampling in situations where there is a direct connection between the natural gas to be sampled and the analytical unit

[SOURCE: ISO 14532:2014, 2.3.1.1]

3.4
indirect sampling
sampling in situations where there is no direct connection between the natural gas to be sampled and the analytical unit

[SOURCE: ISO 14532:2014, 2.3.1.2]

3.5
representative sample
sample having the same composition as the natural gas sample when the latter is considered as ahomogeneous whole

[SOURCE: ISO 14532:2014, 2.3.4.2]

3.6
gas chromatographic method
GC method
method of analysis by which the components of a gas mixture are separated using gas chromatography

Note 1 to entry: The sample is passed in a stream of carrier gas through a column that has different retention properties relative to the components of interest. Different components pass through the column at different rates and are detected as they elute from the column at different times.

[SOURCE: ISO 14532:2014, 2.2.2.1]

3.7
main component
major component
component whose content influences physical properties

[SOURCE: ISO 14532:2014, 2.5.2.2.1]

3.8
trace component
trace constituent
component present at very low levels

[SOURCE: ISO 14532:2014, 2.5.2.2.3]

3.9
total sulfur
total amount of sulfur found in coal bed methane

[SOURCE: ISO 14532:2014, 2.5.2.3.14]

3.10
compression factor
ratio of the volume of an arbitrary mass of gas at a specified pressure and temperature to the volume of the same mass of gas under the same conditions as calculated from the ideal-gas law

[SOURCE: ISO 14532:2014, 2.6.2.2]

3.11
density
mass of gas divided by its volume at specified conditions of pressure and temperature

[SOURCE: ISO 14532:2014, 2.6.3.1]

3.12
relative density
ratio of the mass of a gas contained within an arbitrary volume to the mass of dry air of standard composition that would be contained in the same volume at the same reference conditions

[SOURCE: ISO 14532:2014, 2.6.3.2]

Note 1 to entry: The relative density is also defined in ISO 6976.

3.13
Wobbe index
calorific value on a volumetric basis at specified reference conditions, divided by the square root of the relative density at the same specified metering reference conditions

[SOURCE: ISO 14532:2014, 2.6.4.3]

3.14
water dew point
temperature at a specified pressure at which water vapour condensation initiates

Note 1 to entry: For any pressure lower than the specified pressure, there is no condensation of water vapours at this water dew point temperature.

[SOURCE: ISO 14532:2014, 2.6.5.1.1]

3.15
water content

mass concentration of the total amount of water contained in a gas

Note 1 to entry: Water content is expressed in units mass per unit volume.

Note 2 to entry: For gas below the water dew point, this means water in the form of both liquid and vapour; but for gas above the water dew point, this means only water vapour.

Note 3 to entry: Water content can be also expressed as mole or volume fraction.

[SOURCE: ISO 14532:2014, 2.6.5.1.2]

3.16
hydrocarbon dew point
HCDP
temperature at a specified pressure at which hydrocarbon vapour condensation initiates

Note 1 to entry: In chemical thermodynamics, the “true” hydrocarbon dew point is the temperature (at a stated pressure) at which the fugacity of the gas and liquid phases is identical. Since measurement of the dew point involves reduction of the system temperature, this equates to the temperature at which the first appearance of the liquid phase occurs. At this point, the quantity of liquid phase is infinitesimally small. Since no instrument or observer is able to detect this infinitesimally small amount, the measured value by a chilled mirror instrument (measured hydrocarbon dew point) differs from the “true” hydrocarbon dew point. Depending on the gas composition and the sensitivity of the detection system of the automatic hydrocarbon-dew-point chilled-mirror instrument or the observer (manual chilled mirror instrument), the measured hydrocarbon dew point can be considerably lower than the “true” hydrocarbon dew point.

[SOURCE: ISO 14532:2014, 2.6.5.2.1]

3.17
potential hydrocarbon liquid content
PHLC
property of natural gas defined as the amount of the condensable liquid (in milligrams) at the pressure, p, and temperature, T, per unit volume of gas at normal conditions, that is, at a temperature of 0 °C and a pressure of 101,325 kPa obtained by passing a representative sample of the gas through an apparatus where it is first brought to the pressure, p, and then cooled to the temperature, T

Note 1 to entry: It is necessary to take care that only gas, not a two-phase mixture, has been withdrawn from the pipeline.

[SOURCE: ISO 14532:2014, 2.6.5.2.3]

4 Symbols, abbreviations and units

4.1 Symbols and units

Symbol	Meaning and units
d	Relative density
H_c	Molar basis calorific value (kJ/mol)
H_m	Mass basis calorific value (MJ/kg)
H_V	Volumetric basis calorific value (MJ/m^3)
M	Mass per mole (kg/kmol)
p	(Absolute) pressure (kPa)
T	Celsius temperature (°C)
T_{abs}	Thermodynamic (absolute) temperature (K)
V	(Gas) volume (m^3)
W	Wobbe index (number) (MJ/m^3)
Z	Compression factor
ρ	Density (kg/m^3)

4.2 Abbreviations

Abbreviations	Meaning
CBM	Coalbed methane

5 Applicability of sampling standard

ISO 10715 provides concise guidelines for the collection, conditioning and handling of representative samples of processed natural gas streams. It also contains guidelines for sampling strategy, probe location and the handling and design of sampling equipment. According to ISO 10715, the factors affecting sampling representativeness include sampling material and equipment, sample containers, sampling method, heavy hydrocarbon condensate and flow characteristics of gas sources.

NOTE Specific CBM sampling standards exist at national level[5].

CBM is a kind of unconventional natural gas, which falls into the category of natural gas. It is basically free of heavy hydrocarbon and organic sulfur compounds. The composition of CBM is simpler than that of natural gas.

Therefore, ISO 10715 is applicable to the direct and indirect sampling of CBM.

6 Applicability of test and calculation standard

6.1 General

This clause deals with the various parameters which may be referred to in a designation of the quality of CBM. The parameters actually selected will depend upon the purpose for which the designation is required and it is unlikely that all the parameters listed in this document will be used.

6.2 Gas composition

6.2.1 General

CBM is composed primarily of methane and ethane with smaller amounts of propane, butane and of non-combustible gases, carbon dioxide and nitrogen, the approximate content of each component is shown in Table 1. The relevant ISO/TC 193 test standards for major and minor components and trace constituents and whether these standards are applicable to CBM are shown in Table 2, 3 and 4.

Limits are not given in this document, but limits on CBM components or properties are given in Chinese national standard GB/T 26569:2011[26] and GB/T 26127:2010[27], Chinese energy industry standard NB/T 10035:2006, Australian standard AS 4564-2011[28], New Zealand Standard NZS 5442:2008[29] (for more information, see Annex A and Bibliography).

Table 1 — Approximate content of each component of CBM

Component	Unit	Approximate content range
Methane	mol%	50 to 99
Ethane	mol%	0,1 to 5
Propane	mol%	0 to 1
Butanes	mol%	0 to 1
Pentanes	mol%	0 to 0,5
Nitrogen	mol%	0,1 to 40
Carbon dioxide	mol%	0,1 to 15
Hydrogen	mol%	0 to 0,1
Oxygen	mol%	0 to 5
Carbon monoxide	mol%	0 to 1
Helium	mol%	0 to 0,5
Argon	mol%	0 to 0,5
Sulfur hydrogen	mg/m^3	0 to 20
Total sulfur	mg/m^3	0 to 20

6.2.2 Major components

Table 2 presents the main components of coalbed methane.