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Methods for the petrographic analysis of coals —

Part 4: Method of determining microlithotype, carbominerite and minerite composition

Méthodes d'analyse pétrographique des charbons —
Partie 4: Détermination de la composition en microlithotypes, carbominérites et minérites

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee TC 27, *Solid mineral fuels*, Subcommittee SC 5, *Methods of analysis*.

This second edition cancels and replaces the first edition (ISO 7404-4:1988), which has been technically revised.

A list of all the parts in the ISO 7404 series can be found on the ISO website.

Introduction

Petrographic analyses have been recognized internationally as important in the context of the genesis, vertical and lateral variation, continuity, metamorphism and usage of coal. The International Committee for Coal Petrology (ICCP) has made recommendations concerning nomenclature and analytical methods and has published and described in detail the characteristics of a wide range of coals. This document agrees substantially with the text of relevant ICCP publications and incorporates many useful comments made by members of the ICCP and by member bodies of ISO/TC 27.

Petrographic analyses of a single coal provide information about the rank, the maceral and microlithotype compositions and the distribution of mineral matter in the coal. The reflectance of vitrinite is a useful measure of coal rank and the distribution of the reflectance of vitrinite in a coal blend, together with a maceral group analysis, can provide information about some important chemical and technological properties of the blend.

The ISO 7404 series is concerned with the methods of petrographic analysis currently employed in characterizing coal in the context of its technological and/or geological use. It establishes a system for petrographic analysis and comprises five parts, see ISO website:

Microlithotypes are the naturally occurring associations of macerals which characterize the microscopically visible different types of coal. By convention, the identity of a microlithotype is determined by the maceral group or groups occurring within an area of at least 50 µm × 50 µm and which are present in amounts equal to or exceeding 5 % by volume. Hence, they can comprise a single maceral or maceral group if it exceeds these dimensions. Microlithotypes may include up to 20 % by volume of minerals such as clay, quartz and carbonates or up to 5 % by volume of sulfide minerals. If the content of mineral matter exceeds these amounts, the material is designated as minerite or carbominerite depending on the proportions of coal and mineral matter.

Carbominerites can be subdivided according to the type of mineral matter.

Microlithotypes contribute information on the genesis of coal seams and can assist in solving problems of seam correlation. Because they determine, together with rank and mineral matter, the hardness and density of the bulk coal substance, microlithotypes affect the behaviour of coal in mining and coal preparation processes. The different microlithotypes determine, under given geological conditions, the distribution of micro-cracks and to some extent the cleat in the coal. The results of maceral analyses can be interpreted more meaningfully from a knowledge of microlithotype composition. Such information can assist in explaining the behaviour of coal in commercial and experimental utilization processes where the association of macerals is known to be important.

NOTE The percentage volume of carbonate, clay and quartz minerals on the one hand and sulfide minerals on the other, which define the carbominerites and minerites, correspond to the densities which separate acceptable coal from middlings (1,5 g/cm^3) and from rejects in coal preparation.

Methods for the petrographic analysis of coals —

Part 4:
Method of determining microlithotype, carbominerite and minerite composition

1 Scope

This document specifies a method, using a graticule with 20 crossline intersections, for determining the proportions of microlithotypes, carbominerite and minerite in coals. It applies only to determinations made on polished particulate blocks using reflected white light (about 400 nm to 700 nm). Additional blue, blue-violet or UV light excitation (365 nm to 440 nm) for better identification of liptinite in fluorescence may be used especially at low rank coals.

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 7404-1, *Methods for the petrographic analysis of coals — Part 1: Vocabulary*

ISO 7404-2, *Methods for the petrographic analysis of coals — Part 2: Methods of preparing coal samples*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7404-1 and the following apply.

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

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

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

3.1
point
observation of a portion of the particulate block through the eyepiece graticule made during the analysis

Note 1 to entry: The allocation of a point to a particular microlithotype, or to carbominerite or minerite, is determined by the macerals and/or mineral matter present at the 20 intersections of the graticule. A point is only counted if at least 10 intersections fall on a particle.

4 Principle

Examination by using a reflected light microscope and point count procedure of a representative sample of coal prepared as a particulate block as described in ISO 7404-2. Identification under an immersion medium of the microlithotypes from their maceral composition. The proportions of the macerals are determined using a graticule having a grid with 20 points of intersection spaced to define a distance of 50 µm on the specimen between extreme intersections in the x (abscissa) and y (ordinate) directions, respectively. The use of such a graticule allows the analyst to comply with the 5 % minimum content and 50 µm minimum size stipulation.

5 Material

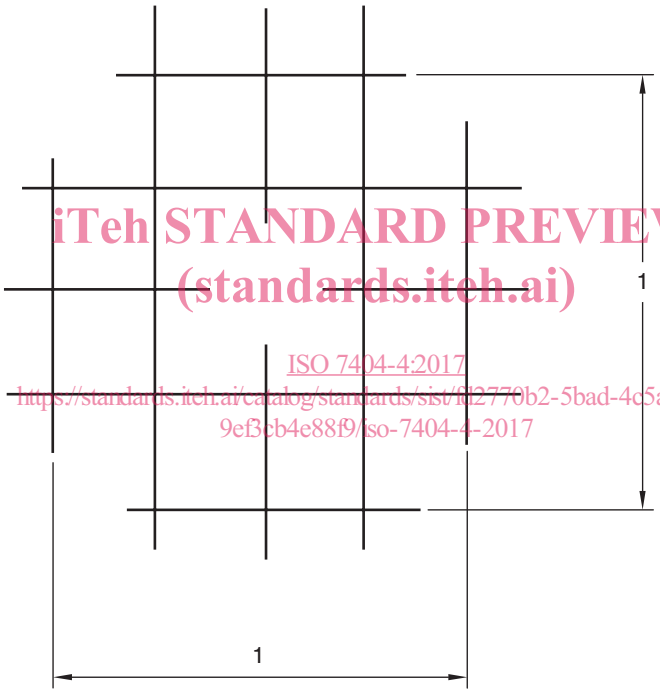
Immersion medium, having a suitable refractive index and compatible with the microscope objective.

NOTE If reflectance measurements are required on the same particulate block, an immersion oil as specified in ISO 7404-5 is used.

6 Apparatus

6.1 Reflected light microscope, having an immersion objective of magnification between ×25 and ×60 and eyepiece of magnification between ×8 and ×12. The eyepiece shall have the facility for inserting a graticule.

6.2 Graticule, inscribed with a grid having 20 crossline intersections according to the pattern shown in Figure 1. The effective distance between extreme intersections in the x- and y-directions, respectively, is 50 µm.



Key

1 50 µm on the specimen

Figure 1 — Design of grid for microlithotype analysis

NOTE 1 With a total number of 20 cross line intersections, a maceral appearing beneath a single intersection can be assumed to occupy 5 % by volume of the area covered by the grid.

NOTE 2 The graticule is designed for use with a particular combination of objective and eyepiece. Change in either objective or eyepiece will necessitate the use of a grid of different dimensions.

6.3 Mechanical or scanning stage, capable of advancing the specimen in the x-direction by equal steps of such length that only a negligibly small proportion of the particles examined receives more than one count on the same particle. The step-length is equal to half the maximum particle diameter, i.e. 0,5 mm to 0,6 mm for samples with a standard top particle size of 1 mm. The stage also permits a similar stepped advance in the y-direction. The stage movement may be actuated manually, by the counter mechanism or a computer attached to the stage.

6.4 Counter/computer, capable of registering the points in each category and preferably the grand total of points counted.

6.5 Sample mounting equipment, comprising slides, modelling clay and levelling press.

7 Procedure

Insert the graticule (6.2) into the eyepiece of the adjusted microscope (6.1).

Place the levelled particulate block, prepared in accordance with ISO 7404-2, on the stage. Add the immersion medium to the surface of the block, focus and observe the image in the microscope.

Assess the number of crossline intersections lying on the particle in order to decide whether the point should be recorded in the counting procedure and, if so, whether it should be assigned to the category of a microlithotype, carbominerite or minerite. If the number of intersections on one particle is 10 or more the point shall be accepted for analysis. If there are no intersections on coal or mineral matter, the point is ignored (i.e. it is not recorded). If the number is less than 10 it shall be recorded as a rejected category and the stage shall be advanced by one step. The number of such rejected points shall not exceed 10 % of the total accepted and rejected points. If the proportion exceeds 10 %, excessive fines may have been produced during preparation and a fresh sample should be prepared if material is available. If this is not possible the fact shall be recorded in the test report. For identifying the material under the individual crosslines, apply the procedure described in ISO 7404-3. The criteria for determining accepted and rejected points are shown in Figure 2.

If the particle is accepted for analysis, assess the number of intersections lying on mineral matter. If the number of crossline intersections on mineral matter exceeds the number shown in Table 1 for a given number of intersections lying within the particle, the material is either carbominerite or minerite.

Table 1 — Maximum permissible number of intersections falling on mineral matter for the point to be classified as a microlithotype

No. of intersections lying within the particle	Number of intersections on	
	carbonate, clay, quartz	sulfide
16 to 20	3	0
11 to 15	2	0
10	1	0

If the particle is a microlithotype, it is identified according to the criteria shown in Table 2 ignoring any intersections on carbonate, clay or quartz.