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Coal and coke — Coal preparation plant — Density tracer testing for measuring performances of coal density separators

Charbon et coke — Installation de préparation du charbon — Essais des traceurs de densité pour la mesure des performances des séparateurs de charbon en fonction de la densité

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Foreword

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This document was prepared by Technical Committee ISO/TC 27, *Coal and coke*, Subcommittee SC 1, *Coal preparation: Terminology and performance.*

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

The objective of this document is to provide the coal preparation industry with an accurate, safe, rapid and site-based method for determining the density partitioning performances of density separators and, to utilize statistical and mathematical procedures to avoid personal biases in fitting partition curves to the observed data. To meet the second objective, this document includes formulae which can be incorporated in a user spreadsheet.

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Coal and coke — Coal preparation plant — Density tracer testing for measuring performances of coal density separators

1   Scope

This document specifies the requirements for testing the performances of coal density separators using density tracers and provides a method for the presentation of test results.

This document is partly based on AS 5213.

This document is applicable to dense medium cyclones (DMCs) and dense medium baths, as follows:

a)   for a single separator;

b)   for a group of separators where the feed is distributed between them at a point downstream of density tracer insertion;

c)   for density tracers of any size; but rarely used for particles with maximum dimension less than 2 mm.

This document also provides guidance for testing the performances of other types of density separators with density tracers.

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.

AS 2418, *Coal and coke — Glossary of terms*

3   Terms and definitions

For the purposes of this document, the terms and definitions given in AS 2418 and the following apply.

ISO and IEC maintain terminology 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
cut-off time
time which follows the time of last *density tracer* (3.3) *insertion* (3.5) by 5 min plus the greater of *floats transit time* or *sinks transit time*

Note 1 to entry: Floats transit time is the average time in minutes since insertion into a separator feed for particles collected from, or detected in, a separator floats stream. Sinks transit time is the average time in minutes since insertion into a separator feed for particles collected from, or detected in, a separator sinks stream.

3.2
density separator
device for the cleaning of coal, in which particles are separated into two or more streams according to their densities

3.3
density tracer
non-porous particle of defined shape and density that is not easily broken or abraded

Note 1 to entry: Types include radio frequency identified (RFID) density tracers and non-RFID recoverable density tracers.

3.4
average probable deviation
écart probable moyen
E_{pm}
half of the difference between the densities corresponding to the 75 % and 25 % partition coefficients as obtained from the partition curve

3.5
insertion
placement of a *density tracer* (3.3) into a separator feed stream, typically by dropping into a feed preparation screen oversize launder

4 Test method

4.1 General

The test method specified in 4.2 to 4.5 covers the following:

a) generation and capture of density tracer test data utilizing either:

1) retrieved, re-usable non-RFID density tracers; or

2) automatically detected RFID density tracers;

b) use of those data to estimate density partition coefficients;

c) presentation of those data and results in tabular and graphical forms;

d) fitting one of two alternative mathematical forms for the partition curve to the density partition coefficients;

e) determination, from the partition curves, of key partitioning criteria.

4.2 Apparatus

4.2.1 Density tracers

For the purposes of this document, density tracers shall have the following properties:

a) shape and dimensions: any that can be fully described in the density tracer test report;

   EXAMPLE   Cubic, with edge length 13 mm.

b) tolerance on dimensions: 100 % within ±10 % of nominal;

c) nominal densities: any;

d) tolerances on density, for cubic tracers of 8 mm edge length and larger:

1) for nominal relative density (RD) values up to 1,60: 99 % within ±0,006 RD of the nominal value;

2) for nominal RD values greater than 1,60: 99 % within ±0,011 RD of the nominal value.

e) density designation:

1) non-RFID density tracers: by engraving or colour-coding;

2) RFID density tracers: electronically written to an internal memory chip.

NOTE   See Annex A for details of suitable density tracers.

4.2.2   Density tracer retrieval or detection equipment

If a test is to be conducted using non-RFID density tracers, apparatus for use as aids for retrieval shall be suitable for the circumstances (see Annex B).

If a test is to be conducted using RFID density tracers, radio equipment shall be present for retrieval of data from each density tracer in the floats and sinks streams from the density separator(s) (see Annex B).

4.3   Procedure

4.3.1   Density tracer selection

Density tracer selection shall be as follows.

a) Decide on one or more nominal sizes.

b) For each nominal size, decide the nominal densities (guidance is provided in Annex C).

c) For each nominal size, decide the number of density tracers to be used at each nominal density, being:

    1) no less than 30;

    2) equal to the number selected at every other nominal density.

d) Assemble those density tracers.

4.3.2   Insertion of density tracers

The following procedure shall be used for the insertion of density tracers.

a) Decide on the insertion point and required test duration and calculate the required interval between density tracer insertions as the test duration in seconds divided by the total number of density tracers selected.

    NOTE   Annex B provides further information on test durations.

b) Ensure that retrieval personnel or detection equipment are in place and activated.

c) Record the time at which the first density tracer was inserted.

d) At approximately the calculated intervals, insert or drop the density tracers into the feed stream of the density separator(s) to be tested (see Figure 1), either manually or using a mechanical dispenser. The density order of density tracer insertions shall be either:

    1) pseudo-random, by mixing the selected density tracers prior to one-by one selection and insertion; or

2) following a protocol whereby one density tracer of every selected size and density is inserted, one-by-1, followed by a second density tracer of every selected size and density, etc.

e) Record the time at which the last density tracer was inserted.

Unplanned interruptions to plant feed of up to 10 min duration can be tolerated, but tracer insertion shall be stopped, restarted when feed is resumed and documented.

Figure 1 shows typical locations for the insertion of density tracers and for the retrieval or detection of density tracers.
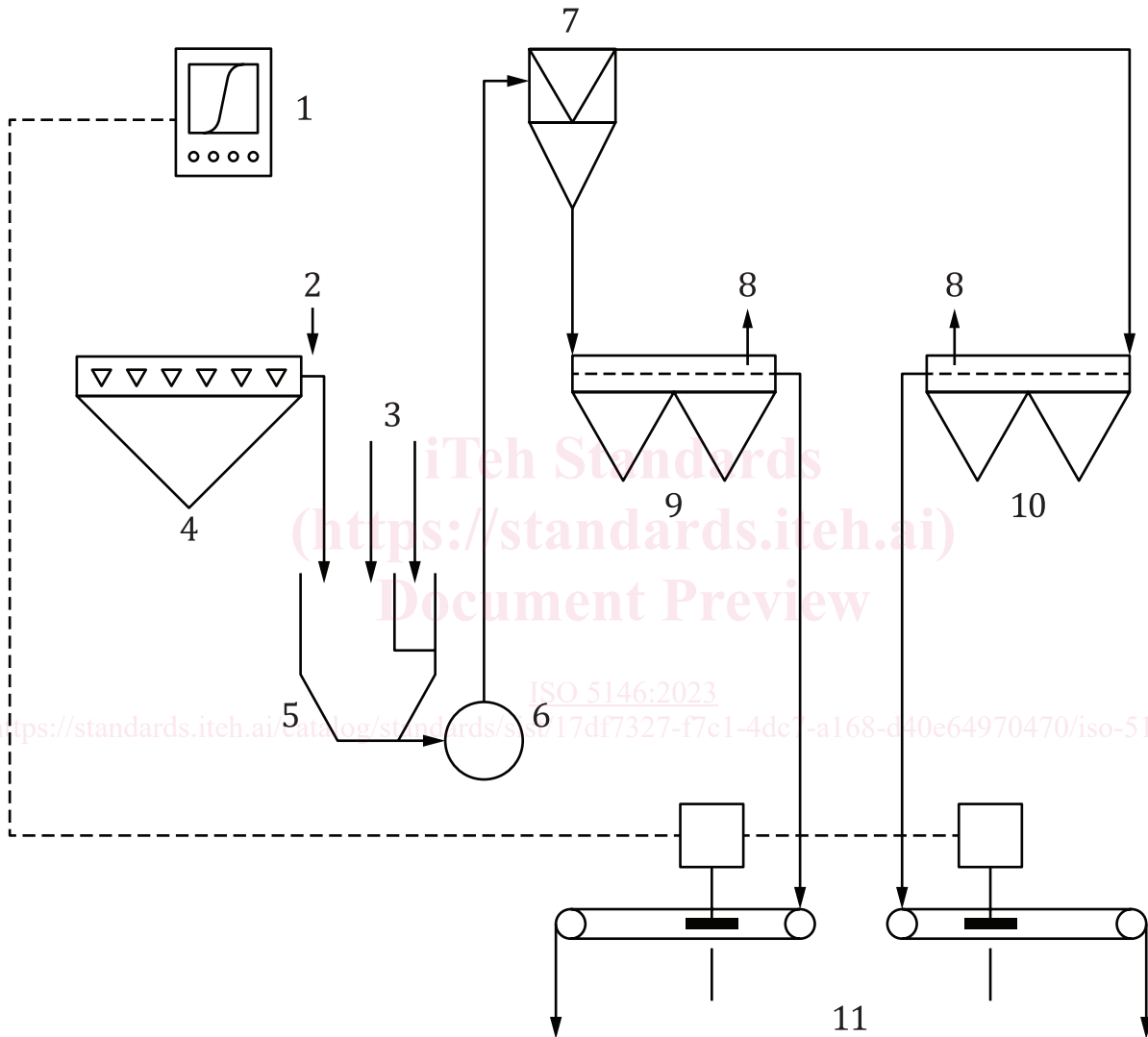
Key

1	real-time display of partition curve	7	DMC module
2	typically, density tracers would be added here	8	non-radio density tracers would be retrieved here
3	medium	9	sinks drain and rinse screen
4	de-sliming screen	10	floats drain and rinse screen
5	sump or wing tank	11	detectors for radio density tracers
6	pump		

NOTE 1   This is a simplified typical flowsheet showing points of addition and retrieval of density tracers.

NOTE 2   In this case, the separator is a dense medium cyclone.

NOTE 3   For RFID density tracers, alternative locations for detectors are at the drain-and-rinse screens.

Figure 1 — Example of a simplified density separator flowsheet

4.3.3 Density tracer retrieval or detection and data capture

4.3.3.1 Non-RFID density tracers

The procedure shall be as follows.

a) Retrieve density tracers from the material on the floats drain and rinse screen(s) (see Figure 1) by hand or using a scoop or net or magnets. Place them in one or more containers marked "Floats" (see Figure 1, NOTES 1, 2 and 3).

b) Retrieve density tracers from the material on the sinks drain and rinse screen(s) by hand or using a scoop or net or magnets. Place them in one or more containers marked "Sinks" (see Figure 1, NOTES 1, 2 and 3).

c) Sort the density tracers retrieved from floats before the cut-off time according to their densities and record the number for each density.

d) Sort the density tracers retrieved from sinks before the cut-off time according to their densities and record the number for each density.

In some circuits, screens cannot be readily accessed for density tracer retrieval, and alternative retrieval points should be sought. For example, primary density separator sinks may be fed directly to a secondary density separator without passing a drain-and-rinse screen. In that case, density tracers retrieved from secondary density separator floats and sinks should be reported as primary density separator sinks.

Any density tracers retrieved from the screens after the cut-off time should not be included in the test data.

If the density tracers are to be retrieved by magnets, they should be ferromagnetic.

4.3.3.2 Automatically detected RFID density tracers

The procedure shall be as follows.

a) Detect and record the densities of RFID density tracers in the floats stream using RFID apparatus located downstream of the density separator (see Figure 1). In some cases, circuit configuration may dictate that two or more detection points are required.

b) Detect and record the densities of RFID density tracers in the sinks stream using RFID apparatus located downstream of the density separator (see Figure 1). In some cases, circuit configuration may dictate that two or more detection points are required.

Any density tracers detected after the cut-off time shall not be included in the test data.

If access to suitable locations for detector placement is limited, alternative locations should be sought. For example, primary density separator sinks may be fed directly to a secondary density separator without passing a conveyor. In that case, density tracers retrieved from both floats and sinks of a secondary density separator should be reported as primary density separator sinks.

4.4 Data processing

4.4.1 Data acceptability

4.4.1.1 Selection of tracer densities

To be acceptable, the selected density tracer densities shall include the following eight RDs from Table 1:

a) the four RDs which are closest to the d_{50};