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GB/T 213-2008

Replacing GB/T 213-2003, GB/T 18856.6-2002

Determination of calorific value of coal

(ISO 1928:1995, Solid mineral fuels - Determination of gross calorific value by the bomb calorimetric method and calculation of net calorific value, MOD)

煤的发热量测定方法

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Standardization Administration of the People's Republic of China.

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Foreword

The revision of this Standard adopted ISO 1928:1995 “Solid mineral fuels - Determination of gross calorific value by the bomb calorimetric method and calculation of net calorific value” (English version).

This Standard was redrafted based on ISO 1928:1995 (English version). Annex A lists the control table on sub-clause numbers between this Standard and ISO 1928:1995.

Considering our national conditions, when adopting ISO 1928:1995, this Standard made some modifications. Relevant technical differences have been incorporated into the text and are marked with vertical single lines in the margins of the articles to which they relate. Annex B gives these technical differences and reasons for reference.

This Standard replaces GB/T 213-2003 “Determination of calorific value of coal” and incorporated the content of GB/T 18856.6-2002 “Test methods for quality of coal water mixture - Part 6: Determination of calorific value of coal water mixture” into this Standard.

Compared with GB/T 213-2003, the main changes in this Standard are as follows:

- added the introduction;

- added that it is applicable to coal water slurry (Clause 1 of this Edition);

- added the content of weighing coal water slurry sample (8.2.2 of this Edition);

- added the determination method for endpoint when the internal cylinder temperature cannot be observed during the main period (8.2.8 of this Edition);

- added the calculation formulas for net calorific value at constant pressure and net calorific value at constant volume when weighing coal water slurry sample (1.3.1 and 1.3.2 of this Edition);

- added the interpretation of constant terms in the calculation formulas for net calorific value at constant pressure and net calorific value at constant volume (formula 13 and formula 15 of this Edition);

- added two annexes (Annex A and Annex B of this Edition);

- made appropriate text changes.

Determination of calorific value of coal

1 Scope

This Standard specifies the principle, test conditions, reagents and materials, instruments and devices, determination steps, calculation of determination result, thermal capacity, instrument constant calibration and method precision for oxygen bomb calorimetric method that is used to determine the gross calorific value of coal. This Standard also specifies the calculation method for net calorific value.

This Standard is applicable to solid fossil fuels such as peat, lignite, bituminous coal, anthracite, coke, carbon shale, and coal water slurry.

2 Normative references

The provisions in following documents become the provisions of this Standard through reference in this Standard. For dated references, the subsequent amendments (excluding corrigendum) or revisions do not apply to this Standard, however, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 211, *Determination of total moisture in coal* (GB/T 211-2007, ISO 589:2003, NEQ)

GB/T 212, *Proximate analysis of coal* (GB/T 212-2008, ISO 11722:1999, ISO 1171:1997, ISO 562:1998, NEQ)

GB/T 214, *Determination of total sulfur in coal* (GB/T 214-2007, ISO 334:1992, ISO 351:1996, NEQ)

GB/T 476, *Ultimate analysis of coal* (GB/T 476-2008, ISO 625:1996, Solid mineral fuels - Determination of carbon and hydrogen - Liebig method, MOD)

GB/T 483, *General rules for analytical and testing methods of coal* (GB/T 483-2007, ISO 1213-2:1992 Solid mineral fuels - Vocabulary - Part 2: Terms relating to sampling, testing and analysis, NEQ)

GB/T 19227, *Determination of nitrogen in coal* (GB/T 19227-2008, ISO 333:1996, Coal - Determination of nitrogen - Semi-micro Kjeldahl method, ISO/TS 11725:2002, Solid mineral fuels - Determination of nitrogen - Semi-

micro gasification, MOD)

3 Terms and definitions

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

3.1 heat unit

The unit of heat is Joule (J).

Joule (J) is the work done by a force of 1 Newton (N) to move its point of action by 1m in the direction of the force.

$$1J = 1N \cdot m$$

The determination result of calorific value is expressed in mega Joules per kilogram (MJ/kg) or Joules per gram (J/g).

3.2 bomb calorific value

The value of heat released when the unit mass of the sample is burned in an oxygen bomb that is filled with excess oxygen and the products of combustion consist of oxygen, nitrogen, carbon dioxide, nitric acid and sulfuric acid, liquid water and solid ash.

NOTE: The heat of combustion of any substance (including coal) changes with the final temperature of the combustion products. The higher the temperature, the lower the heat of combustion. Therefore, a strict definition of calorific value, the final temperature (reference temperature) of the combustion products shall be specified (the reference temperature specified in ISO 1928 is 25°C). However, in the actual measurement of calorific value, it is unrealistic to limit the final temperature of the combustion products to a specific temperature or a narrow range due to the limitation of specific conditions. For every 1K increase in temperature, the combustion heat of coal and benzoic acid decreases approximately (0.4~1.3) J/g. When calibrating the heat capacity and measuring the calorific value at similar temperatures according to regulations, the effect of temperature on the heat of combustion can be nearly completely cancelled without consideration.

3.3 gross calorific value at constant volume

The absolute value of the specific energy of combustion for unit mass of a solid fuel burned in oxygen in a calorimetric bomb under the conditions specified. The products of combustion are assumed to consist of gaseous oxygen, nitrogen, carbon dioxide and sulfur dioxide, of liquid water saturated with carbon dioxide under the conditions of the bomb reaction, and of solid ash, all at the reference temperature.

The gross calorific value at constant volume is the calorific value obtained by

4.2 Net calorific value

The net calorific value at constant volume and the net calorific value at constant pressure of coal can be calculated by analyzing the gross calorific value of the sample. It requires to know the water content and the hydrogen content in coal sample to calculate the net calorific value at constant volume. In principle, it also needs to know the content of oxygen and the content of nitrogen in coal samples to calculate the net calorific value at constant volume.

5 Laboratory conditions

The laboratory that conducts the calorific value measurement shall meet the following conditions:

- The laboratory that conducts the calorific value measurement shall be a separate room. No other test items shall be conducted simultaneously in the same room;

- The room temperature shall remain relatively stable. The temperature change of each measurement shall not exceed 1°C, and the room temperature shall be in the range of (15~30)°C;

- There shall be no strong air convection in the room, so there shall be no strong heat sources, cold sources, fans, etc. Avoid opening doors and windows during the test;

- The laboratory shall be facing north to avoid sunlight, otherwise the calorimeter shall be placed in a place that is not exposed to direct sunlight.

6 Reagents and materials

6.1 Oxygen: at least 99.5% purity; free of combustible components; electrolytic oxygen is not allowed; pressure is sufficient to oxygenate the oxygen bomb to 3.0MPa.

6.2 Sodium hydroxide standard solution: c(NaOH) ≈0.1mol/L.

Weigh 4g of guaranteed-reagent sodium hydroxide. Dissolve in 1000mL of water that has been boiled and cooled. Mix well. Load into a plastic bottle or a plastic tube. Tighten the lid. Then use guaranteed-reagent potassium hydrogen phthalate (GB/T 12257) to calibrate.

6.3 Methyl red indicator: 2g/L.

Weigh 0.2g of methyl red. Dissolve in 100mL of water.

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