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Method for Determination of the Carbon Content on the Inner Surface of Copper and Copper-Alloy Tube

铜及铜合金管材内表面碳含量的测定方法

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Foreword

This Standard was drafted as per the rules specified in GB/T 1.1-2009.

This Standard was proposed by China Nonferrous Metals Industry Association.

This Standard shall be under the jurisdiction of National Technical Committee for Standardization of Nonferrous Metals (SAC/TC 243).

Drafting organizations of this Standard: Zhejiang Province Metallurgic Products Quality Test Station Co., Ltd., Zhejiang Hailiang Co., Ltd., and Zhejiang Tianning Alloy Material Co., Ltd.

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Method for Determination of the Carbon Content on the Inner Surface of Copper and Copper-Alloy Tube

1 Scope

This Standard specifies the method for determination of carbon content in copper and copper-alloy tube or on the inner surface of tube.

This Standard is applicable to the quantitative test of carbon content in n copper and copper-alloy tube or on the inner surface of tube; the measuring range is 5mg/m^2 ~ 500mg/m^2.

2 Terms and Definitions

The following terms and definitions are applicable to this document.

2.1 Residual carbon (C_R)

The carbon existing in the single substance form.

2.2 Potential carbon (C_P)

The carbon existing in the organic compounds (e.g.: organic compounds of oil, grease, etc.).

2.3 Total carbon (C_T)

The total sum of residual carbon and potential carbon.

3 Method Summary

Heat the copper and copper-alloy tube or tube sample in the oxygen stream to certain temperature, and burn the carbon existing on the inner surface. Use the infrared absorption spectroscopy to determine the generated carbon dioxide; then measure the content of residual carbon and potential carbon, respectively.

The content of potential carbon shall be calculated by substracting the residual carbon

from total carbon.

4 Reagents

4.1 Oxygen (minimum mass purity of 99.99%): the oxygen that can be purified to 99.99% by the purifier.

4.2 Deionized water (containing no carbon dioxide): boil the deionized water for 30min; inject the oxygen (4.1) for 15min during the process of cooling off the deionized water to the room temperature; prepare before use.

4.3 Tetrachloroethylene (analytically pure).

4.4 Trichloroethylene (analytically pure).

4.5 Trichloroethane (analytically pure).

4.6 Nitric acid (1+1).

4.7 Mannitol Standard Solution A: weigh 1.2640g of mannitol ($C_6H_{14}O_6$, pre-dry at 100°C~105°C, and place into the desiccator to cool off to the room temperature); place into 100mL beaker; add deionized water (4.2) to dissolve. Transfer into 100mL volumetric flask; dilute with deionized water (4.2) to the scale; mix evenly. 1μL of such solution contains 5μg of carbon.

4.8 Mannitol Standard Solution B: transfer 10.00mL of mannitol standard solution (4.7) into 100mL volumetric flask; dilute with deionized water (4.2) to the scale; mix evenly. 1μL of such solution contains 5μg of carbon.

4.9 Carbon dioxide gas (minimum mass purity of 99.99%).

4.10 Soda asbestos.

4.11 Anhydrous magnesium perchlorate.

5 Apparatus

5.1 Tube furnace heating-infrared carbon and sulfur analyzer

The connection schematic diagram of the device can refer to Figure 1. The burning process is implemented in the quartz pipe.

6.3.3 Use the cleaning square saws or bow saws with dense teeth to cut off the required length; avoid the overheating of the specimen.

6.3.4 If the specimen length is greater than the length of combustion zone specified by the combustion device in the sample chamber; cut the pipe fitting into two parts; so that the two parts can enter into the combustion zone at the same time. If using the electric saws, ensure the all saw surfaces contacting with the pipe fitting surface have been degreased. When cutting and filing the pipe fitting, ensure the pipe sample is fixed firmly (for instance, placing into the pliers) without excessive distortion.

6.3.5 When the diameter of copper and copper-alloy tube or pipe fitting exceeds the furnace diameter, flatten the copper and copper-alloy tube and pipe fitting, so that obtain the specimen with the inner surface meeting the requirements of test.

7 Test Procedures

7.1 Specimen

Take the prepared specimen (see 6.3).

7.2 The number of measurement

Perform two separate measurements, then take their average value.

7.3 Preparation before analysis

Inject the oxygen, check whether the pipe and piston of the whole device leaks gas. Adjust and maintain the instrument into the normal working state. Turn on the power and raise temperature to 600°C±10°C. The recommended analysis condition can refer to Appendix A.

7.4 Blank test

7.4.1 Perform two blank tests before measurement.

7.4.2 Take the blank test specimen (see 6.2.4, 6.3); measure as per 7.6; the blank value shall be calculated by the total surface area (inner and outer surface areas) of the blank specimen. The blank value shall be the arithmetic mean of two specimens measured; the blank value shall be no greater than 1.5mg/m^2.

7.4.3 If the blank value is too large, the specimen preparation shall be re-evaluated and re-set the blank value.

7.5 Calibration test

7.5.1 According to the carbon content in the specimen, select the corresponding