Sulfur and Carbon in Coal and Coke

LECO Corporation; Saint Joseph, Michigan USA

Instrument: SC832 Series

Introduction

Total sulfur value is an important characterization measurement for coal and coke fuel materials, and is considered to be part of the ultimate analysis parameters (determination of carbon, hydrogen, nitrogen, sulfur, and ash with oxygen calculation by difference). The total sulfur value is a primary parameter used for assessing the quality of a fuel, calculating coal and coke preparation and cleaning processes, and the emissions potential of the fuel.

Total carbon in these materials is typically used to calculate CO_2 emissions potential when used as a fuel, to calculate a material balance and process efficiency, or to determine a material quality.

Sample Preparation

A representative, uniform sample is required. Samples should be prepared in accordance to ASTM D2013. Coal and coke reference materials such as those offered by LECO and NIST are properly prepared. Samples are analyzed on an as-determined basis. A separate portion of the sample is analyzed for moisture content in accordance with ASTM D3173, ASTM D7582, or ISO 11722 for calculations to dry basis.

Method Reference

ASTM D4239 Sulfur (Method A)

Accessories 528-203 Ceramic Boat

Calibration Samples

LECO coal and coke reference materials, NIST, or other suitable coal, or coke reference materials.

*Method Parameters**

Furnace Temperature	1350°C
Lance On Delay	20 seconds
Manual Analysis Model	Single Sample
Nominal Blank Mass	1.0000 g

Element Parameters

	Sulfur	*Carbon*
Wait for Baseline Stability	Yes	Yes
Starting Baseline	2 sec	2 sec
Use Comparator	Yes	Yes
Comparator	0.30	0.30
Minimum Integration Time	90 sec	180 sec
Maximum Integration Time	360 sec	360 sec

Automatically Started Analysis

Auto Detect Data Missed Time	5 sec	5 sec
Low Cell Autostart Level	0.01 V	0.01 V
High Cell Autostart Level	0.01 V	

Manually Started Analysis

Integration Delay	0 sec	0 sec

**Refer to SC832 Operator's Instruction Manual for Method Parameter definitions.*

Procedure

1. Prepare instrument for operation as outlined in the operator's instruction manual.
2. Condition the system by analyzing a minimum of three ~0.10 g coal or coke samples.
3. Determine instrument blank.
   a. Login a minimum of three blanks.
   b. Place the ceramic boat in front of the furnace entrance or in the appropriate autoloader position.
   c. Initiate the analysis by pressing the Analyze button.
   d. For manual systems, load the sample into the furnace and press the analyze button when prompted by the software.
   e. Repeat steps 3b through 3d a minimum of three times.
   f. Set the Blank according to the procedure outlined in the operator's instruction manual.
4. Instrument calibration/drift correction.
   a. Login a minimum of three Standard reps for each calibration/drift reference material to be used for calibration/drift.
   b. Weigh ~0.10 g of a calibration/drift reference material into the ceramic boat and enter the mass and reference material identification into the standard login.
   c. Place the ceramic boat in front of the furnace entrance or in the appropriate autoloader position.
   d. Initiate the analysis by pressing the Analyze button.
   e. For manual systems, load the sample into the furnace when prompted by the software.
   f. Repeat steps 4b through 4e a minimum of three times.
   g. Calibrate/drift correct by following the procedure in the operator's instruction manual.
5. Sample Analysis
   a. Login a Sample with a desired number of reps.
   b. Weigh ~0.10 g of sample into the ceramic boat and enter the mass and sample identification into the sample login.
   c. Place the ceramic boat in front of the furnace entrance or in the appropriate autoloader position.
   d. Initiate the analysis by pressing the Analyze button.
   e. For manual systems, load the sample into the furnace when prompted by the software.
   f. Repeat steps 5b through 5d as necessary.

Organic Application Note

Delivering the Right Results

Typical Results SC832

Description	Mass (g)	% Carbon	% Sulfur
Bituminous Coal	0.1005	76.8	1.47
NIST SRM 1632d	0.1001	76.8	1.46
76.88% Carbon	0.1003	76.8	1.43
±0.15%	0.0957	76.8	1.45
1.462% Sulfur	0.1057	76.9	1.46
±0.074	***Avg.***	***76.8***	***1.45***
	Std. Dev.	***0.04***	***0.02***
Foundry Coke	0.1001	91.74	0.57
NIST SRM 2775	0.1085	91.84	0.57
91.34% Carbon	0.1058	91.74	0.57
±0.49%	0.1081	91.59	0.57
0.5816% Sulfur	0.0968	91.78	0.57
	Avg.	***91.74***	***0.57***
	Std. Dev.	***0.09***	***0.003***
Bituminous Coal	0.1055	69.2	4.07
LECO 502-674	0.1057	69.1	4.06
Lot 14157	0.1073	69.0	4.08
4.16% Sulfur	0.1087	68.9	4.07
±0.14%	0.1006	69.2	4.07
NOTE: Carbon content not certified.	***Avg.***	***69.1***	***4.07***
	Std. Dev.	***0.13***	***0.01***
Metallurgical Coke	0.0939	88.9	0.72
LECO 502-683	0.0963	88.9	0.74
Lot 15034	0.1051	89.2	0.73
88.5% Carbon	0.1047	88.9	0.74
±2.3%	0.1088	89.0	0.73
0.76% Sulfur	***Avg.***	***89.0***	***0.73***
±0.04%	***Std. Dev.***	***0.13***	***0.01***
Bituminous Coal	0.0941	73.4	1.93
NIST SRM 2683c	0.1013	73.3	1.94
73.38% Carbon	0.1020	73.5	1.95
±0.22%	0.1035	73.4	1.97
1.955% Sulfur	0.1059	73.4	1.94
±0.044%	***Avg.***	***73.4***	***1.95***
	Std. Dev.	***0.07***	***0.02***

Typical Results SC832DR

Description	Mass (g)	% Carbon	% Sulfur
Bituminous Coal	0.1025	76.6	1.44
NIST SRM 1632d	0.1011	76.9	1.45
76.88% Carbon	0.1005	76.9	1.44
±0.15%	0.1018	77.0	1.44
1.462% Sulfur	0.1029	77.0	1.45
±0.074	***Avg.***	***76.9***	***1.44***
	Std. Dev.	***0.16***	***0.01***
Foundry Coke	0.1046	90.94	0.59
NIST SRM 2775	0.1091	91.18	0.59
91.34% Carbon	0.1013	91.08	0.58
±0.49%	0.1071	91.13	0.58
0.5816% Sulfur	0.1070	91.04	0.58
	Avg.	***91.09***	***0.58***
	Std. Dev.	***0.09***	***0.005***
Bituminous Coal	0.1081	68.7	4.06
LECO 502-674	0.1065	69.1	4.11
Lot 14157	0.1036	69.1	4.09
4.16% Sulfur	0.1072	69.0	4.11
±0.14%	0.1053	68.9	4.11
NOTE: Carbon content not certified.	***Avg.***	***69.0***	***4.10***
	Std. Dev.	***0.14***	***0.02***
Metallurgical Coke	0.1020	88.5	0.75
LECO 502-683	0.0995	88.7	0.74
Lot 15034	0.1092	88.4	0.74
88.5% Carbon	0.1090	88.5	0.74
±2.3%	0.1038	88.3	0.74
0.76% Sulfur	***Avg.***	***88.5***	***0.74***
±0.04%	***Std. Dev.***	***0.15***	***0.01***
Bituminous Coal	0.1030	73.3	1.92
NIST SRM 2683c	0.1027	73.4	1.93
73.38% Carbon	0.0972	73.5	1.93
±0.22%	0.1016	73.4	1.92
1.955% Sulfur	0.1026	73.4	1.93
±0.044%	***Avg.***	***73.4***	***1.93***
	Std. Dev.	***0.07***	***0.01***

**Results dry basis (moisture corrected) using a linear force through origin calibration.*
LECO and NIST standard reference materials were used for the calibrations.

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