

## Instrument: SC832 Series

## Sulfur and Carbon in Coal and Coke

LECO Corporation; St. Joseph, Michigan USA

### 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<sub>2</sub> 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  | 90 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.

## 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          | <b>Avg.</b>      | <b>76.8</b> | <b>1.45</b> |
|                 | <b>Std. Dev.</b> | <b>0.04</b> | <b>0.02</b> |

|                |                  |              |              |
|----------------|------------------|--------------|--------------|
| 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         |
|                | <b>Avg.</b>      | <b>91.74</b> | <b>0.57</b>  |
|                | <b>Std. Dev.</b> | <b>0.09</b>  | <b>0.003</b> |

|                                     |                  |             |             |
|-------------------------------------|------------------|-------------|-------------|
| 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. | <b>Avg.</b>      | <b>69.1</b> | <b>4.07</b> |
|                                     | <b>Std. Dev.</b> | <b>0.13</b> | <b>0.01</b> |

|                    |                  |             |             |
|--------------------|------------------|-------------|-------------|
| 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       | <b>Avg.</b>      | <b>89.0</b> | <b>0.73</b> |
| ±0.04%             | <b>Std. Dev.</b> | <b>0.13</b> | <b>0.01</b> |

|                 |                  |             |             |
|-----------------|------------------|-------------|-------------|
| 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%         | <b>Avg.</b>      | <b>73.4</b> | <b>1.95</b> |
|                 | <b>Std. Dev.</b> | <b>0.07</b> | <b>0.02</b> |

## 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          | <b>Avg.</b>      | <b>76.9</b> | <b>1.44</b> |
|                 | <b>Std. Dev.</b> | <b>0.16</b> | <b>0.01</b> |

|                |                  |              |              |
|----------------|------------------|--------------|--------------|
| 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         |
|                | <b>Avg.</b>      | <b>91.09</b> | <b>0.58</b>  |
|                | <b>Std. Dev.</b> | <b>0.09</b>  | <b>0.005</b> |

|                                     |                  |             |             |
|-------------------------------------|------------------|-------------|-------------|
| 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. | <b>Avg.</b>      | <b>69.0</b> | <b>4.10</b> |
|                                     | <b>Std. Dev.</b> | <b>0.14</b> | <b>0.02</b> |

|                    |                  |             |             |
|--------------------|------------------|-------------|-------------|
| 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       | <b>Avg.</b>      | <b>88.5</b> | <b>0.74</b> |
| ±0.04%             | <b>Std. Dev.</b> | <b>0.15</b> | <b>0.01</b> |

|                 |                  |             |             |
|-----------------|------------------|-------------|-------------|
| 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%         | <b>Avg.</b>      | <b>73.4</b> | <b>1.93</b> |
|                 | <b>Std. Dev.</b> | <b>0.07</b> | <b>0.01</b> |

\*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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