

Instrument: SC832 Series

Sulfur and Carbon Determination in Flour and Plant Tissue

LECO Corporation; Saint Joseph, Michigan USA

Introduction

Sulfur is one of the essential macronutrients required for plant growth, aiding the formation of amino acids and proteins, as well as chlorophyll formation. Sulfur deficiencies in a plant can cause chlorosis in new leaf formations, as well as stunted growth and higher plant mortality rates. Measuring the sulfur content of the plant tissue can serve as a health check for plants, or in the case of troubleshooting a growth or yield issue in a crop, provide a diagnostic tool for establishing a possible macronutrient deficiency.

Sample Preparation

A representative, uniform sample is required. Reference materials should be prepared as directed by the certificate prior to analysis.

Note: Sulfur and carbon results for flour and plant tissue samples are generally reported on a dry basis. The material can either be dried prior to analysis or the moisture content can be determined on the day of analysis and used to correct the values for moisture utilizing the instrument's software. Flour and plant tissue samples are typically dried between 80 °C and 85 °C for two hours prior to analysis. The dried samples should be stored in a desiccator and must be used for analysis within 24 hours.

Accessories

528-203 Ceramic Boats*, 761-929 Crucible Tongs, 501-614 Spatula, 502-321 Com-Cat™

**For best precision, ceramic boats should be baked off in a muffle furnace at 1000 °C for a minimum of 40 minutes. Once the ceramic boats have cooled, they can be transferred to a desiccator for storage. If the ceramic boats are not used within twenty-four hours, they should be re-baked. After preheating, handle ceramic boats with clean tongs only; do not use fingers.*

Calibration Samples

LCRM®, LRM®, NIST, or other suitable plant or flour reference materials.

Method Parameters*

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

Element Parameters

	Sulfur	Carbon
Wait for Baseline Stability	Yes	Yes
Starting Baseline	2 s	2 s
Use Comparator	Yes	Yes
Comparator	0.30	0.30
Minimum Integration Time	120 s	75 s
Maximum Integration Time	360 s	360 s

Automatically Started Analysis

Auto Detect Data Missed Time	3 s	3 s
Autostart Level	0.01 V	0.01 V

Manually Started Analysis

Integration Delay	0 s	0 s
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*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 ~0.15 g samples of a similar matrix.
3. Determine instrument blank.
 - a. Login a minimum of three Blank replicates.
 - b. Add ~1.0 g of 502-321 Com-Cat into a pre-baked 528-203 Ceramic Boat.
 - c. Place the ceramic boat in front of the furnace entrance or the appropriate autoloader position.
 - d. Initiate the analysis by pressing the Analyze button.
 - e. For manual systems, when prompted by the software, load the sample into the furnace and press the Analyze button.
 - f. Repeat steps 3b through 3e a minimum of three times.
 - g. 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/drift replicates for each reference material to be used for calibration/drift.
 - b. Weigh ~0.15 g of a reference material into the pre-baked ceramic boat and enter the mass into the standard login.
 - c. Add ~1.0 g of 502-321 Com-Cat into the pre-baked ceramic boat containing the reference material and thoroughly mix with the sample.
 - d. Place the ceramic boat in front of the furnace entrance or in the appropriate autoloader position.
 - e. Initiate the analysis by pressing the Analyze button.
 - f. For manual systems, when prompted by the software, load the sample into the furnace and press the Analyze button.
 - g. Repeat steps 4b through 4f a minimum of three times.
 - h. 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 ~0.15 g of sample into the pre-baked ceramic boat and enter the mass into the sample login.
 - c. Repeat steps 4c through 4f as necessary.

Typical Results*

Name	Description	Mass (g)	Sulfur (%)	Carbon (%)
LECO 502-055 Lot: 1036	$0.126 \pm 0.008 \text{ %S}$	0.1516	0.131	49.58
Orchard Leaves	$49.55 \pm 0.25 \text{ %C}$	0.1502	0.128	49.79
		0.1546	0.128	49.70
		0.1573	0.124	49.70
		0.1564	0.126	49.72
		0.1531	0.127	49.75
		0.1534	0.128	49.64
		0.1545	0.129	49.65
		0.1553	0.126	49.63
		0.1546	0.126	49.69
	Avg =	0.127	49.69	
	<i>s =</i>	0.002	0.06	
LECO 502-273 Lot: 1026	$0.38 \pm 0.02 \text{ %S}$	0.1527	0.402	45.26
Alfalfa	$45.05 \pm 0.23 \text{ %C}$	0.1558	0.394	45.22
		0.1581	0.392	45.10
		0.1545	0.390	45.12
		0.1557	0.390	45.17
		0.1523	0.386	45.21
		0.1537	0.387	44.93
		0.1555	0.384	45.02
		0.1547	0.386	45.14
		0.1547	0.383	45.15
	Avg =	0.389	45.13	
	<i>s =</i>	0.006	0.10	
LCRM 502-692 Lot: 1000	$0.193 \pm 0.016 \text{ %S}$	0.1562	0.196	45.43
Wheat Flour	$45.34 \pm 0.38 \text{ %C}$	0.1568	0.195	45.40
		0.1525	0.196	45.30
		0.1574	0.196	45.17
		0.1576	0.198	45.27
		0.1574	0.197	45.22
		0.1530	0.197	45.43
		0.1543	0.197	45.26
		0.1574	0.197	45.26
		0.1539	0.198	45.15
	Avg =	0.197	45.29	
	<i>s =</i>	0.001	0.10	

*Results based on using a linear force through origin calibration utilizing LECO 502-692 (Lot 1000) LCRM. LECO Reference Materials were dried according to the certificate and used for the calibrations.



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