

Determination of Carbon and Sulfur in Cast Iron

LECO Corporation; Saint Joseph, Michigan USA

Instrument: CS744 Series



Introduction

The following application note outlines the setting and steps required to determine the carbon and sulfur levels in cast iron with the CS/C/S744 series of elemental analyzers. Carbon is the main alloying element in cast iron at levels greater than 2%. Sulfur is typically a contaminant in cast iron, and will prevent the formation of graphite thus making the cast iron harder. Most foundries maintain sulfur at levels less than 0.15%. With its simultaneous carbon and sulfur detection capability and easy-to-use touch-screen interface, the CS744 carbon and sulfur by combustion analyzer makes the perfect addition to any foundry laboratory.

Sample Preparation

Refer to ASTM E1806 for proper sampling of cast iron.

Accessories

528-018 or 528-018HP Crucible; LECOCEL II (502-173 or 501-008); 502-231 Iron Chip or 501-077 Accelerator; 773-579 Metal Scoop; 761-929 Tongs

For optimal sulfur precision, ceramic crucibles can be pre-baked in a muffle oven at $\geq 1000^{\circ}\text{C}$ for a minimum of 1 hour, or tube furnace (LECO TF1/TF-10) at $\geq 1250^{\circ}\text{C}$ for a minimum of 15 minutes. The crucibles are removed from the tube furnace/muffle oven, allowed to cool, and are then transferred to a desiccator for storage. Baked crucibles must be handled with clean tongs only to avoid contamination.

Calibration

501-024 Cast Iron Powder; 501-105 Cast Iron Powder; 501-994 Cast Iron Powder; 501-999 Cast Iron Powder; or other suitable reference materials.

Method Parameters

General Parameters

Purge Time:	5 s
Delay Time:	10 s
Sample Cool Time:	10 s
Furnace Power:	100%

Element Parameters	Carbon	Sulfur
Integration Delay:	0 s	0 s
Starting Baseline:	2 s	2 s
Use Comparator:	No	No
Integration Time:	60 s	65 s
Use Endline:	Yes	Yes
Ending Baseline:	2 s	2 s

Procedure

1. Prepare instrument for operation as outlined in the operator's instruction manual.
2. Determine the instrument Blank.
 - a. Login a minimum of three Blank reps.
 - b. Add one 773-579 Scoop (~ 1.2 g) of LECOCEL II and one 773-579 Scoop (~ 0.8 g) Iron Chip.
 - c. Place the crucible on the furnace pedestal (or appropriate autoloader position if applicable), and initiate analysis.
 - d. Repeat steps 2b through 2c a minimum of three times.
 - e. Set the blank by following the procedure outlined in the operator's instruction manual.
3. Calibrate/Drift Correct
 - a. Login a minimum of three standard/drift reps.
 - b. Weigh ~ 0.5 g of 501-024 Cast Iron reference material or other suitable calibration/drift material into a 528-018 or 502-018 HP crucible and enter the mass and identification of the reference material.
 - c. Add one 773-579 Scoop (~ 1.2 g) of LECOCEL II and one 773-579 Scoop (~ 0.8 g) Iron Chip. accelerator on top of the reference material.
 - d. Place the crucible on the furnace pedestal (or appropriate autoloader position if applicable) and initiate analysis.
 - e. Repeat steps 3b through 3d a minimum of three times for each calibration/drift reference material intended for calibration/drift.
 - f. Calibrate/drift correct by following the procedure outlined in the operator's instruction manual. Linear force through origin calibration is recommended.
4. Sample Analysis
 - a. Login a sample with appropriate number of reps.
 - b. Weigh ~ 0.5 g of cast iron sample into the crucible and enter the mass and identification.
 - c. Add one 773-579 Scoop (~ 1.2 g) of LECOCEL II and one 773-579 Scoop (~ 0.8 g) Iron Chip. accelerator on top of the sample.
 - d. Place the crucible on the furnace pedestal (or appropriate autoloader position if applicable), and initiate analysis.



Typical Results

Sample	Mass (g)	% Carbon	% Sulfur
Cast Iron	0.4986	3.38	0.042
	0.5035	3.37	0.042
	0.5008	3.37	0.041
	0.4971	3.37	0.042
	0.5014	3.37	0.041
	0.4969	3.38	0.043
	0.4976	3.37	0.041
	0.4992	3.39	0.042
	0.4972	3.39	0.042
	0.4998	3.38	0.042
	Avg =	3.38	0.042
	s =	0.01	0.001