Carbon and Sulfur in Metal-Bearing Ores and Related Materials

LECO Corporation; Saint Joseph, Michigan USA

Instrument: CS600

Introduction

The determination of carbon and sulfur levels in metal-bearing ores is a necessary quality control, environmental monitoring, and cost-saving step in the metals recovery process. These levels are used as a means of ore classification for process selection, and waste classification for the determination of potential environmental impact. For example, the amount of sulfur present in gold-bearing ores gives an indication of the level of sulfides present, which are refractory in nature. The sulfur level helps determine the optimal type of oxidative pretreatment process, and the potential for harmful environmental effects like acid rock/mine drainage. The amount of carbon present in gold-bearing ores is relative to the amount of carbonaceous material present. These materials adsorb gold during processing, thus reducing the recovery rate. Other ores, such as copper-bearing ores, are also analyzed for similar reasons.

Sampling and Sample Preparation

Samples should be uniform powder of <100 mesh (150 micron). Samples should be dried at 105°C to constant weight.

Method Reference ASTM E1915

Accessories

528-018 or 528-018HP Ceramic Crucibles*; LECOCEL (763-266 or 763-263) or LECOCEL II (501-008 or 502-173) accelerator, and Iron Chip accelerator (501-077 or 502-231)

**For best precision, ceramic crucibles should be baked in a muffle or tube furnace (LECO TF10) at 1250°C for a minimum of 15 minutes, or at 1000°C for 40 minutes. The crucibles are removed from the furnace, allowed to cool for 1 to 2 minutes, and transferred to a desiccator for storage. If the crucibles are not used within four hours, they should be re-baked. Handle crucibles with clean tongs only.*

Calibration

NIST reference materials and/or LECO 502-318, 502-319, 502-320, 502-372 Ore samples

Method Parameters

Purge Time (seconds)	5**
Delay Time (seconds)	10**
Furnace Low Power (%)	100
Furnace High Power (%)	100
Furnace Ramp Rate	0

	Carbon	*Sulfur*
Minimum Timeout (seconds)	40	40
Comparator Level	1.00	1.00
Significant Digits	4 or 5	4 or 5
Integration Delay	0	0

***For optimum analytical performance on samples with low carbon and sulfur content (<0.05%), a purge time of 10 seconds and a delay time of 20 seconds is recommended.*

Procedure

1. Prepare instrument for operation as outlined in the operator's instruction manual.
2. Determine blank.
   a. Enter 1.0000 g mass into Sample Login (F3), using Blank as the sample name.
   b. Add ~1.5 g of LECOCEL (or LECOCEL II) and ~1 g of Iron Chip accelerator to crucible.
   c. Place the crucible on the furnace pedestal (or appropriate autoloader position if so equipped), and initiate analyze (F5).
   d. Repeat steps 2a through 2c a minimum of three times.
   e. Set blank following procedure outlined in operator's instruction manual.
3. Calibrate/Drift Correct.
   a. Weigh ~0.2 to 0.3 g calibration/drift sample into crucible and enter mass and sample identification into Sample Login (F3).
   b. Add ~1.5 g of LECOCEL (or LECOCEL II) and ~1 g or Iron Chip accelerator on top of sample.
   c. Place the crucible on the furnace pedestal (or appropriate autoloader position if so equipped), and initiate Analyze (F5).
   d. Repeat steps 3a through 3c a minimum of three times for each calibration/drift sample intended for calibration/drift.
   e. Calibrate/drift correct using the procedure outlined in the operator's instruction manual.
4. Analyze Samples.
   a. Weigh ~0.2 to 0.3 g sample into crucible and enter mass and sample identification into Sample Login (F3).
   b. Add ~1.5 g of LECOCEL (or LECOCEL II) and ~1 g of Iron Chip accelerator on top of sample.
   c. Place crucible on furnace pedestal (or appropriate autoloader position if so equipped), and initiate Analyze (F5).

   Note: Samples with high carbon and sulfur content may require reduced sample mass to prevent saturation of the IR detection cells.

Inorganic Application Note

Delivering the Right Results

*Typical Results**

Sample	*Mass g*	*C %*	*S %*	*Sample*	*Mass g*	*C %*	*S %*
LECO	0.2236	1.38	1.39	NIST	0.2516	5.63	1.48
502-319	0.2212	1.38	1.39	SRM 886	0.2515	5.73	1.46
Ore Tailing	0.2229	1.38	1.39	Gold Ore	0.2512	5.70	1.47
1.38% C	0.2222	1.39	1.36	(5.7)% C	0.2504	5.65	1.46
1.36% S	0.2249	1.39	1.37	1.466% S	0.2538	5.66	1.44
	0.2261	1.38	1.38		0.2495	5.60	1.48
	X =	***1.38***	***1.38***		***X =***	***5.66***	***1.46***
	s =	***0.01***	***0.01***		***s =***	***0.05***	***0.02***
LECO	0.2526	0.519	0.733	NIST	0.2513	3.36	0.347
502-318	0.2545	0.522	0.739	SRM 8704	0.2503	3.35	0.356
Ore Tailing	0.2532	0.520	0.737	River Sediment	0.2513	3.35	0.359
0.50% C	0.2521	0.520	0.725	3.351% C	0.2541	3.35	0.359
0.73% S	0.2502	0.521	0.733	(sulfur not	0.2536	3.32	0.361
	0.2512	0.518	0.738	certified)	0.2502	3.33	0.372
	X =	***0.520***	***0.734***		***X =***	***3.34***	***0.360***
	s =	***0.001***	***0.005***		***s =***	***0.02***	***0.008***

**Carbon results based on single-standard calibration with NIST SRM 8704, sulfur results based on single-standard calibration with NIST SRM 886.*

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