Application Note

Instrument: GDS900

Bulk Analysis of Cast Iron

LECO Corporation; Saint Joseph, Michigan USA

Key Words: Cast Iron, GDS900 Atomic Emission Spectrometer

Introduction

Cast irons are a major family of ferrous alloys containing percentage levels of carbon and silicon. Alloying elements such as chromium and nickel enhance the physical properties of the metal while the structure maintains a rich carbon phase. Whether the objective is to improve the strength, abrasion resistance, corrosion resistance, or another characteristic of the basic iron, the chemical composition must be controlled in order to achieve the desired physical properties. Chilled buttons or coupons are typically cast for quick analysis. Unlike point-to-plane sources as-cast iron, both gray and ductile, can be analyzed by the GDS900.

The LECO GDS900 is an atomic emission spectrometer that determines the elemental content of solid conductive materials by measuring the intensity of characteristic light emitted from the sample when excited. The glow discharge source uniformly removes (sputters) material from the sample surface, outperforming other excitation sources. Excitation of the atoms occurs in the glow discharge plasma discretely apart from the sample surface thereby reducing the metallurgical and chemical history inherent in all samples. Neutral atomic emission lines predominate the glow discharge spectra. While singly ionized transitions are observed in the glow discharge, the spectra are notably less complex than those produced by most other atomic emission techniques, resulting in few spectral interferences. In addition, the response of the typical glow discharge analytical line is linear and thus fewer wavelengths are required to determine the full range of concentrations.

The GDS900 offers you state-of-the-art technology designed specifically for routine elemental determination in most ferrous and nonferrous materials. LECO's exclusive CCD-based design ensures measurement stability, flexibility, and analytical performance in a production environment.

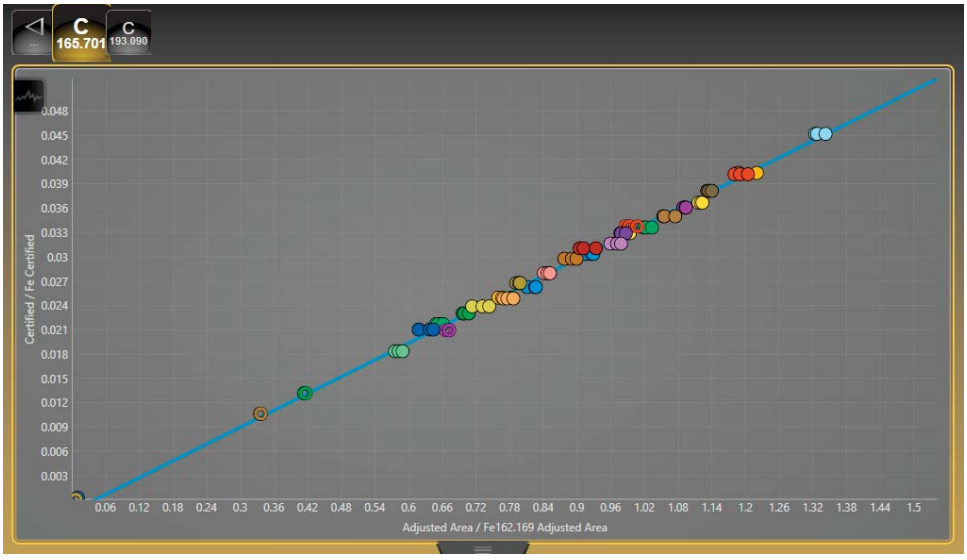
Sample Preparation

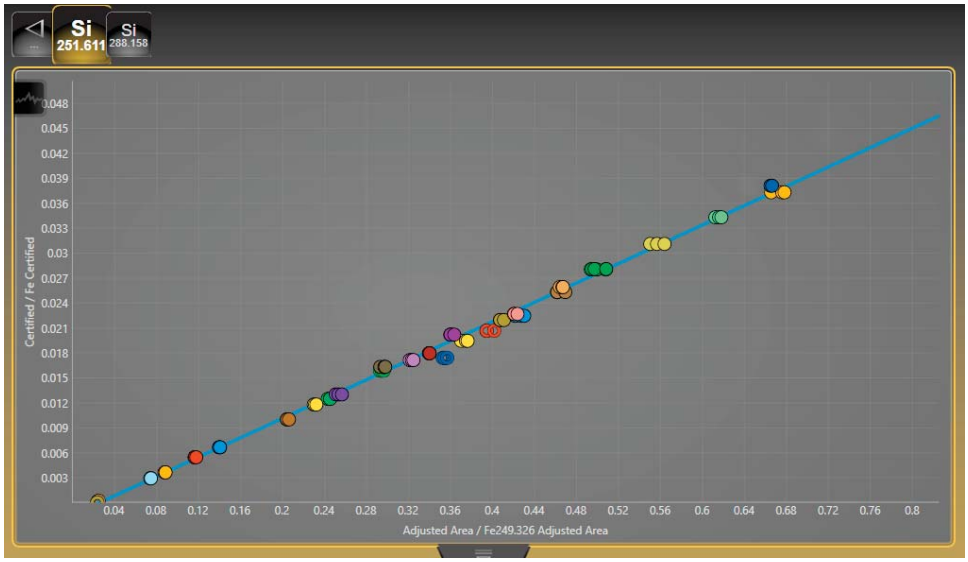
Chilled cast iron is prepared with a 120 grit zirconium oxide belt. As-cast samples are polished to a surface finish using 600 grit paper.

Accessories

Sample surface preparation: Belt grinder (LECO BG) or polisher (LECO PX).

Calibration Curves





Calibration Standards

A factory-installed calibration is based upon customer requirements. Working curves are comprised of Certified Reference Materials (CRM's) and Reference Materials (RM's) from the following manufacturers: Brammer, CKD, CTIF, and MBH. Customer-supplied calibration pieces are useful to complement the calibration.

Drift Control of Calibration

Homogenous non-certified set-up standards (SUS's) are used to drift correct calibration curves. When necessitated by customer ranges or lack of suitable SUS material, RM's and CRM's can be substituted.

Analysis Times

The LECO GDS900 has the ability to perform multiple analyses without dropping the sample. This is possible due to the sputtering of material to reveal new untouched sample. Three analyses can be completed in a minute and a half when using the "Analyze all consecutive burns in the same spot" option in the software.

	Single Burn	**Three Burns w/o Dropping**	**As-Cast Iron; Single Burn**
Start-up and Pre-burn	60 s	60 s	180 s
Analyze	10 s	10 s	10 s
Analyze		10 s	
Analyze		10 s	
Total	**70 s**	**90 s**	**190 s**

Typical Analysis Results

CHILLED DUCTILE IRON: CKD STANDARD 242

ELEMENT	CERT	AVG	STDEV	RSD	Run #1	Run #2	Run #3
Fe	92.57	92.54			92.48	92.57	92.58
Al	0.075	0.078	0.001	0.8	0.078	0.077	0.078
B	0.0070	0.0079	0.0001	1.3	0.0079	0.0080	0.0078
C	2.21	2.24	0.03	1.4	2.28	2.23	2.22
Cr	0.026	0.026	0.0001	0.4	0.0254	0.0256	0.0256
Cu	0.045	0.046	0.0002	0.4	0.0461	0.0464	0.0461
Mn	0.045	0.043	0.0004	0.9	0.0433	0.0426	0.0432
Mo	1.20	1.21	0.002	0.2	1.209	1.213	1.213
Ni	0.024	0.026	0.0003	1.0	0.0258	0.0257	0.0253
P	0.040	0.03	0.0003	1.0	0.0345	0.0339	0.0339
Pb	0.020	0.023	0.001	5.3	0.021	0.023	0.024
S	0.033	0.038	0.0009	2.4	0.0383	0.0367	0.0382
Si	2.88	2.83	0.03	0.9	2.86	2.82	2.81
Ti	0.314	0.315	0.003	1.1	0.316	0.318	0.311
V	0.43	0.43	0.004	1.0	0.435	0.428	0.429

CHILLED IRON: CKD STANDARD 248

ELEMENT	CERT	AVG	STDEV	RSD	Run #1	Run #2	Run #3
Fe	92.98	92.87			92.87	92.87	92.87
Al	0.045	0.051	0.0001	0.3	0.0513	0.0512	0.0515
B	0.036	0.033	0.0001	0.4	0.0326	0.0328	0.0328
C	3.41	3.42	0.004	0.1	3.420	3.423	3.427
Cr	0.022	0.020	0.0002	0.9	0.0202	0.0205	0.0203
Cu	0.12	0.12	0.0002	0.2	0.1185	0.1181	0.1183
Mg	0.064	0.067	0.002	2.3	0.068	0.065	0.067
Mn	0.25	0.25	0.008	3.1	0.247	0.260	0.246
Ni	0.70	0.70	0.002	0.3	0.700	0.704	0.701
P	0.050	0.048	0.0002	0.4	0.0480	0.0483	0.0479
Pb	0.012	0.011	0.0004	3.5	0.0110	0.0117	0.0117
S	0.006	0.009	0.0003	3.0	0.0089	0.0084	0.0085
Si	1.81	1.84	0.01	0.5	1.85	1.83	1.85
Ti	0.17	0.17	0.002	1.1	0.176	0.173	0.175
V	0.17	0.17	0.001	0.9	0.169	0.172	0.170

AS-CAST (GRAY) IRON: BRAMMER STANDARD BS21A-G

ELEMENT	CERT	AVG	STDEV	RSD	Run #1	Run #2	Run #3
Fe	92.54	92.57			92.59	92.60	92.52
Al	0.020	0.021	0.0004	1.7	0.0214	0.0207	0.0210
C	3.83	3.83	0.05	1.3	3.79	3.80	3.88
Cr	0.10	0.10	0.0005	0.5	0.1013	0.1010	0.1003
Cu	0.23	0.23	0.002	0.7	0.236	0.233	0.234
Mn	1.18	1.10	0.02	1.7	1.12	1.10	1.09
Mo	0.19	0.19	0.002	0.8	0.192	0.189	0.189
Ni	0.19	0.19	0.0002	0.1	0.1911	0.1911	0.1907
P	0.070	0.072	0.001	1.4	0.071	0.072	0.073
S	0.018	0.017	0.0004	2.4	0.0165	0.0162	0.0170
Si	1.56	1.53	0.003	0.2	1.531	1.532	1.537
Ti	0.014	0.014	0.0007	4.9	0.0135	0.0147	0.0135
V	0.016	0.017	0.0005	3.1	0.0167	0.0178	0.0174

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