Measurement of Carbon in Ferrosilicon

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Keywords: ferrosilicon, carbon, EMIA 820V

1 Introduction

Ferrosilicon is added as a deoxidant and as a alloying element to steel, that require a special low carbon content.
The low Carbon in Ferrosilicon decreases the electrical conductivity and magnetostriction of electrical steels.

2 Instrumentation

2.1 Principle

The test was performed on the model EMIA 820V. The measurement principle is shown in Figure 2.
The sample is placed in a ceramic crucible in a high frequency induction furnace. The sample is heated at a programmable temperature. Gases produced during the combustion are then analyzed using four Infrared detectors, after dust and moisture removal. The analysis of SO_2 determines sulfur concentration. The analysis of low and high CO_2 and CO determine carbon concentration.

2.2 Unique Features

2.2.1 - Programmable Temperature Curves
The high frequency or induction furnace is equipped with a plate current control function. This allows users to easily optimize the temperature according to the samples. Some customized temperature curves can be created in order to observe various phenomena such as surface con-

Figure 1: EMIA 820V

tamination and different phases or forms of carbon and sulfur.

2.2.2 - Direct gas analysis without conversion
Four Infrared analyzers (NDIR) are used to directly analyze CO, CO_2 and SO_2 over the full range of concentrations. No converter is used nor cellulose filter to trap SO_3 generated in the converter.

2.2.3 - Computer System
All EMIA Series Analyzers are operated by a separate computer system. The software is compatible with Windows 95/98/2000/NT/XP. It includes several functions such as maintenance, diagnostis, statistical studies, curve and data traceability, etc.

2.2.4 - Automatic Cleaning
The double Auto Cleaner option features two brushes to simultaneously clean the combustion tube and the cylindrical dust filter after each measurement. The dust is removed to the dust box by a difference in pressure, which avoids the need for an external vacuum cleaner.

2.2.5 - Automation
It is possible to add standard modules for partial to full automation for 24/7 operation. For more detail see EA.TN 26: Options for Partial and Complete Automation.

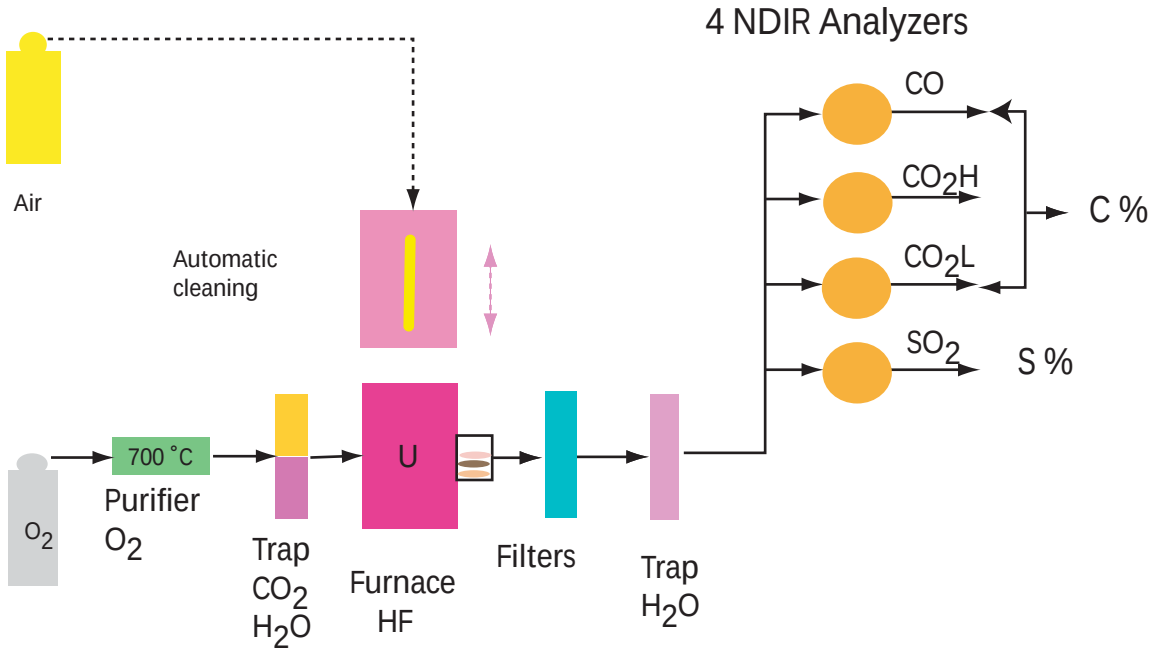

Figure 2: Operating principle

3 Sample preparation

The sample was in the form of a powder.

1. Weigh 0.1 g of sample into a ceramics crucible preburned previuosly in another furnace.

2. Weigh 0.5 g of pure iron, 1.5g of Tungsten and 0.3 g Tin as accelerator, And cover the sample with each metal.

3. Set the ceramic crucible with sample on the crucible stand, and press the [START] button to start analysis.

4 Conditions of analysis

Table 1: Operating conditions

	Start power (mA)	End power (mA)	Time from start to end power (sec)
Step 1	0	175	5
Step 2	175	175	35

	Carbon	Sulfur
Purge time	15 sec	
Integration wait time	5 sec	
Integration time	60 sec	
Comparator level	1.0 %	
Comparator wait time	15 sec	

5 Calibration

1. Set up the system to the analytical condition for the steel in the operator's instruction manual.

2. Calibrate the system following the procedure in the operator's instruction manual.

3. Weigh 1.5g of Tungsten and 0.3g of Tin as blank into a ceramics crucible baked previously by another furnace. Enter 1.0g as sample weight for blank analysis. Repeat measurement 3 times at minimum.

4. Weigh 1.0g of JSS 155-14 (C: 0.037 mass%) into a ceramics crucible baked previously by another furnace. And cover the sample with 1.5g of Tungsten and 0.3g of Tin. Repeat measurement 3 times at minimum.

5. Change sample analysis condition to the above table condition.

6. Compensate the blank signal because analytical condition to steel standard sample and an unknown sample is different. (As for the details, refer to the content of the blank shift of the instruction manual.)

7. Weigh 0.5g of Pure Iron, 1.5g of Tungsten and 0.3g of Tin in the crucible. Enter 0.1g as sample weight for blank analysis. Repeat measurement 3 times at minimum.

6 Results on ferrosilicon

Table 2: Ferrosilicon

Weight (g)	Carbon (mass%)	Sulfur (mass%)
0.106	0.0146	
0.104	0.0138	
0.109	0.0139	
0.108	0.0141	
0.102	0.0135	
Average	0.0140	
Standard Deviation	0.0004	
RSD(%)		
Range	0.0011	

7 Summary

Instrument: EMIA-820V C/S Determinator

Calibration: JSS 155-14 (C: 0.037 mass% 1.0 g

Sample: Ferrosilicon (NBS 58a
C 0.014 mass%)
Type: Powder
Weight: 0.1 g

Accelerator: Pure iron (P/N 905.110.300.001) 0.5g
Tungsten (P/N 905.110.140.001) 1.5g
Tin (P/N 905.202.200.001)0.3g

Crucible: Ceramic (P/N 905.202.200.001)

Crucible Preburning Crucible Preburning unit (FK-10)

8 Conclusion

Carbon measurement in Ferrosilicum samples is compatible with the EMIA 820 V Series equipped with a high frequency furnace. The extraction is complete and efficient in all cases, and the results are repeatable.

This technical note is adapted from an Horiba technical note.

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