Determination of Surface Carbon on Aluminum Sheets/Rods/Wire

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Instrument: RC612

Introduction

For industries that process aluminum sheets or rods, the level of surface contamination, lubrication, or surface modifiers is a critical quality control parameter. This is especially true in high-volume food grade processes like beverage container manufacturing. For example, the amount of surface carbon contamination can be directly related to the performance of coatings such as ink and paint, or the effectiveness of the cleaning process.

The LECO RC612 is a multiphase carbon and moisture determinator specifically designed to differentiate various forms of carbon by the temperature at which they combust. This capability facilitates the determination of the amount of carbon present on the surface of aluminum sheets or rods, which is relative to the amount of oils or surface modifying treatments. The RC612 provides a robust, fast, and direct determination with little to no sample preparation required.

Accessories

781-335 Quartz Crucibles, 625-505-430 Nickel Crucibles

Sample Size

Maximum Length:	4 in (10 cm)
Maximum Width:	1 in (2.5 cm)
Maximum Diameter (Rod):	0.9 in (2.3 cm)

Reference Materials

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

Note: Surface Carbon calibration samples are not readily available. Therefore, 502-029 or 502-630 Synthetic Carbon reference materials are typically used for calibration, and the calibration verified utilizing 502-632. These reference materials require different furnace parameters than used for surface carbon determination (refer to Furnace Step Method: Synthetic Carbon Calibration parameters listed below).

Method—Surface Carbon on Aluminum

Analysis Parameters

Carrier Gas:	Oxygen
Purge Flow:	3.00 lpm
Analysis Flow:	0.75 lpm
Catalyst Heater Temperature:	850 °C
Afterburner Temperature:	850 °C

Element Parameters

	Carbon	Water
Analyze	Yes	No
Conversion Factor	1.00	1.00
Significant Digits	5	5

Carbon Range	Auto
Switch level to High Cell	35000
Switch level to Low Cell	34000
IR Baseline Time	2 s
Endline Time	2 s

Furnace Step Method—Synthetic Carbon Calibration

Step	*Name*	*Target (°C)*	*Ramp*	*Hold (s)*	*Est Time (s)*
Start	Synthetic Carbon	1000	N/A	Synthetic Carbon	100 to 600

Hold Parameters

Synthetic Carbon	Carbon	Water
Minimum Analysis Time (s)	100	0
Peak Threshold	0	0
Comparator Level (%)	1.00	1.00
Maximum Analysis Time (s)	600	0

Furnace Step Method—Surface Carbon Sample Analysis

Step	*Name*	*Target (°C)*	*Ramp*	*Hold (s)*	*Est Time (s)*
Start	Surface Carbon	550	N/A	200	200

Procedure

1. Prepare the instrument as outlined in the operator's instruction manual.
2. Determine blank.

   Note: 781-335 Quartz Crucibles and 625-505-430 Nickel Crucibles, should be pre-baked at 1100 °C, to remove any residual carbon, and cooled in a desiccator until time of analysis. Handle the crucibles with clean tongs only.

   a. Enter 1.0000 g mass into Sample Login (F3) using Blank as the sample name, select the number of replicates, "Surface Carbon on Aluminum" as the Method, and "Synthetic Carbon Calibration" as the Furnace Step Method (parameters noted above).
   b. Place a "clean" crucible on the shelf directly in front of the closed combustion tube door and initiate the analysis sequence (F5).
   c. When the load sample message appears, select "Ok" in the message box and load the crucible into the combustion tube until it reaches the sample stop, remove the sample puller, and close the door.
   d. When analysis is complete, remove the crucible and close the combustion tube door.
   e. Repeat steps 2a-2d a minimum of three times.
   f. Set the blank following the procedure outlined in the operator's instruction manual.
3. Calibration
   a. Weigh ~0.25 g of the selected reference material into a "clean" crucible.
   b. Enter mass and sample identification into Sample Login (F3), select "Surface Carbon on Aluminum" as the Method, and "Synthetic Carbon Calibration" as the Furnace Step Method (parameters noted above).
   c. Place the crucible, containing the sample, on the shelf directly in front of the closed combustion tube door and initiate the analysis sequence (F5).

Inorganic Application Note

d. When the load sample message appears, select "Ok" in the message box and load the crucible into the combustion tube until it reaches the sample stop, remove the sample puller, and close the door.
e. When analysis is complete, remove the crucible and close the combustion tube door.
f. Repeat steps 3a through 3f a minimum of three times for each calibration sample.
g. Calibrate the instrument using single standard curve following the procedure outlined in the operator's instruction manual.
h. Verify the calibration by analyzing 0.10-0.25 g of a reference material, different than the material used for calibration, following steps 3a-3e.

4. Determine Sample Blank.

Note: Aluminum sheets and rods are typically analyzed without the use of a crucible. As such, the sample blank should be determined without a crucible. For analysis of Aluminum wire, follow the outlined procedure utilizing a crucible.

a. Enter 1.0000 g mass into Sample Login (F3) using Blank as the sample name, select the number of replicates, "Surface Carbon on Aluminum" as the Method, and "Surface Carbon Sample Analysis" as the Furnace Step Method (parameters noted above).
b. Analyze Blank following steps 2b-2d a minimum of three times.
c. Set the blank following the procedure outlined in the operator's instruction manual.

5. Analyze Samples.

Note: Aluminum sheets and rods are typically analyzed without the use of a crucible. For analysis of Aluminum wire, follow the outlined procedure utilizing a crucible.

a. Configure the appropriate display fields using the Sample Display Configuration feature (refer to the RC612 instruction manual for details). Select the proper units (such as mg/ft^2 or mg/dm^2).
b. Enter the appropriate surface area and sample identification into Sample Login (F3), select "Surface Carbon on Aluminum" as the Method, and "Surface Carbon Sample Analysis" as the Furnace Step Method (parameters noted above).
c. Initiate the analysis sequence (F5). When the load sample message appears, select "Ok" in the message box and load the sample into the combustion tube until it reaches the sample stop, remove the sample puller, and close the door.
d. When analysis is complete, remove the crucible and close the combustion tube door.

Method Equation Parameters

Equation Name/Equation Formula

Surface Carbon (mg/dm^2)
@PeakCO2("Surface Carbon")*10/[Surface Area dm^2]

Surface Carbon (mg/m^2)
@PeakCO2("Surface Carbon")*10/[Surface Area m^2]

Surface Carbon (mg/in^2)
@PeakCO2("Surface Carbon")*10/[Surface Area in^2]

Surface Carbon (mg/ft^2)
@PeakCO2("Surface Carbon")*10/[Surface Area ft^2]

Typical Results

Sample	*Surface Area (dm^2)*	*Surface Carbon (mg/dm^2)*
Aluminum Weld Wire	0.31661	0.025
Diameter = 0.07 cm	0.31474	0.028
	0.32078	0.024
	0.32575	0.030
	0.32264	0.033
	Avg =	***0.028***
	s =	***0.004***
Aluminum Rod	0.07544	0.110
Diameter = 0.233 cm	0.07431	0.151
	0.07449	0.165
	0.07575	0.149
	0.07509	0.157
	Avg =	***0.146***
	s =	***0.021***
Aluminum Sheet	0.51613	0.054
1.0" x 4.0"	0.51613	0.051
	0.51613	0.051
	0.51613	0.053
	0.51613	0.064
	Avg =	***0.055***
	s =	***0.006***

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