Carbon, Nitrogen, and Sulfur in Soil

LECO Corporation; Saint Joseph, Michigan USA

Instrument: TruMac® CNS

Introduction

Nitrogen and sulfur are both considered essential macronutrients for proper plant growth. Carbon content in soils can represent the presence of organic matter and is used to estimate nitrogen availability from the natural decay of organic materials, especially when using organic fertilizers. Testing for total carbon, nitrogen, and sulfur in arable soils is most useful just before the planting season in order to predict the fertilization needs, and make fertilization management decisions for the soil.

Sample Preparation

A representative, uniform sample is required.

Note: Carbon, Nitrogen, and Sulfur results for soil samples are typically reported on a dry basis. Therefore, either the materials can be dried prior to analysis or the moisture content determined and entered during the Sample Login procedure. Samples are typically dried at 105°C for one hour prior to analysis.

Accessories

LECO 528-203 Ceramic Boat, LECO 502-321 COM-CAT™

Calibration Sample

LECO 502-654 BBOT, LECO 502-298 Sulfamethazine, or other suitable reference materials.

Analysis Parameters

Furnace Temperature	1450°C
Dehydration Time	0 sec
Purge Cycles	3

Element Parameters

	Carbon	Nitrogen	Sulfur
Analyze	Yes	Yes	Yes
Baseline Delay Time	0 sec	10 sec	0 sec
Minimum Analysis Time	18 sec	35 sec	15 sec
Endline Time	2 sec	2 sec	2 sec
Conversion Factor	1.00	1.00	1.00
Significant Digits	5	5	5
IR Baseline Time	1 sec	—	1 sec
TC Baseline Time	—	10 sec	—

Burn Profile

Burn Cycle	Lance Flow	Purge Flow	Time
1	Off	On	5 sec
2	On	On	End

Ballast Parameters

Equilibrate Time	30 sec
Not Filled Timeout	300 sec

Aliquot Loop

Equilibrate Pressure Time	4 sec

Procedure

1. Prepare instrument for operation as outlined in the operator's instruction manual.
2. Condition the system by following the procedure outlined in step 5, using five replicates.
3. Determine blank.
   a. Enter 1.0000 g mass into Sample Login (F3) using Blank as the sample name.
   b. Add ~1.0 g of 502-321 COM-CAT into a 528-203 LECO Ceramic Boat.
   c. Place Ceramic Boat in the appropriate position of the autoloader carousel.
   d. Repeat steps 3a through 3c a minimum of five times.
   e. Initiate the analysis sequence (F5).
   f. Set the blank following the procedure outlined in the operator's instruction manual.
4. Calibrate
   a. Weigh ~0.10 g of pure compound calibration sample (BBOT, Sulfamethazine, etc.) into a LECO 528-203 Ceramic Boat.
   b. Enter sample mass and identification into Sample Login (F3).
   c. Tare balance, add ~1.0 g of COM-CAT to the crucible and thoroughly mix with the sample.
   d. Place the sample in the appropriate position of the autoloader carousel.
   e. Repeat steps 4a through 4d a minimum of five times.
   f. Initiate the analysis sequence (F5).
   g. Calibrate the instrument using single standard calibration (fixed at origin) following the procedure outlined in the operator's instruction manual.
   h. Verify the calibration by analyzing ~0.10 g of another pure compound following steps 4a through 4d.

   Note: Multi-point (fractional weight or multiple calibration samples) may be used to calibrate if desired. Typically single-point calibration using a pure compound provides a suitable and cost-effective calibration. Refer to the operator's instruction manual for details regarding multi-point calibration.

5. Analyze Samples
   a. Weigh ~0.25 g of soil sample into a LECO 528-203 Ceramic Boat.
   b. Enter mass and identification information into Sample Login (F3).
   c. Tare balance, add ~1.0 g of COM-CAT to the crucible and thoroughly mix with the sample.
   d. Transfer sample to the appropriate position of the sample carousel.
   e. Initiate the analysis sequence (F5).

Typical Results*

Sample	Mass (g)	% Carbon	% Nitrogen	% Sulfur
Soil	0.2518	12.28	1.06	0.215
LECO 502-309	0.2526	12.26	1.07	0.209
12.25% ±0.34% C	0.2545	12.24	1.05	0.200
1.03% ±0.05% N	0.2544	12.17	1.05	0.207
0.207% ±0.009% S	0.2508	12.22	1.04	0.198
	Avg.	*12.23*	*1.05*	*0.206*
	Std. Dev.	*0.04*	*0.01*	*0.007*
Soil	0.2510	2.33	0.171	0.027
LECO 502-308	0.2541	2.33	0.178	0.027
2.30% ±0.06% C	0.2512	2.34	0.173	0.030
0.172% ±0.011% N	0.2509	2.33	0.172	0.029
0.031% ±0.004% S	0.2524	2.34	0.175	0.028
	Avg.	*2.33*	*0.174*	*0.028*
	Std. Dev.	*0.005*	*0.003*	*0.001*
Soil	0.2531	22.7	1.94	0.333
LECO 502-814	0.2503	22.7	1.95	0.321
22.6% ±0.3% C	0.2535	22.6	1.96	0.314
1.93% ±0.05% N	0.2521	22.6	1.96	0.318
0.323% ±0.012% S	0.2513	22.7	1.97	0.320
	Avg.	*22.7*	*1.96*	*0.321*
	Std. Dev.	*0.05*	*0.01*	*0.007*
Soil	0.2523	2.04	0.184	0.031
LECO 502-062	0.2518	2.02	0.181	0.028
1.99% ±0.04% C	0.2523	2.02	0.182	0.027
0.180% ±0.014% N	0.2532	2.05	0.182	0.030
0.027% ±0.003% S	0.2509	2.04	0.186	0.028
	Avg.	*2.03*	*0.183*	*0.029*
	Std. Dev.	*0.01*	*0.002*	*0.002*

Results based on single-standard calibration using LECO 502-654 BBOT @ 72.53% C, 6.50% N, and 7.47% S.