Application Note

Instrument: TGA801

Determination of Moisture and Ash in Soil

LECO Corporation; Saint Joseph, Michigan USA

Introduction

In soil science, hydrology, and agricultural sciences, soil water content plays an important role in groundwater recharge and soil chemistry. The amount of moisture or soil water is important as it serves as a solvent and carrier of food nutrients for plant growth. The yield of a crop is more often determined by the amount of water available rather than the deficiency of other soil nutrients. Soil moisture also regulates soil temperature and aids in the chemical and biological activities within the soil. Microorganisms require water for their metabolic activities and their activities are important in releasing nutrients within the soil. Water is also essential for the process of photosynthesis in plants. Monitoring soil moisture on an ongoing basis allows growers to systematically use this information to make irrigation decisions. Ash determination can be utilized to calculate the organic matter content of soils. Additionally, the determination of a variety of analytically important constituents within soil (Carbon, Nitrogen, Sulfur etc.) require moisture correction utilizing an accurate moisture value.

Thermogravimetric analysis (TGA) is an analytical technique in which changes in sample mass, due to changes in physical and chemical properties of materials, is measured as a function of temperature and/or time. TGA is commonly used to determine selected characteristics of materials that exhibit either mass loss, or gain, due to decomposition, oxidation, or loss of volatile materials such as moisture.

The LECO TGA801 is a macro thermogravimetric analyzer designed to determine moisture and ash content of materials by measuring the change in mass of the sample as a function of the oven temperature, while controlling the atmosphere and ventilation rate. The TGA801 allows up to 19 samples to be analyzed simultaneously.

Sample Preparation

Samples must be of a uniform consistency to produce suitable results.

Accessories

621-331 Ceramic Crucibles, 621-011-507 Double Sided Spoon.

Sample Mass ~1.0 g

Method Reference

ASTM D2974-13 Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.

Analysis Time ~4.5 h

General Method Parameters

Crucible Type	Ceramic
Minimum Crucible Weight	19.0000
Maximum Crucible Weight	30.0000
Crucible Density	3.0
Lid Density	3.0
Sample Type	Other
Sample Density	1.0
Minimum Sample Weight	0.8000
Maximum Sample Weight	1.2000

Method Step Parameters - Moisture

Step Type	Preset
Preset Method Step	Moisture
Cooling Option	Active
Crucible Lids	No
Start Temperature	25.0 °C
End Temperature	110.0 °C
Ramp Rate	10.0 °C/min
Hold Time	60 min
Maximum Time	180 min
Atmosphere	Air
Flow Rate	10.0 LPM
Final Weight	At Constancy
Constancy Window	9 min
Constancy Level	0.0010 g

Method Step Parameters - Ash @ 440°C

Step Type	Custom
Preset Method Step	Ash @ 440°C
Cooling Option	Active
Crucible Lids	No
Start Temperature	110.0 °C
End Temperature	440.0 °C
Ramp Rate	15.0 °C/min
Hold Time	60 min
Maximum Time	180 min
Atmosphere	Air
Flow Rate	10.0 LPM
Final Weight	At Constancy
Constancy Window	9 min
Constancy Level	0.0010 g

Method Step Parameters - Ash @ 750°C

Step Type	Custom
Preset Method Step	Ash @ 750 °C
Cooling Option	Active
Crucible Lids	No
Start Temperature	440.0 °C
End Temperature	750.0 °C
Ramp Rate	15.0 °C/min
Hold Time	60 min
Maximum Time	180 min
Atmosphere	Air
Flow Rate	10.0 LPM
Final Weight	At Constancy
Constancy Window	9 min
Constancy Level	0.0010 g

Method Step Calculations - Moisture

Calculation Type	Custom
Measurement Type	Mass Ratio
Calculation Name	Moisture
Enable Calibration	Disabled
Moisture Calculation*	(((Initial Mass – Moisture Mass)) ÷ Moisture Mass)

Method Step Calculations - Ash @ 440°C

Calculation Type	Custom
Measurement Type	Mass Ratio
Calculation Name	Ash @ 440°C
Enable Calibration	Disabled
Ash @ 440 °C Calculation*	(Ash @ 440 °C Mass ÷ Moisture Mass)

Method Step Calculations - Ash @ 750°C

Calculation Type	Custom
Measurement Type	Mass Ratio
Calculation Name	Ash @ 750°C
Enable Calibration	Disabled
Ash @ 750 °C Calculation*	(Ash @ 750 °C Mass ÷ Moisture Mass)

**As specified in ASTM D2974-13; 440 °C Ash for General Purpose Materials; 750°C for Ash and Fuel Purpose Materials*

Procedure

1. Create and/or select a method, using the Method Step Parameters listed above, following the procedure outlined in the LECO TGA801 Instruction Manual.
2. Log in and load samples following the procedure outlined in the LECO TGA801 Instruction Manual.

Typical Results

	Initial Mass (g)	*% Moisture*	*% Ash @ 440 °C*	*% Ash @ 750 °C*
Soil	1.0105	5.86	79.96	78.98
502-694 LCRM®	1.0715	5.84	80.00	79.04
Lot: 1000	1.0152	5.88	79.91	78.96
	1.0086	5.92	79.73	78.78
	1.0256	5.90	79.80	78.85
	Avg =	***5.88***	***79.88***	***78.92***
	s =	***0.03***	***0.11***	***0.10***
Soil	1.0188	9.44	61.18	57.57
502-814 CRM	1.0108	9.45	61.24	57.61
Lot: 1002	1.0341	9.45	61.04	57.54
	1.0311	9.45	61.13	57.58
	1.0199	9.45	61.25	57.62
	Avg =	***9.45***	***61.17***	***57.58***
	s =	***<0.01***	***0.09***	***0.03***
Soil	1.0383	2.64	97.62	96.79
502-962 LCRM	1.0013	2.61	97.62	96.80
Lot: 1000	1.0027	2.62	97.65	96.80
	1.0045	2.61	97.62	96.79
	1.0047	2.59	97.65	96.80
	Avg =	***2.61***	***97.63***	***96.80***
	s =	***0.02***	***0.02***	***0.01***

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