Application Note

Total Carbon and Nitrogen Analysis in High Carbon Containing Compost Sample

Introduction

Compost, which is made from organic matters (leaves, food, scraps, etc.), is a popular soil amendment with farmers, growers, landscapers and in residential gardening [1]. The compost is highly beneficial for the land on several counts, including as a soil conditioner, a fertilizer and a natural pesticide [2]. Carbon to nitrogen ratio is a ratio of the mass of carbon to the mass of nitrogen in a substance [3]. Organisms which decompose organic matter use carbon as an energy source and nitrogen to build cell structure [4]. In the presence of high carbon content, decompositon slows when the nitrogen is used up and some of the organisms die. That is, decomposition takes longer if the carbon content is high. If the energy source, carbon, is less than required amount, this leads to release of ammonia to the athmosphere which should be kept minimum for the compost pile and environment [4]. Therefore, total carbon (TC) and total nitrogen (TN) content of the compost should be firstly known to determine C/N ratio which is essential for the characterization of compost. This application note reports simultaneous TC/TN analysis results of a compost sample.

Principle of operation

Total carbon (TC) and total nitrogen (TN) measurements were made with Trl-CN analyzer under experimantal parameters in table 1.

Table 1: Analysis Parameters

Parameters	Total Carbon (TC)	Total Nitrogen (TN)
Decomposition furnace temperature	900 ^{o}C	900 ^{o}C
Catalytic furnace temperature	720 ^{o}C	720 ^{o}C
Air pressure	2 bar	2 bar
Air flow rate	3 L/min	3 L/min
NDIR gas flow rate	100 mL/min	100 mL/min
Oxygen flow rate	-	100 mL/min
Detector	NDIR	CLD

TC and TN Analysis: Samples were carefully weighed in to quartz sample boat without any pretreatment and weights of the samples were input to the Trl-CN software. Quartz sample boats with compost samples were placed in the sample loading car. The sample was

automatically moved into the decomposition reactor with the starting of the analysis. The carbon and nitrogen concentrations of the sample was then calculated against the calibration curves created before.

Results

TC Results: TC, TN results and RSD values, calculated by Trl-CN software, of soil samples are shown in table 2 and table 3.

Table 2: TC Results of soil samples

Repeat Number	Sample Size (mg)	TC Results (%)	Rsd (%)
1	50.0	40.32	**2.79**
2	51.0	42.53	
3	50.5	40.88	

Table 3: TN Results of soil samples

Repeat Number	Sample Size (mg)	TN Results (%)	Rsd (%)
1	50.0	1.78	**0.64**
2	51.0	1.80	
3	50.0	1.80	

Conclusions

In this study, total carbon (TC) and total nitrogen (TN) content of a compost sample were determined with Trl-CN analyzer to calculate C:N ratio. According to results C:N ratio was calculated as 23:1. As seen in the results part of the report, result showed high repeability with acceptable RSD values. In the experimental part, in spite of the high carbon content of the samples, high sample loading was achieved up to 50 mg sample. Total nitrogen of the compost samples were analyzed with same analyzer by installation of nitrogen analyzer unit module (TN) to Trl-CN analyzer. To conclude, Trl-CN analyzer provides high repeability and accuracy in simultaneous total carbon and nitrogen anaysis of the high carbon containing solid samples on the same instrument with high solid sample loading.

References

[1]: Compost Quality: Performance Requirements. (n.d.). Retrieved February 4, 2015, from http://www.calrecycle.ca.gov/organics/products/quality/Needs.htm

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[3]: Carbon-to-nitrogen ratio. (n.d.). Retrieved May 17, 2016, from https://en.wikipedia.org/wiki/Carbon-to-nitrogen_ratio

[4]: Compost Fundamentals: Compost Needs - Carbon Nitrogen Relationships. (n.d.). Retrieved May 17, 2016, from http://whatcom.wsu.edu/ag/compost/fundamentals/needs_carbon_nitrogen.htm