APPLICATION NOTE

E-CN-001-2019/A1

Total Carbon and Nitrogen Determination in Soil

Reference:

ISO 10694: Soil quality - Determination of organic and total carbon after dry combustion (Elemental analysis);

ISO 13878: Soil quality - Determination of total nitrogen content by dry combustion (Elemental analysis)

EN13654-2: Soil improvers and growing media - Determination of nitrogen - Part 2: Dumas method

Gazzetta ufficiale Official Italian Method 248.1999

Tested with **VELP Scientifica CN 802 Carbon Nitrogen Analyzer** (Code F30800090)

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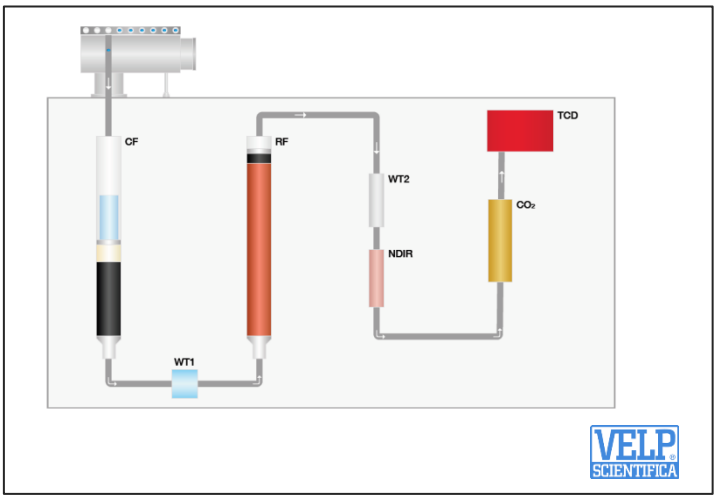
Introduction

A carbon-to-nitrogen ratio (C:N ratio) is a ratio of the mass of carbon to the mass of nitrogen in a substance. For example, if we have a C:N ratio of 24:1, this means we have 24 units of carbon to 1 unit of nitrogen. The C:N ratio is important because it has a direct impact on residue decomposition and also nitrogen cycling in soils.
It can, amongst other things, be used as indicator for nitrogen limitation of plants and other organisms. As a rule of thumb, the higher the ratio, the longer it takes for the material to decompose. Likewise, the smaller the ratio is, the more rapidly the plant material will decompose. This also has a direct relationship with the amount of nitrogen that is tied up in the soil that will be available to the next growing plant.
The performance of the VELP CN 802 was evaluated by participating in the **Proficiency Testing program** organized by **WEPAL** (Wageningen Evaluating Programs for Analytical Laboratories).
Samples of soil were analyzed using the CN 802 and the results obtained (as C % and N %) were compared with the statistical range accepted by WEPAL.

Carbon and nitrogen determination in soils

The elemental analysis starts with a combustion (CF) to burn the sample, obtaining elemental compounds.
Water is removed by a first physical trap (WT1 - **DriStep™**), placed after the combustion, and a second chemical one (WT2). Between the two, the elemental substances passed through a reduction furnace (RF).
VELP exclusive **Non Dispersive Infrared NDIR Detector** accurately measures the CO2 concentration that the unit is able to convert in carbon quantity. Then, the auto-regenerative CO_2 absorbers (CO_2) let pass only the elemental nitrogen that is detected by the innovative **LoGas™** Thermal Conductivity Detector (TCD) with no requirement for a reference gas.
The CN 802 is controlled via PC through the intuitive **CNSoft™**.



CN 802 Preliminary Operations (daily)

Follow the operating manual to start the CN 802 and check that the following parameters are set:

Temperature Combustion reactor (Code A00000158): 1030 °C
Temperature Reduction reactor (Code A00000226): 650 °C
Flow rate MFC1 He: 190 ml/min
Flow rate MFC2 He: 220 ml/min
Condition the system by testing 2 EDTA standard (Code A00000149) and 3 to 5 empty tin foils (Code A00000153) as Check up. Verify the calibration curves with one or more tests as Standard by testing the same standard used for the curves creation.

Sample Preparation

4 reference samples:	Expected values on dry matter:	
Wepal ISE 2018-4 Sediment sample 860	C % = 4.524 ± 0.207	N % = 0.1628 ± 0.0132
Wepal ISE 2018-4 Clay sample 879	C % = 2.911 ± 0.072	N % = 0.1688 ± 0.0126
Wepal ISE 2018-4 Sandy soil sample 919	C % = 2.586 ± 0.207	N % = 0.1487 ± 0.0142
Wepal ISE 2018-4 Sandy soil sample 993	C % = 2.624 ± 0.119	N % = 0.2361 ± 0.0117

Soils samples have been dried at 105 °C before the analysis.
Using a spatula, put 300 mg of sample into the tin foil. Close the tin foil, obtaining a capsule and load the capsule into the autosampler.

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Analysis Procedure

Fill the following fields in the database: Sample name, Weight, Method, Sample type, Calibration number

Create a new customizable method with the following parameters:
Protein factor: none
O_2 flow rate: 300 ml/min
O_2 factor: 0.7 ml/mg
Press to start the analysis.
Analysis time: from 3 minutes for one run.

Typical C and N Results on Soil samples

Carbon results have been obtained with the calibration curve using the standard $CaCO_3$ (C% = 12), in a range of 0 – 20 mg C. For Nitrogen results, the standard used for the calibration curve has been aspartic acid ($C_4H_7NO_4$), in the range of 0 – 1.5 mg N. The data obtained are included in the tolerance admitted by the certificate of analysis.
All four Wepal reference samples have been analyzed ten times to evaluate the repeatability of the CN 802. The table below shows the total carbon and total nitrogen results on dry matter, obtained simultaneously by the CN 802. The software CNSoft™ automatically calculates the ratio C:N, shown in the table.

Sample	C % (Average ± SD%)	%N (Average ± SD%)	C:N
Wepal Sediment sample 860	**4.498 ± 0.158**	**0.175 ± 0.011**	**25**
Wepal Clay sample 879	**2.844 ± 0.006**	**0.171 ± 0.013**	**15**
Wepal Sandy soil sample 919	**2.531 ± 0.084**	**0.160 ± 0.007**	**15**
Wepal Sandy soil sample 993	**2.595 ± 0.065**	**0.239 ± 0.012**	**11**

n = 10

Conclusion

VELP Scientifica CN 802 Carbon Nitrogen Analyzer is the ideal solution for the determination of carbon and nitrogen and C:N ratio in soil samples. The analyzer ensures reliable results in easy and fast way with automatic calculation by the software CNSoft™.

All data obtained are acceptable and comparable to the expected values, demonstrating excellent repeatability and accuracy of the CN 802 Analyzer with no memory effect observed.

With high productivity and non-stop performances, CN 802 combustion apparatus is ideal for high throughput, being fully automated and requiring from 2-5 minutes per analysis.

Connecting the CNSoft™ to **VELP Ermes Cloud Platform** it's possible to easily monitor the analysis in real time via PC, smartphone or tablet.

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