APPLICATION NOTE

E-EA-007-2023/A1

# Carbon and Nitrogen Determination in Liquid fertilizers

## with CN802 Carbon and Nitrogen analyzer

Dumas reference: **AOAC 993.13** Nitrogen (Total) in Fertilizers

Tested with **VELP Scientifica CN802 Carbon and Nitrogen Analyzer** (Code F30800090)


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## Introduction

A fertilizer is any type of organic or inorganic substance that contains nutrients, macroelements or microelements, in forms assailable by plants, to maintain or increase the content of these elements in the soil, improve the quality of the substrate at the nutritional level, stimulate the vegetative growth of the plants, etc.

Fertilizers play an important role in improving the productivity of farming. Solid and liquid fertilizers are both widely used in the agriculture industry, with the latter gaining up because of their easiness of use.

Liquid fertilizers have many advantages over traditional granular fertilizers. They are able to carry with them different sources of nitrogen in one product, helping to prevent leaching and ensuring at the same time nutrients immediately available in soil.

Detecting the carbon and nitrogen content in liquid fertilizer is essential to maintain the expected yields and ensure an healthy crop.

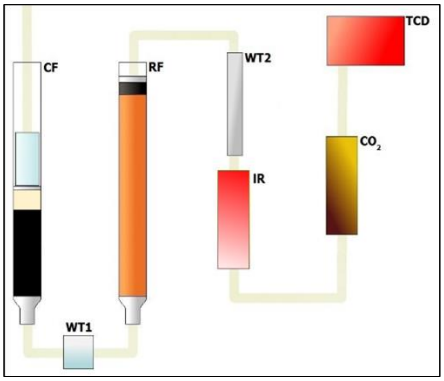
## Dumas method

The elemental analysis starts with a **combustion furnace** (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 pass 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 CO2 absorbers (CO2) let pass only the elemental nitrogen that is detected by the **LoGas™ innovative 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 Helium**: 190 ml/min

**Flow rate MFC2 Helium**: 220 ml/min

Condition the system by testing 2 to 5 empty tin foils (Code A00000153) as checkup and 2 EDTA standard (Code A00000149) to check the calibration curve accuracy.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## Sample Preparation

The liquid fertilizer samples should be mixed right before taking the portion to be analysed. In the tin foil place the superabsorbent powder in a ratio 1:2 with the sample. Let the sample to be absorbed on the powder, close the tin foil, record the weight and load it into the autosampler. For more viscous liquids that can't be absorbed on to the powder, use the closing device tin foil cup (Code A00000217).

| Sample | Expected Carbon | Expected Nitrogen |
|---|---|---|
| **Liquid fertilizer 1** | 1,8 – 2,2% | 2,0 – 2,3% |
| **Liquid fertilizer 2** | 3,6 – 4,0% | 6,7 – 7,0% |
| **Liquid fertilizer 3** | 7,0 – 7,5% | 4,5 – 4,8% |

## Analysis procedure

Run the analyses using the fertilizer method with the following parameters:

**$O_2$ flow rate**: 200 ml/min

**$O_2$ factor**: 1.0 ml/mg

Press to start the analysis.

**Analysis time**: from 5 minutes for one run.

Nitrogen results have been obtained with the calibration curve in a range of 0,9 - 10mg N with EDTA standard (%N = 9.59) (Code A00000149).

For carbon detection a calibration curve built in a range of 1,2 – 12mg C with $CaCO_3$ has been used.


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## Typical Results on liquid fertilizers

| Sample | Sample quantity (mg) | C % | N % |
|---|---|---|---|
| **Liquid fertilizer 1** | 209,49 | 1,90 | 2,11 |
| | 194,18 | 1,89 | 2,10 |
| | 214,20 | 1,89 | 2,11 |
| | 197,60 | 1,90 | 2,13 |
| | 207,99 | 1,90 | 2,12 |
| | **Average ± SD%** | **1,89 ± 0,01** | **2,11 ± 0,01** |
| **Liquid fertilizer 2** | 110,06 | 3,85 | 6,75 |
| | 115,71 | 3,83 | 6,81 |
| | 113,19 | 3,83 | 6,72 |
| | 108,95 | 3,85 | 6,81 |
| | 110,93 | 3,82 | 6,83 |
| | **Average ± SD%** | **3,84 ± 0,01** | **6,78 ± 0,05** |
| **Liquid fertilizer 3** | 126,74 | 7,18 | 4,62 |
| | 115,15 | 7,14 | 4,69 |
| | 110,64 | 7,14 | 4,79 |
| | 110,86 | 7,11 | 4,78 |
| | 117,97 | 7,16 | 4,81 |
| | **Average ± SD%** | **7,15 ± 0,03** | **4,74 ± 0,08** |

## Conclusion

**VELP Scientifica CN802 Carbon/Nitrogen Analyzer** is the ideal solution for the **determination of nitrogen and carbon in liquid fertilizers** following AOAC 999.13.

- The analyzer ensures reliable results in a fast and easy way with automatic calculation made by the software CNSoft™.
- All data obtained show an excellent repeatability and accuracy, meeting the demand of most of the laboratories.
- With high productivity and non-stop performances, CN 802 combustion apparatus is ideal for high throughput, both with Helium and Argon as carrier gas, being fully automated and requiring from 4-5 minutes per analysis.
- Connecting the system to **VELP Ermes Cloud Platform** makes possible to easily monitor and control the analysis in real time via PC, smartphone or tablet.


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