Food and Agriculture Organization of the United Nations

Raising confidence in quality measurements from soil laboratories in Sub-Saharan Africa

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GLOSOLAN Standard operating procedure for soil total carbon

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Dumas dry combustion method

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Application field

- Dumas → TOTAL carbon (TC) = all chemical forms of C in soil (organic + inorganic)
- Equipment: autoanalyzer
- Advantages: accuracy and versatility (not only C, but also N, S, etc.)
- Disadvantages:
  - Costs of equipment and its maintenance
  - Small amount of sample needed (i.e. accurate balance is needed)
  - Amount of labs using autoanalyzers worldwide (issues with comparability)

Principle - Dumas dry combustion

- The sample is burned at **high temperature** (between 900 and 1000 °C or 1400 and 1600 °C) in an **atmosphere of pure oxygen**

- Under these conditions, all C-containing compounds are completely decomposed and converted into **carbon oxides** (mainly carbon dioxide)

- The autoanalyzer measures and reports the TC value based on the concentration of carbon oxides present using various procedures

Apparatus and materials

- Autoanalyzer
- Analytical balance (±0.0001 g)
- Milling system (according to the autoanalyzer requirements)
- Certified Reference Material (CRM) with known C content to calibrate the autoanalyzer.
- Oxygen gas (O2), along with reference or carrier gases of very high purity (greater than 99.99%).
- Consumables specific to the autoanalyzer

Sample preparation

- Dry and sieve soil material to 2 mm (even to inferior size)

Follow the sample preparation instructions provided by the manufacturer for use of the autoanalyzer

Procedure

1. Calibration

- Use a CRM provided or recommended by the manufacturer (soil, acetanilide, calcium carbonate, EDTA, glucose anhydrous, etc)
- The CRM should cover the range of TC typically found in test samples
- Store all CRM as indicated by the manufacturer label
- Replicated blanks must also be analysed to determine the baseline according the specific equipment procedure

2. Mesurement

- Because the analysis procedure varies between manufacturer's, analyse samples according to the manufacturer's guidelines for soil analysis.
- To check autoanalyzer performance, **CRM, control samples, and blanks should be incorporated at regular intervals in each test batch**. The number and frequency of control and check samples depends on the method used and the calibration stability of the autoanalyzer

Calculation

- Report TC using the **International Units System** (g) per kilogram (kg) of soil, g/kg.
- Results must be reported on an ovendry soil basis.
- The number of decimals reported must conform to the conventional rules of maintaining 3 numbers:
  - values greater than 100, no decimal reported;
  - values between 10 and 100, 1 decimal (0.1) reported; and
  - values less than 10, 2 decimals (0.01) reported.

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