O·I·Analytical

Methodology

Total Kjeldahl Nitrogen (TKN) in Soil and Plant Digestates by Segmented Flow Analysis (SFA)

(Cartridge Part #A002617)

1.0 Scope and Application

1.1 This method is used for the determination of Total Kjeldahl Nitrogen (TKN) in soil and plant digestates.

1.2 During digestion, amino acids, proteins, peptides, and other nitrogen compounds of biological origin are converted to ammonium sulfate. Nitrogenous compounds of some industrial wastes, such as amines, nitro compounds, hydrazones, oximes, semicarbazones, and some tertiary amines, may not be converted.

1.3 The Method Detection Limit (MDL) of this method is 0.01 mg/L TKN. The applicable range of the method is 0.20–250 mg/L TKN. The range may be extended to analyze higher concentrations by sample dilution.

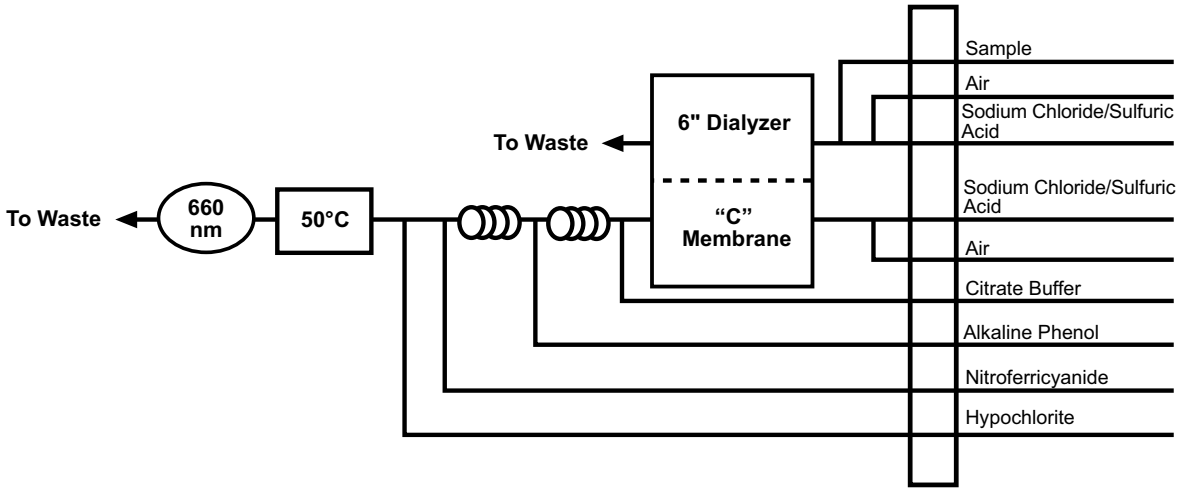
2.0 Summary of Method

2.1 The sample is digested prior to analysis in the presence of sulfuric acid, potassium sulfate, and a mercury catalyst at a final temperature of 380°C. Free ammonia and organic nitrogen compounds are converted to ammonium sulfate under these conditions.

2.2 Ammonia reacts with alkaline phenol and hypochlorite to form indophenol blue in an amount that is proportional to the ammonia concentration. The blue color is intensified with sodium nitroferricyanide, and the absorbance is measured at 660 nm (Reference 15.3).

2.3 The quality of the analysis is assured through reproducible calibration and testing of the Segmented Flow Analysis (SFA) system.

2.3 A general flow diagram of the SFA system is shown below (see Section 17.0 for a detailed flow diagram).



3.0 Definitions

Definitions for terms used in this method are provided in Section 16.0, "Glossary of Definitions and Purposes."

4.0 Interferences

4.1 Eliminate precipitation of calcium and magnesium hydroxides by adding sodium citrate.

4.2 Filter turbid digestates prior to analysis.

4.3 Digestates with background absorbance at the analytical wavelength may interfere.

5.0 Safety

5.1 The toxicity or carcinogenicity of each compound or reagent used in this method has not been fully established. Each chemical should be treated as a potential health hazard. Exposure to these chemicals should be reduced to the lowest possible level.

5.2 For reference purposes, a file of Material Safety Data Sheets (MSDS) for each chemical used in this method should be available to all personnel involved in this chemical analysis. The preparation of a formal safety plan is also advisable.

5.3 The following chemicals used in this method may be highly toxic or hazardous and should be handled with extreme caution at all times. Consult the appropriate MSDS before handling.

5.3.1 Ammonium Sulfate, $(NH_4)_2SO_4$ (FW 132.14)

5.3.2 Potassium Sulfate, K_2SO_4 (FW 174.26)

5.3.3 Phenol, solid or liquified, 88%, C_6H_5OH (FW 94.11)

5.3.4 Red Mercuric Oxide, HgO (FW 216.61)

5.3.5 Sodium Chloride, NaCl (FW 58.44)

5.3.6 Sodium Citrate Dihydrate, $C_6H_5Na_3O_7 \cdot 2H_2O$ (FW 294.10)

5.3.7 Sodium Hydroxide, NaOH (FW 40.00)

5.3.8 Sodium Hypochlorite, 5.25% available chlorine (household bleach) (FW 74.44)

5.3.9 Sodium Nitroferricyanide Dihydrate, $Na_2Fe(CN)_5NO \cdot 2H_2O$ (FW 297.95)

5.3.10 Sulfuric Acid, concentrated, H_2SO_4 (FW 98.08)

5.4 Unknown samples may be potentially hazardous and should be handled with extreme caution at all times.

5.5 Proper personal protective equipment (PPE) should be used when handling or working in the presence of chemicals.

5.6 This method does not address all safety issues associated with its use. The laboratory is responsible for maintaining a safe work environment and a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method.

6.0 Apparatus, Equipment, and Supplies

6.1 Segmented Flow Analysis (SFA) System (OI Analytical Flow Solution® IV) consisting of the following:

6.1.1 Model 502 Multichannel Peristaltic Pump

6.1.2 Random Access (RA) Autosampler

6.1.3 Expanded Range (ER) Photometric Detector with 5-mm path length flowcell and 660-nm optical filter

6.1.4 Data Acquisition System (PC or Notebook PC) with WinFLOW™ software

6.1.5 Ammonia/TKN in Soil and Plant Extracts Cartridge (Part #A002617)

6.2 Sampling equipment—Sample bottle, amber glass, with polytetrafluoroethylene (PTFE)-lined cap. Clean by washing with detergent and water, rinsing with two aliquots of reagent water, and drying by baking at 110°–150°C for a minimum of one hour.

6.3 Standard laboratory equipment including volumetric flasks, pipettes, syringes, etc. should all be cleaned, rinsed, and dried per bottle cleaning procedure in Section 6.2.

7.0 Reagents and Calibrants

7.1 Raw Materials

7.1.1 Ammonium Sulfate, $(NH_4)_2SO_4$ (FW 132.14)

7.1.2 Brij®-35 (Part #A21-0110-33)

7.1.3 Deionized Water (ASTM Type I or II)

7.1.4 Potassium Sulfate, K_2SO_4 (FW 174.26)

7.1.5 Phenol, solid or liquified, 88%, C_6H_5OH (FW 94.11)

7.1.6 Red Mercuric Oxide, HgO (FW 216.61)

7.1.7 Sodium Chloride, NaCl (FW 58.44)

7.1.8 Sodium Citrate Dihydrate, $C_6H_5Na_3O_7 \cdot 2H_2O$ (FW 294.10)

7.1.9 Sodium Hydroxide, NaOH (FW 40.00)

7.1.10 Sodium Hypochlorite, 5.25% available chlorine (household bleach) (FW 74.44)

7.1.11 Sodium Nitroferricyanide Dihydrate, $Na_2Fe(CN)_5NO \cdot 2H_2O$ (FW 297.95)

7.1.12 Sulfuric Acid, concentrated, H_2SO_4 (FW 98.08)

7.1.13 Teflon® or glass boiling stones