Soil, Sediment & Water Characterisation

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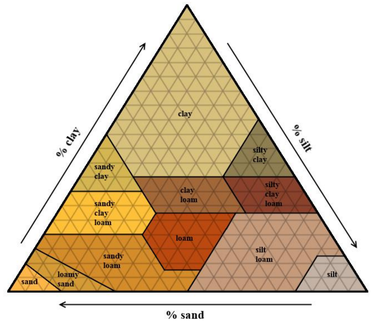
With over 20 years experience, Smithers performs a range of physical, chemical and biological analysis to characterise the test systems used in studies conducted to meet the requirements of the Environmental Fate Guidelines for adsorption/desorption to soil (OECD 106), aerobic and anaerobic soil (OECD 307), aerobic and anaerobic aquatic sediment (OECD 308) and mineralisation (OECD 309) studies.

Soil & Sediment Physical Analysis

Particle Size Analysis

Soil consists of mineral particles of different sizes. The particle size significantly affect the ability of the soil to drain and hold water. Soil particles are split into three categories; sand, silt and clay. The limits between these categories are arbitrary and a number of classification systems are in place worldwide.

The soil particle size is determined by the hydrometer method. A dispersing reagent is added to a soil sample to limit the attraction of soil particles to one another. The soil is suspended in a column of water, thoroughly mixed and an ASTM 152H hydrometer added. At specific times after settling has begun the density of the suspension is measured by reading the hydrometer at specified times to calculate the USDA and UK sand, silt and clay fractions. To determine the textural classification of the soil the calculated percentage sand, silt and clay are plotted on the relevant triangular graph.

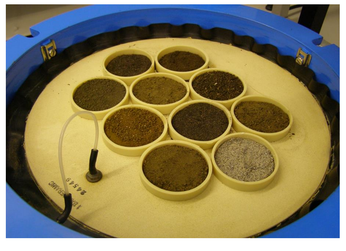


Water Holding Capacity

When a soil is saturated, nutrients may be lost through leaching. Plants extract water from the soil until permeant wilting point is reached. Knowledge of the water holding capacity of a soil is essential for plant growth and irrigation planning. A sandy soil will take less water to reach saturation and also hold less water as it dries out than a clay soil.

The maximum water holding capacity (MWHC) of a soil is the amount of moisture required to fully saturate that soil. To measure the MWHC of a soil a suction of 0.001 bar (pF 0) is applied by means of a foam capillary saturation system until the soil sample is saturated.

Water holding capacities can also be measured at higher suctions using a pressure plate extractor system. This comprises of a ceramic pressure plate cell mounted in a pressure vessel, with a ceramic plate outflow connected to the atmosphere. Soil samples are saturated and a known suction applied until the sample reaches equilibrium. Common suctions applied are 0.33 bar (pF 2.5) and 0.1 bar (pF 2.0).



The percentage water holding capacity is determined by calculating the difference in weight between the wet and oven dry soil.

Soil & Sediment Chemical Analysis

Organic Matter and Organic Carbon

Soil organic matter is defined as the organic fraction of the soil (plant, animal and microbial residue and soil humus). Organic carbon is a proportion of the total organic matter of a soil.

The organic carbon s digested with chromic and sulphuric acid and any excess chromic acid not reduced by the organic carbon in the soil is determined by titration against ferrous sulphate. It is assumed that 58% of organic matter is organic carbon, therefore organic matter is measured in accordance with the Walkley-Black rapid titration method. The soil is calculated by applying the Van Bemmelen factor (1.724) to the organic carbon result.

pH

Soil pH is determined by measuring the number of hydrogen ions (H+) present in a soil suspension, using a pH meter. The greater the number of H+ ions present the more acidic a soil, the fewer H+ ions present the more alkaline a soil. pH is measured on a logarithmic scale ranging from 0 to 14, pH 7.0 is considered to be neutral, values above this become increasingly alkaline and below increasingly acidic.

pH is determined in accordance with ISO 10390 in both water and calcium chloride. Measuring in calcium chloride minimises the effect environmental changes have on the pH. This gives a more consistent reading and therefore a pH value that is representative of the permanent characteristic of the soil.

Cation Exchange Capacity

Cation exchange capacity is a measure of the quantity of readily exchangeable cations present in a soil that neutralise the negative charge in a soil. The commonly held cations are calcium, magnesium, potassium, hydrogen, aluminium, sodium and ammonium.

The cation exchange capacity of a soil is determined by displacing the exchangeable cations by leaching the soil with buffered barium chloride solution. The barium chloride is washed from the soil and magnesium sulphate added to replace the barium ions with magnesium ions. Excess magnesium in solution is titrated against EDTA solution and the results used to calculate the cation exchange capacity.

Total Nitrogen

Nitrogen is an essential plant nutrient and its availability for plant growth is the principle limiting factor for crop production. The main natural source of nitrogen available to plants in soil are microbially-converted organic forms of nitrogen. Soil total nitrogen determination is a measurement of the organic forms of nitrogen present in a sample.

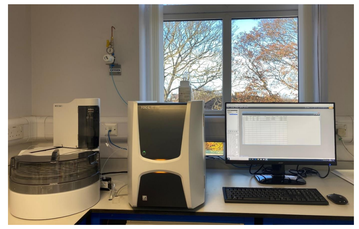
Total nitrogen is determined using a modified Kjeldahl method. The nitrogen is converted to ammonium salts by sulphuric acid and hydrogen peroxide digestion. The ammonia is analysed using a spectrophotometer.

Soil & Sediment Biological Analysis

Microbial Biomass

Microbial biomass is a measure of the mass of the living component of soil and is determined in accordance with ISO 14240-2. The fumigation-extraction method is used as it is suitable for both aerobic and anaerobic soils across all pH ranges.

To determine the biomass a sample is fumigated with chloroform, during this process microbial cells present are lysed and the organic carbon held within the living organic matter is released. The organic carbon is extracted using potassium sulphate and the carbon content is determined in both fumigated and non-fumigated samples using a Shimadzu TOC-L analyser with combustion oxidization infrared analysis. The difference in carbon content between the fumigated and non fumigated samples is used to calculate the microbial biomass.



Water Analysis

Nutrients

Nutrients in water systems come from both natural sources and human activity. Excess nutrients can lead to eutrophication of waterbodies.

Ammonium, nitrate, nitrite, total phosphorus, and total nitrogen are determined by spectrophotometric analysis.

TOC & DOC

Total organic carbon (TOC) is a measure of the total organic compounds in the water. Dissolved organic carbon (DOC) is the fraction of carbon that passes through a 0.45µm filter.

TOC and DOC are measured using a Shimadzu TOC-L analyser.

Hardness & Alkalinity

Alkalinity is a measure of the total amount of bases present in the water. Essentially it is buffering capacity of water and its ability to resist change in pH (i.e. maintain a stable pH).

Hardness is a measure of the concentration of divalent salts. Magnesium and calcium are the most common sources of water hardness.

Alkalinity is determined by an acid-based titration and hardness is measured by an EDTA titration.

BOD

Biological oxygen demand (BOD) is a measure of the amount of oxygen required by organisms to decompose organic matter in water.

BOD is measured by determining the oxygen consumption over a set period.