



Centurion  
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ASAC 1101 (2-1-0)

# FUNDAMENTALS OF SOIL SCIENCE

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PRACTICAL MANUAL



*Shaping Lives... Empowering Communities...*

MSSSoA

EX No.1

**CHEMICAL ANALYSIS- PRINCIPLES, TECHNIQUES AND  
CALCULATIONS**

**Aim:** To understand analytical techniques, terminology and calculations used in soil analysis

**Classification:**

Analytical techniques in soil analysis are generally divided into two groups:

**I. Qualitative** – identifies the species composition in a sample. It answers the question of the presence or absence of the component of interest without really answering the question of how much is present.

**Eg :** Rapid tissue analysis, Quality of fertilizers

**II. Quantitative** – determines how much of the component of interest in the sample.

**I. Quantitative Analysis:** two types.

1. Chemical analysis/ classical methods
2. Physical analysis/ Instrumentation

**1. Chemical analysis or classical analytical techniques**

Majority of early analytical techniques involved weight and volume as their final measurement.

**a. Gravimetric analysis** involve weight as the final measurement

Apparatus required – weighing balance and hot air oven

**Eg.** Per cent moisture in soil, plant or fertilizer sample

**b. Volumetric analysis** – involve volume as the final measurement done by titration. 5 types.

	<b>Type of titration</b>	<b>For estimation of</b>
i	Acid-base titration	Standardization of solution
ii	Complexiometric (or) EDTA titration	<b>Ca &amp; Mg</b> in soil and plant
iii	Precipitation titration	<b>Chlorides</b> in soil and water
iv	Oxidation –reduction (or) Redox (or) potentiometric titration	<b>Organic carbon</b> in soil
v	Back titration	<b>Nitrogen</b> in soil and plant

**i. Acid-base titration:** Selection of indicator is important. Type of indicator depends on equivalence point pH.

Indicator	Acid medium	Alkaline medium
Methyl orange	Red	Yellow
Methyl red	Red	Yellow
Phenolphthalein	Colourless	Pink
Bromothymol blue	Yellow	Blue

**ii. Complexiometric titration:** Used to determine metal concentration in soil extract with EDTA reagent. The reagent acts as chelating agent as it form complex with the metal.

**iii. Precipitation Titration:** Typified by titration of chloride with silver.

**iv. Redox or oxidation reduction or potentiometric titration:** titrations based on redox reactions include oxidizing/reducing agents.

Redox reagent	Used in soil analysis
Oxidizing agents/Oxidants	$K_2Cr_2O_7$ , $KMnO_4$ , FAS
Reducing agents/Reductants	Oxalic acid, $Na_2S_2O_3$
Both Oxidizing and reducing agent	$H_2O_2$ , $H_2SO_3$

## 2. Physical analysis or Instrumental techniques : Two types

a. Optical techniques      b. Electroanalytical techniques

**a. Optical techniques:** involve measurements based on interaction of electromagnetic waves with analyte. This could either be absorption or emission or scattering or rotation/resonance.

Principle	Instrument	Soil analysis
Absorption of EMR	Atomic Absorption Spectrophotometer (AAS)	Micronutrients (Fe, Mn, Cu, Zn)
	Spectrophotometer/Colorimeter	Phosphorus
Emission of EMR	Flame Photometer (FPM)	K & Na
Scattering of EMR	Turbidimeter Nephelometer	Sulphur
Rotation of EMR	Polarimeter	Sugars

**b. Electroanalytical techniques:** involve measurement of electrical properties of the sample solution include potential differences, amount of charges, current, resistance and conductivity. Two types.

	Technique	Principle	Instrument
i.	Potentiometry	Potential difference	pH meter
ii.	Conductometry	Change in resistance/conductance	Electrical Conductivity meter

### Terminology used in in soil analysis:

*Dissolution:* Breaking down of component parts in a liquid. The transformation is driven by the binding of solutes by the solvent E.g. Salt in distilled water

*Digestion:* Breaking down into component parts which dissolve in a liquid. It is driven by externally applied energy

E.g. Plant sample in di acid or tri acid mixture

*Adsorption:* Binding to a surface E.g. Activated charcoal

*Desorption:* Detachment from surface E.g. Ethanol

*Atomization:* breaking a collection of atoms into individual atoms

E.g. Flame photometer

*Extraction:* Transferring analyte from one matrix into another. The first matrix is a solid or liquid, the second a fluid.

E.g. Mechanical shaker or centrifuge

### Preparation of concentrations

Molarity or Molar solution	M.w./lit
Normality or Normal solution for bases	Eq.w./lit
for acids	$(\text{Eq.w./lit}) \times \frac{\text{Purity}}{\text{Density}}$
Molality	w/w
Percent solutions	1g per 100 mL (1%)

### Result :

**Calculations:**

1. Prepare 0.5 M sodium bicarbonate solution.
2. Prepare 0.02 N sulphuric acid solution. Given purity 98% and density/specific gravity 1.84 g/cc.
3. Prepare 1 m Murexide indicator using NaCl salt.
4. You have diagnosed iron chlorosis in 1 acre of paddy field. Recommendation given is 0.8 %  $\text{FeSO}_4$ . Calculate and suggest the dosage for foliar spray of one acre.

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