MEENAKSHI RAMASWAMY ENGINEERING COLLEGE

M.R. Kalvi Nagar, Thathanur, Ariyalur (Dt) – 621 804.

DEPARTMENT OF AGRICULTURAL ENGINEERING

LABORATORY RECORD BOOK

B.Tech Practical Examination

Name :

Roll. No. :

Branch :

Semester/Year :

Subject code/Subject:

MEENAKSHI RAMASWAMY ENGINEERING COLLEGE

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BONAFIDE CERTIFICATE

Certified that this is the Bonafide record of the Practical work done by Mr. /Ms. ……. Register Number ……..……

Semester …… during the year ..... In ……Laboratory.

Signature of Staff In-Charge **Signature of HOD**

Submitted for the University Practical Examinations held in…….

INTERNAL EXAMINER **EXTERNAL EXAMINER**

AI8411 **SOIL SCIENCE LABORATORY**

OBJECTIVE:

Students should be able to verify various quality aspects of soil and water studied in theory by performing experiments in lab.

1. Identification of rocks and minerals
2. Collection and processing of soil samples
3. Determination of soil moisture, EC and pH
4. Field density determination by Core Cutter and Sand Replacement method
5. Specific gravity determination by Pycnometer
6. Textural analysis of soil by International Pipette method
7. Grain size analysis by using Mechanical shaker
8. Determination of Organic carbon
9. Estimation of Gypsum requirements

TOTAL: 45 **PERIODS**

OUTCOME:

- Students know the techniques to determine various physical and chemical properties of soil that are applicable for agriculture and irrigation by conducting appropriate tests.

REFERENCES:

1. Punmia, B.C, "Soil Mechanics and Foundation Engineering", Laxmi Publishers, New Delhi. 2007.
2. Laboratory Manual, Centre for Water Resources, Anna University, Chennai. 2012.

EXP.NO. 1 **IDENTIFICATION OF ROCKS AND MINERALS**
DATE:
AIM

To identify the given rocks and minerals

DEFINITION OF ROCK:

A rock may be defined as an aggregate of one or more minerals called as rocks, for example an aggregate of the single mineral calcite is the limestone, while the granite rock is composed of several minerals, like orthoclase, mica, quartz with or without hornblende.

Rocks have no definite chemical composition or mineralogical composition nor do they possess any definite symmetrical form e.g. sand, marble, coal and building stone are all called rocks although they are so much unlike. Classification of Rocks: - Rocks are classified into three main groups according to their origin.

IGNEOUS ROCK: (FIRE ROCKS)

Igneous rocks are those rocks, which have been formed by the action of heat. These rocks were the first to be formed when the molten mass cooled and consolidated into solid rock. These rocks are massive and crystalline. They constitute nearly 95% of the earth‟s crust and about 16 km thick. Shale‟s account for about 4% Limestone 0.2% sandstone 0.7% and all the rest 0.1% they mostly consist of primary minerals like quartz, micas, feldspar, pyroxenes etc. Igneous rocks are grouped into two groups. 1) Intrusive or plutonic rocks 2) Extrusive or volcanic rocks.

INTRUSIVE OR PLUTONIC ROCKS

The Igneous rocks, which are formed by the cooling of the original magma beneath the surface, are called intrusive rock e.g. granite. They occur at greater depth in the earths crust. They are very compact. Intrusive rocks were formed as a result of the molten mass having been formed among the pre-existing solid rocks through the cracks and other planes of weakness. Some of these rocks consolidated in vertical cracks and formed wall like masses, called dykes. Other that consolidated in horizontal cracks or planes are known as sills

EXTRUSIVE OR VOLCANIC ROCKS

Extrusive rocks are those that were formed when the molten mass was poured out on the surface of the earth where it is consolidated on cooling. They contain many gas cavities. The rocks, which contain gas cavities or vesicles are known as

vesicular rocks. These cavities may be embedded by some minerals. Hence, such rocks are known as amygdaloidal rocks. The minerals so embedded are quartz, calcite, zeolite, glauconite. The igneous rocks are also classified into four groups according to their chemical composition (i.e. Silica content)

- ACID ROCK- MORE THAN 65% OF SiO_2
- BASIC ROCK – LESS THAN 55% OF SiO_2

SEDIMENTARY ROCK (AQUEOUS, CLASTIC, STRATIFIED ROCKS)

Igneous rocks when exposed to the action of atmosphere break up into loose masses of crushed, crumbled and mellowed material. These are carried away by flowing water, into lakes and seas where they are deposited as sediments. The dissolved material from the rocks is also deposited when the water evaporates. These deposits remain as loose material or cemented consolidated into sedimentary rocks. The cementing material used for compacting the loose material is silica or lime or oxides or iron. Sedimentary rocks are also called classic rocks (Clastos broked) They are also called aqueous rocks as water is the chief agency in their information and stratified rocks as the sediments are usually deposited in layers.

METAMORPHIC ROCKS

Igneous and sedimentary rocks undergo a change. When the change is considerable the rock is said to have undergone metamorphosis and the new rock is known as a metamorphic rock. The metamorphosis is brought about by the action of water heat or pressure.

1) DYNAMO METAMORPHIC ROCKS Dynamo metamorphism is due to pressure brought about by the folding of rocks due to crust movement of the earth. As a result of this pressure, the crystals in rocks are flatted and they are called as folio e.g. thick in the middle and thin at edges. Such rocks is called foliated rock. When the foliation is sight and the folio are not separate, the rock is called the gneiss. If the crystals are very much flattered and the folio are easily separated, then the rock is called an schist e.g. Gneisses-Granite gneiss, Diorite gneiss. Schist: Mica, Schist, Quartz, schist, Chlorite, schist, Talc schist.

2) THERMO METAMORPHIC ROCK: Thermo –metamorphism may be caused by volcanic lava and the4 heat can fuse or melt the original rocks e.g. Sandstone is converted into quartzite and limestone is converted into marble.

3) HYDRO METAMORPHIC ROCKS: Water in combination with heat and pressure can bring about chemical changes as well. Hot water or stream converts

feldspar into mica and potassium silicate e.g. Basalt and granite converted into literate.

A. Igneous Rocks

Rocks	Texture	Essential minerals	Most common accessory minerals	Average specific gravity	Remarks
Granite	Plutonic Halocrystalline	Predominant Quartz 20-35% Orthoclase	Hornblende, Mica Magnetite	2.64	White or reddish or blackish
Syenite	---do---	Predominance Quartz 10% plus Orthoclase, Nepheline and Albite	Hornblende, Biotite Magnetite	2.80	---do---

B. Sedimentary Rocks

Name	Mineral composition	Colour and structure
Sandstone	Mainly quartz with cementing agents, such as calcium carbonate, iron oxides and clays	Light to red. Usually granular and porous structure
Limestone	Mainly calcite or calcite dolomite with iron oxides, clay, phosphate and organic matter	Usually light greyto yellow. Fine grained and compact

C. Metamorphic rocks

Gneiss	Formed from granite, mineral composition like that of granite	Alternating light and dark colours, Banded and foliated texture
Schist	Formed from basalt or shale. Mineral composition as that of original rock	As original rock, foliated structure

Quartzite	Formed from sandstone and of same composition	Light to brown. Compact and uniform in texture with Non-foliated structure
Slate	Formed from shale and of same composition	Grey to black; compact and uniform in texture with foliated structure
Marble	Formed from limestone, consists mainly of calcite and dolomite with minor amounts of pigments such as iron oxide	Light red to green to black. Compact, fine to coarse texture, non-foliated structure

IDENTIFICATION, CHEMICAL COMPOSITION AND PHYSICAL CHARACTERISTICS OF IMPORTANT MINERALS

Two types of minerals are found in natural system and are primary minerals and secondary minerals. The type of mineral mainly depends on the mode of formation but not on mineral composition. Minerals that crystallize from cooling of magma are called as primary minerals while minerals that crystallize during weathering of primary minerals are called as secondary minerals.

A. PRIMARY MINERALS

S.No	Mineral	Chemical composition	Colour	Streak	Lusture	Transparency	Hardness	Specific gravity
I.	**Orthosilicates/ Neosilicates**							
1.	Olivine	$(FeMg)SiO_4$	Green	White	Vitreous	Transparent to Translucent	6.5-7.0	3.2-4.3
2.	Zircon	$ZrSiO_4$	Yellow, reddish brown	White	Adamantine, vitreous, greasy	Transparent, Translucent, opaque	7.5	4.6-4.7
3.	Garnet	$X^{2+}{}_3Y^{3+}{}_2Si_3O_{12}$ (X= Ca, Fe, Mn, Mg Y = Al, Cr, Fe^{3+})	Wine red to reddish brown, yellow, green black	Colourless	Vitreous	Transparent to Translucent	6.5-8.0	3.5-4.3
II.	**Inosilicates**							
1.	Phyroxine group - Augite	$(Ca,Na)(Mg,Fe,Al)(Al, Si)_2O_6$	Green, grayish green, greenish brown, dark brown, black	Light green to colourless	Vitreous to dull	Opaque, Translucent in thin sections	5-6	3.2-3.6
2.	Amphiboles group - Horneblende	$(Ca,Na)^{2-}{}_3(Mg,Fe,Al)_5Si_6\,Si,Al)_2\,O_{22}(OH,F)_2$	Dark green to black	Colourless	Vitreous to dull	Opaque, Translucent in thin sections	6.0	3.0-3.4
III.	**Phyllosilicates**							
1.	Mica group-Muscovite	$KAl_2(AlSi_3O_{10})$	Colourless to white	White	Pearly to vitreous	---do---	2.5	2.8-3.1
2.	Mica group-Biotite	$K(Mg,Fe)_3(AlSi_3OH)(OH)_3$	Brown to dark grey	Grey	Vitreous to pearly	Transparent	2.5 – 3.0	2.8 - 3.4
3.	Chlorite	$Mg_{10}\,(Al_2Si_6\,Al_2)O_{20}(OH)_{16}$	Brownish grey	Greyish white	Earthy to pearly	---do---	1.5 - 2.5	2.6 - 3.3
IV.	**Tectosilicates**							
1.	SiO_2 group-Quartz	SiO_2	Various	White	Various	Opaque to Translucent	7.0	2.6-2.7
2.	**Feldspar group**							
a. Orthoclase feldspar								
1.	Microcline (Triclinic)	$K\,AlSi_3O_8$	Grey to pinkish white	White Vitreous	---do---	---do---	6.0	2.56

2.	Orthoclase (Monoclinic)	K $AlSi_3O_8$	Colourless to pinkish white	White Vitreous	---do---	---do---	6.0	2.56
b. Plagioclase feldspar								
1.	Albite	$NaAlSi_3O_3$	Grayish white	White	Sub-vitreous	---do---	6.0	2.6 - 2.7

B. SECONDARY MINERALS

S.No	Mineral	Chemical composition	Colour	Streak	Lusture	Transparency	Hard-ness	Specific gravity
I.Nonsilicates								
a.Oxides								
1.	Hematite	Fe_2O_3	Steel	Red	Metallic	---	5 - 6.5	4.9-5.2
b.Hydroxides								
1.	Gibbsite	Al $(OH)_3$	Greenish White	White	---do---	Transparent	2.5 - 3.5	2.4
c. Carbonates								
1.	Calcite	$CaCO_3$	Colourless	White	---do---	---do---	3	2.71
2.	Dolomite	$CaCO_3.MgCO_3$	White	White	Vitreous to pearly	---do---	3.5 – 4	2.85
d. Sulphates								
1.	Gypsum	$CaSO_4.2H_2O$	White	Greenish white	Vitreous to pearly	Transparent to translucent	3.5	2.96
e. Phosphates								
1.	Apatite	$Ca_3(PO_4)_2.X$	Pink to yellow	White	Vitreous	Transparent	5	3.1-3.2
f. Sulphides								
1.	Iron pyrite	FeS_2	Brownish Yellow	Greenish black	Metallic	Opaque	6 - 6.5	5.01
g.Silicates	Secondary clay minerals – Kaolinite, Montmorillonite, Vermiculite, Illite, Chlorite, etc.							

EXP. NO. 2 **COLLECTION AND PROCESSING OF SOIL SAMPLES**

DATE:

AIM

To collect and process the soil sample from nearby field

INTRODUCTION

The importance of having a true representative sample can be very well realized from the fact that only a minute fraction of huge soil mass of the field is actually used for the analysis in the laboratory to find out the quantity of essential nutrients available to plants and other relevant physical and chemical characteristics. Therefore, while collecting soil samples the following aspects should be carefully considered.

The soil samples collected should be representative of the area. A field can be treated as single sampling unit if it is appreciably uniform in all respects. Variation in slope, colour, texture, crop growth and management practices should be taken in to account and separate set of composite soil samples should be collected from each unit of such area.

The main purpose for which samples collected are:

a. Soil fertility evaluation and fertilizer recommendation.
b. Reclamation of problematic soils.
c. Plantation of orchards.

The methods of sampling to be used and the amount of soil to be collected mainly depends on

1. The purpose for which sample is required
2. The nature of soil
3. The time available

Tools and materials required :-

1. Soil auger, tube auger, spade, pick-axe, khurpi.
2. Bucket or tray.
3. Paper tages (Labels).
4. Information sheet
5. Cloth bags (alternatively polythene bags).
6. Ball point pen or copying pencil

SAMPLING FOR FERTILITY EVALUATION AND FERTILIZER RECOMMENDATION

For soil fertility point of view, normally the samples are taken from the plough layer i.e., 0-15 cm depth. This is applicable for the fields growing cereals and other crop. In case of deep-rooted crops and under dry farming conditions, it may be necessary to obtain samples from different depths (or layers) of soil. For collecting proper soil samples following steps should be kept in mind:

1. Divide the field into small areas so that each sample represents an area of approximately I hectare.
2. A sample should be collected separately from areas which differ in soil colour or past management, e.g., liming, manuring, fertilization, cropping pattern etc.
3. Scrap away the surface litter and insert soil auger or sampling root to a plough depth (about 15 cm). Take at least 15 samples randomly distributed over each area and place them in a clean bucket. A spade or khurpi can be very well used if auger is not available.
4. If a spade or khurpi is used for taking samples, then dig a V-shaped hole to a plough depth and cut 1.5 cm thick slice of soil from top to bottom of the exposed face of the V-shaped hole and collect soil in a clean bucket.
5. Thoroughly mix the soil samples collected from 15 or more spots in a bucket.
6. Collect only ½ to 1 kilogram soil and discard remaining soil samples by quartering.
7. Quartering is done by dividing the thoroughly mixed soil in to four equal parts and discarding two opposite quarters. Remix the remaining two quarters and again divide it into four parts and reject two of them, repeat this procedure until about one half kilogram of soil is left.

SAMPLING FOR SOIL RECLAMATION

For reclamation purpose the samples should be drawn to the plough layer but the salt crusts (visible or suspected) on the soil surface should be sampled separately. On
saline and alkali soils, samples can be taken by either using a soil auger or digging a 90 cm deep pit. The samples should be collected as follow:

1. Make one side of the pit vertical (sun facing side) and put mark on it at 15, 30, 60 and 90 cm depth from the surface.
2. Hold a suitable container at 15 cm mark and scrap a uniform slice of soil from the surface down to this mark and collect about 500 gram of the soil sample. Transfer the soil sample to a cloth bag and mark it as 0-15 cm. Similarly, collect 500 gram soil sample from each layer, i.e. 15-30, 30-60 and 60-90 cm and put them separately in three cloth bags and then after dry in shade.
3. Take a separate sample of the surface crust also, if any.
4. Prepare two labels for each sample showing the depth from samples has been taken, name of farmer, name of village, exact location of the field, conditions and growth of crop if any.
5. Put up one label inside the bag and the other on the bags. Label should be written with a copying pencil/ball pan.

6. Information sheet may also be prepared if necessary as given in soil sample information sheet.
7. Send the sample along with information sheet to be nearest soil testing laboratory.

PRECAUTIONS

1. Do not draw any sample from the extreme corners of the field, area recently manured or fertilized, old bounds and marshy spots.
2. Avoid sampling from furrows, acidic or alkaline pockets.
3. Keep the sample in a bag and tag it properly.
4. Do not take less than 0.5 kg of a composite sample.
5. Sampling should be done from a uniform piece of land.
6. If there is a hard pan in the pit, it should be sampled separately and also note down its depth and thickness.

SAMPLING FOR ORCHARD PLANTATION

For horticultural plants, the samples may be taken from different depth or layer depending upon the root penetration of plants. The success of fruit tree plantation depends upon the physico-chemical properties and fertility status of sub-soil layers. Therefore, it is necessary to test soil before fruit tree plantation. Soil samples for plantation are to be taken as follows:

1. Dig a pit 1.80 meter deep and make its one side vertical, put marks at 15, 30, 60, 90, 120, 150 and 180 cm depths from the surface.
2. Collect samples separately from 0-15, 15-30, 30-60, 60-90, 90-120, 120-150 and 150-180 cm depths in the same way that of saline alkali soils.
3. In case there is a hard pan in the pit, sample it separately and note down its depth and thickness.
4. Pack the soil samples depth wise in separate cloth bags.
5. Put up label on each cloth bags indicating the depth, name of farmers, name of village, location of the field etc.
6. Send the samples to nearest soil testing laboratory along with detailed information.

PREPARATION OF SAMPLES FOR ANALYSIS

Drying: Wet soil sample should not be stored as changes may occur in the chemical nature of certain ions and organic matter. Samples are generally air dried at temperature (25-35 ^{0}C) and relative humidity (20-60%) then after are stored. Fresh samples from the field without any drying are required.

Sieving: Soil in the right moisture condition can be passed through a 2 mm sieve (about 10 mesh per inch). The common practice of sieving a portion of the gross sample through a 2 mm sieve and discarding the rest is undesirable as it increase the concentration of most of the elements involved in soil fertility. When the gravels in the soil exceeds 2% limit over a 2 mm sieve their exact percentage should be recorded.

Grinding: A roller, rubber pestle in an agate mortar, or a motorized grinder is commonly used. Crushing of the gravel or primary sand particles should be avoided for heavy soils, it is better to pass these through a 2 mm sieve before allowing them to get completely air dried.

Mixing: Sample should be thoroughly mixed by rolling procedure. Place the dried ground and sieved sample on a piece of cloth. Hold all the four corners of the cloth and then up the one corner and down the other corner across the sample alternatively. Now repeat the process in the reverse direction to roll the soil from one corner to another. Continue this until thorough mixing is assured.

Storage: Store the soil in paper carton (soil sample box) using a polythene bag as in inner lining. Label the carton mentioning cultivators name, plot number, date of sampling and initials.

Soil sample information sheet

1. Name of farmer---------- Date----------
2. Address----------
   Village---------- P.O.----------
   Block---------- District ----------
   State----------

1.	Sample No. ----------	2.	Depth of sampling (cms)----------
3.	Area (in hectare)----------	4.	Slope or topography- level/sloping/ undulating
5.	Elevation ----------		Up land/ low land
6.	Drainage----------		Well drained/ moderate/ impeded
7.	Irrigation ----------		Irrigated/unirrigated (rain fed)
8.	Source of irrigation ----------		Well /tube well/ canal/ pond
9.	Type of soil ----------		Sandy/loamy/ clayey
10.	Special soil conditions----------		Hardpan layer/rocky subsoil/ concentration
11.	Cropping Details ----------		

EXP.NO. 3 DETERMINATION OF SOIL MOISTURE, EC AND pH

DATE:

A.DETERMINATION OF SOIL MOISTURE (GRAVIMETRY METHOD)

Soil moisture is estimated both by direct and indirect methods. In direct methods soil moisture is estimated thermo - gravimetrically either through oven drying or by volumetric method while in indirect methods it is estimated through the properties of water in the soil. These methods of measuring soil moisture are divided in to many branches:

1. **Direct methods:** Measurement of moisture content in the soil (wetness) includes methods such as gravimetric, volumetric, using methyl alcohol and calcium carbide.
2. **Indirect methods:** Measurement of water potential or stress or tension under which water is held by the soil. The most commonly used methods are: Tensiometer, gypsum block, Neutron probe, pressure plate apparatus, etc.

GRAVIMETRIC METHOD

PRINCIPLE

Soil moisture content is determined by drying a known quantity of soil sample in an electric oven at 105°C and finding out the loss in weight.

MATERIALS REQUIRED

i. Moisture bottle / aluminum box

ii. Chemical balance/top pan balance

iii. Desiccator

PROCEDURE

Place a clean and empty moisture bottle or aluminum box with lid separately in an electric oven at 105°C for 15 minutes. Replace the stopper or lid, remove the moisture bottle or aluminum box, cool in a desiccator, weigh accurately and record the weight. Fill the moisture bottle or aluminum box to about two third of its capacity with soil sample. Close with stopper / lid and weigh quickly. Remove the stopper / lid and keep it in the oven at 105°C for about 8 hours. After the expiry of time, remove the moisture bottle / aluminum box, cool it in a desiccator and weigh quickly. Calculate the loss in weight and express the moisture content on oven dry basis.

CALCULATION

Weight of empty moisture bottle = a g

Weight of the moisture bottle + moist soil sample = b g

Weight of the moisture bottle + soil sample after drying in the oven = c g

Weight of moisture in the soil = (b - c) g

Percentage of moisture in the soil sample on oven dry basis

$$= \frac{(b - c)}{(c - a)}$$

RESULT

Percentage of moisture in the given soil sample =

B) DETERMINATION OF pH

The pH is defined as the negative logarithm of hydrogen ion concentration or simply the log of reciprocal of the hydrogen ion concentration (Sorensen, 1906).

$$pH = -\log [H^+] = \log 1/ [H^+]$$

PRINCIPLE

A glass electrode in contact with H^+ ions of the solution acquires an electric potential, which depends on the concentration of H^+ ions. This is measured potentiometrically against a reference electrode which is usually a calomel electrode. The potential difference between glass electrode and calomel electrode is expressed in pH units.

Two electrodes are used in the determination of pH. One is **reference electrode** which provides a standard voltage. The reference electrode is usually a saturated calomel electrode which has two layers (1) saturated solution of KCl and (2) mixture of solid $HgCl_2$ and Hg. The outer tube is usually 5-15 cm long, 0.5-1 cm in diameter. The mixture of solid $HgCl_2$ + Hg paste is contained in an inner tube that is connected to the saturated KCl solution in the outer tube by means of small opening. The resistance of this type of electrode is 2000-3000 ohms.

The outer electrode is glass electrode that consists of a tube enclosing a lead wire made of Ag coated with AgCl. This wire is again enclosed in wax insulation. To the tube at the bottom is attached a glass bulb made of a special kind of glass which is sensitive to H^+ ions. The thickness of the glass membrane varies from 0.03 to 0.1 mm and has a resistance of 50 to 500 mega ohms.

When these two electrodes are dipped in solution, the saturated solution of KCl comes out of reference electrode through the small holes and forms an invisible ionic bridge between electrodes through which current passes. The H^+ ions are absorbed by glass electrode and depending on the amount of H^+ ions present in the solution, an electric potential develops between electrodes. This potential difference is measured in terms of pH by suitable galvanometer.

MATERIALS REQUIRED

1) pH meter 2) 100 ml beakers
2) Glass rod 4) Buffer solution (pH 4.0, 7.0 and 9.2)

INSTRUMENT OPERATING PROCEDURE

- Push the MAN/AUTO push button to AUTO (Automatic Temperature Compensation Mode) position (pushed in).
- Push the pH /mV push button to pH position (pushed out)
- Push the STBY/READ push button to STBY position (pushed out)
- Switch on the instrument and allow it to warm for 10 minutes
- Prepare buffer solutions of 4.0, 7.0 and 9.2 pH by dissolving respective buffer tablet in 100 ml of fresh distilled water in separate containers (polythene bottles when combined pH electrodes are used or in beakers when separate electrodes are used).
- Keep the container with 4.0 pH buffer solution on the base plate of the electrode stand
- Clip the electrode clamp at the appropriate height on the rod of electrode stand in such a way the electrodes are fully immersed in buffer solution
- Set the % slope control for the given instrument. Insert the Electrode in 4.0 pH buffer solution and adjust the calibration control to read the exact pH.
- Push the STBY/READ push button to READ position (pushed in) and wait for 30 seconds.
- Adjust the CAL control to read pH value of 4.0 on the READOUT.
- Adjust % SLOPE control slightly to display a pH value of 4.0 exactly on the READOUT.
- Adjust in similar way for 7.0 and 9.2 pH.The reading of the pH value should be stable within 0.01 (1 digit) for repetitive operations of STBY/READ push button.

NOTE

- The electrodes should be properly inserted in the solutions.
- Sufficient time should be allowed for the electrodes to attain the temperature of solution.
- Larger volume of solution to be used so that temperature of the solution does not change during measurement.

MEASUREMENT

- Fill up a clean dry container with sample.

- Immerse the electrode in the sample.
- Push the STBY/READ push button to READ position, wait for 30 seconds.
- The pH of the sample will be displayed on the READOUT.
- Push the button to STBY position.
- Raise the electrodes, remove container with the sample, wash the electrodes(s) with distilled water and blot clean with tissue or filter paper.

RESULT

The pH of the given sample = ---------

RATING

Nature	pH
Extremely acidic	< 4.5
Very strongly acidic	4.5-5.0
Strongly acidic	5.1-5.5
Moderately acidic	5.6-6.0
Slightly acidic	6.1-6.5
Neutral	6.6-7.3
Mildly saline	7.4-7.8
Mildly alkaline	7.9-8.4
Strongly alkaline	8.5-9.0
Very strongly alkaline	> 9.0

RESULT

The pH of the given sample = ---------

INFERENCE

The given sample is ----------

C. DETERMINATION OF ELECTRICAL CONDUCTIVITY

The electrical conductivity (EC) measurement gives the total amount of soluble salts present and is expressed as milli mhos /cm or dSm^{-1}

PRINCIPLE

As the amount of the soluble salts in a solution increases, the electrical conductivity also increases which is measured in terms of resistance offered to the flow of current using a conductivity meter.

It is known that solutions offer resistance to the passage of electric current through them, depending upon the concentration of salts present in it. Hence EC is measured in terms of electrical resistance between parallel electrodes immersed in the solution. In such a system, the solution between the electrodes becomes the electrical conductor to which the physical laws relating to resistance are applicable. The electrical resistance "R" is directly proportional to the distance "L" between the electrodes and inversely proportional to the cross sectional area "A" of the conductor.

$$\text{Hence } R \propto L/A \text{ or } R = r \times L/A$$

Where

r = proportionality constant known as electrical resistivity

If L = 1 cm and A = 1 cm^2 then R = r.

Where, r is called as specific resistivity. Hence specific resistance is the resistance of a conductor of 1 cm in length and 1 cm^2 in area.

Higher the salt content, higher the passage of current and lesser the resistance to the flow of current. Hence the reciprocal of specific resistivity is called as specific conductivity. Therefore specific conductivity is defined as the conductivity of a solution enclosed in a cell whose electrodes are exactly 1 cm apart and possess a surface area of 1 cm^2. The resistance is expressed as ohms/cm and the conductivity is expressed in reciprocal ohms or mhos per cm. A factor called the **cell constant** is determined for the given cell. Modern conductivity meters are calibrated to read directly the electrical conductance with given cell.

MATERIALS REQUIRED

1) Conductivity meter 2) 100 ml beaker 3) Glass rod

4) 0.01 N KCl solution 5) Saturated $CaSO_4$ solution

PROCEDURE

- Switch on the conductivity meter and wait for 10 minutes.
- Check the instrument with saturated $CaSO_4$ solution and 0.01 N KCl solutions. The EC of saturated $CaSO_4$ and 0.01 N KCl solutions should be **2.2 dSm^{-1}** and **1.41dSm^{-1}** respectively.
- Wash the electrodes carefully and immerse them into the solution of which EC is to be found out.
- Adjust the temperature correction. The readings on the scale at this position indicate the electrical conductivity.
- Multiply this by the cell constant (noted on the cell itself) to get specific conductivity.

RESULT

The electrical conductivity (EC) of the given sample = ---------dSm^{-1}

Rating (As per USSL)

EC (dSm-1)	Salinity
<0.250	Low
0.250-0.750	Medium
0.750-2.250	High
>2.250	Very High

EXP NO: 4 FIELD DENSITY DETERMINATION BY CORE CUTTER AND SAND REPLACEMENT METHOD

DATE:

A.CORE CUTTER METHOD

AIM

To determine the field density by core cutter method

NEED & SCOPE

This method covers the determination of the **in-situ density** of compacted soils by using core cutter. The in situ density of natural soil is needed for the determination of bearing capacity of soils, for the purpose of stability analysis of slopes, for the determination of pressures on underlying strata for the calculation of settlement and the design of underground structures. It is a quality control test, where compaction is required, in the cases like embankment and pavement construction.

APPARATUS REQUIRED

1. Rammer
2. Dolly
3. Cutter
4. Balance 15kg. capacity
5. Sensitive Balance
6. Moisture tins

PROCEDURE

1. In the spot adjacent to that where the field density by sand replacement or balloon method has been determined, drive the core cutter using the dolly over the core cutter.
2. Stop ramming when the dolly is just around the surface.
3. Dig out the cutter containing the soil out of the ground and trim off any solid extruding from its ends, so that the cutter contains a volume of soil equal to its internal volume which is determined from the dimensions of the cutter.
4. Determine the weight of the contained soil is found and its moisture content.

OBSERVATIONS & RECORDINGS

Dry density:

Wt. of Core-Cutter (W_1)	=	gms.
Wt. of Core-Cutter + Wet Soil (W_2)	=	gms.
Wt. of Wet Soil ($W_S = W_2 - W_1$)	=	gms.
Volume of Core-cutter V_c	=	c.c.

Bulk Density of Soil ($\gamma_s = W_s/V_c$) = g/c.c.

Dry Density of Soil = = g/c.c.

Moisture Content:

Wt. of Container + Wet Soil (W)	=	gms.
Wt. of Container (W_c)	=	gms.
Wt. of Container + dry Soil (W_d)	=	gms.
Wt. of Moisture ($W - W_d$)	=	gms.
Wt. of dry Soil ($W_d - W_c$)	=	gms.

Moisture content w % = $(W-W_d/W_d-W_c) \times 100$

B.SAND REPLACEMENT METHOD

AIM

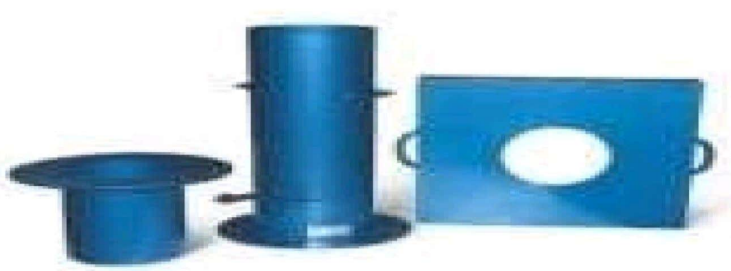
To determine the in situ density of natural or compacted soils using sand pouring cylinders.

THEORY

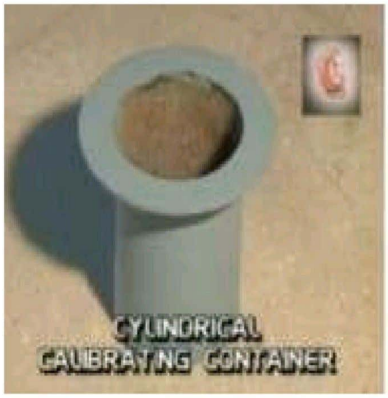
1. In core cutter method the unit weight of soil obtained from direct measurement of weight and volume of soil obtained from field. Particularly for sandy soils the core cutter method is not possible. In such situations the sand replacement method is employed to determine the unit weight.
2. In sand replacement method a small cylindrical pit is excavated and the weight of the soil excavated from the pit is measured. Sand, whose density is known, is filled into the pit.
3. By measuring the weight of sand required to fill the pit and knowing the density of soil, volume of the pit is calculated . Knowing the weight of soil excavated from the pit and the volume of pit the density of soil is calculated. Therefore in this experiment there are two stages (1) Calibration of sand density and (2) Measurement of soil density.

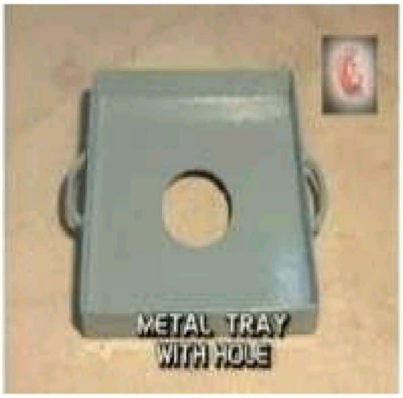
APPARATUS REQUIRED

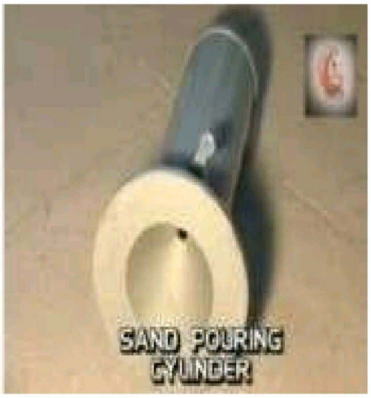
- Sand pouring cylinder of 3 litre/16.5 litre capacity, mounted above a pouring come and separated by a shutter cover plate.
- Tools for excavatin holes; suitable tools such as scraper tool to make a level surface.
- Cylindrical calibrating container with an internal diameter of 100 mm/200 mm and an internal depth of 150 mm/250 mm fitted with a flange 50 mm/75 mm wide and about 5 mm surrounding the open end.
- Balance to weigh unto an accuracy of 1g.
- Metal containers to collect excavated soil.



- Metal tray with 300 mm/450 mm square and 40 mm/50 mm deep with a 100 mm/200 mm diameter hole in the centre.
- Glass plate about 450 mm/600 mm square and 10mm thick.
- Clean, uniformly graded natural sand passing through 1.00 mm I.S.sieve and retained on the 600micron I.S.sieve. It shall be free from organic matter and shall have been oven dried and exposed to atmospheric humidity.
- Suitable noncorrodible airtight containers.
- Thermostatically controlled oven with interior on noncorroding material to maintain the temperature between 105ºC to 110ºC







PROCEDURE

CALIBRATION OF THE CYLINDER

- Fill the sand pouring cylinder with clean sand so that the level of the sand in the cylinder is within about 10 mm from the top. Find out the initial weight of the cylinder plus sand (W1) and this weight should be maintained constant throughout the test for which the calibration is used.
- Allow the sand of volume equal to that of the calibrating container to run out of the cylinder by opening the shutter, close the shutter and place the cylinder on the glass sand takes place in the cylinder close the shutter and remove the cylinder carefully. Weigh the sand collected on the glass plate.
- Its weight (W2) gives the weight of sand filling the cone portion of the sand pouring cylinder. Repeat this step at least three times and take the mean weight (W2) Put the sand back into the sand pouring cylinder to have the same initial constant weight (W1).

DETERMINATION OF BULK DENSITY OF SOIL

- Determine the volume (V) of the container be filling it with water to the brim. Check this volume by calculating from the measured internal dimensions of the container.
- Place the sand poring cylinder centrally on the calibrating container making sure that constant weight (W1) is maintained. Open the shutter and permit the sand to run into the container. When no further movement of sand is seen close the shutter, remove the pouring cylinder and find its weight (W3).

DETERMINATION OF DRY DENSITY OF SOIL IN PLACE

- Approximately 60 cm 2 of area of soil to be tested should be trimmed down to a level surface, approximately of the size of the container. Keep the metal tray on the level surface and excavate a circular hole of volume equal to that of the calibrating container. Collect all the excavated soil in the tray and find out the weight of the excavated soil (Ww).
- Remove the tray, and place the sand pouring cylinder filled to constant weight so that the base of the cylinder covers the hole concentrically. Open the shutter and permit the sand to run into the hole. Close the shutter when no further movement of the sand is seen. Remove the cylinder and determine its weight (W3).
- Keep a representative sample of the excavated sample of the soil for water content determination.

TABLE: OBSERVATION

S.No	Description	Test 1	Test 2
(a) Determination of mass of sand in the cone			
1)	Weight of sand + cylinder before pouring (W1) (g)		
2)	Mean weight of sand in cone (W2) (g)		
(b) Determination of bulk density of sand			
3)	Volume of calibrating container (V) cc		
4)	Weight of sand + cylinder after pouring (W3) (g)		
5)	Weight of sand to fill calibrating containers, $W_a = (W1 - W3 - W2)$ (g)		
6)	Bulk density of sand, $\rho S = (5/3)$ (g/cc)		
(c) Bulk density and unit weight of soil			
7)	Weight of wet soil from the hole (WW) (g)		
8)	Weight of sand+ cylinder after pouring in the hole (W4) (g)		
9)	Weight of sand in the hole, $Wh = (W1 - W4 - W2)$ (g)		
10)	Bulk density of soil, ρ W / Wh)* ρS (g/cm3)		
11)	Bulk unit weight of soil, γ 9.8 * ρ kN/m3)		

(d) Water content determination

12	Container Number		
13	Weight of container + wet soil (g)		
14	Weight of container + dry soil (g)		
15	Weight of container (g)		
16	Weight of dry soil (g)		
17	Weight of water (g)		
18	Water content, W = (R17/R16)*100 (%)		

CALCULATIONS

1. Dry density,= (g/cm^3)
2. Dry unit weight,= (kN/m^3)

RESULTS

1. Dry density =
2. Dry unit weight =

EXP NO. 5 SPECIFIC GRAVITY DETERMINATION BY PYCNOMETER

DATE:

AIM

To determine the specific gravity of the soil sample.

APPARATUS REQUIRED

Pycnometer, IS Sieve, Weighing balance, Oven

THEORY

Specific gravity (G) is defined as the ratio of weight of soil solids at given temperature to the weight of equal volume of water at that temperature. IS specifies 27°C as the standard temperature for recording specific gravity

PROCEDURE

1. Dry the Pycnometer and weight it with its cap (W_1)
2. Take about 200 gm of oven dried soil passing through the 2mm sieve into the Pycnometer and weigh again (W_2)
3. Add sufficient amount de-aried water to cover the soil and screw on the cap.
4. Shake the Pycnometer and remove the entrapped air if any
5. After the air is removed, fill the Pycnometer with water completely
6. Throughly dry the Pycnometer from outside and weigh it (W_3)
7. Clean the Pycnometer by washing thoroughly
8. Fill the cleaned Pycnometer completely with water up to its top with cap screw on.
9. Weight the Pycnometer after drying it on the outside thoroughly.(W_4)
10. Repeat the procedure for three samples and obtain the average value of specific gravity.

$$\textbf{SPECIFIC GRAVITY (G)} = \frac{W_2 - W_1}{(W_4 - W_1) - (W_3 - W_2)}$$

RESULT

The specific gravity (G) of soil sample is

EXP.NO.6. TEXTURAL ANALYSIS OF SOIL BY INTERNATIONAL PIPETTE METHOD

DATE:

AIM

To analyse the soil texture of the given soil using International pipette method

PRINCIPLE

This method is based on **Stokes' law**. According to this law the rate of fall of a particle in liquid is directly proportional to the square of its radius. $V \alpha r^2$

$$V = 2 / 9 \, g \, r^2 (dp-d) / \eta$$

Where

V	=	sedimentation velocity in cm/sec
g	=	acceleration due to gravity cm/sec^2
r	=	radius of the particle or sphere (cm)
dp	=	density of the particle (g/cc)
d	=	density of the liquid (g/cc)
η	=	viscosity of the liquid

The soil is first dispersed by destroying the binding agents with hydrogen peroxide and hydrochloric acid followed by treatment with a dispersing agent. Clay and silt are separated by sedimentation and coarse and fine sand by sieving.

MATERIALS REQUIRED

1000 ml Spout less Measuring Cylinder, Filter stand, 500 ml beaker, Filter paper Whatman No.50, Funnel (7.5 cm), Mechanical stirrer, Rubber stopper for the cylinder, Stop clock, Water bath, 150 ml measuring cylinder, Chemical balance, Tall form beaker, Robinson pipette, Hot air oven, Porcelain dish/basin, 0.2mm sieve, 6% Hydrogen peroxide, N/5 HCl, 1N NaOH, $AgNO_3$ solution, Whatman No 50 filter paper.

PROCEDURE

Transfer exactly 20 g of air dried soil sample to a 500 ml beaker. Add 60 ml of 6 per cent hydrogen peroxide. Stir it well and keep it on a water bath for 30 minutes till frothing ceases. Treatment with hydrogen peroxide is to destroy the organic matter which is binding soil particles. Hydrogen peroxide treatment is not necessary when the organic matter content of the soil is negligible. Then add 200 ml of N/5 HCl, stir it well and keep it over night. Hydrochloric acid is added to destroy $CaCO_3$ which is also binding agent.

Filter the contents through Whatman No.50 filter paper and wash it with water till the filtrate runs free of chloride (collect about 10 ml of the filtrate in a test tube and add 2-3 drops of silver nitrate solution. Formation of curdy white precipitate indicates the presence of chloride). When the filtrate runs free of chloride, transfer the soil material from the filter paper to another 500 ml beaker and add about 400 ml water. Then add 8 ml of 1N sodium hydroxide and stir it well for 10 minutes with a mechanical stirrer. Transfer the contents to a 1000 ml spout less

measuring cylinder and make up to 1000 ml mark with water. Cover the cylinder tightly with a rubber stopper and shake the contents thoroughly by repeated inversions holding the rubber stopper tightly so as to avoid spilling of the soil water suspension.

CLAY PLUS SILT

Remove the rubber stopper and place the cylinder under Robinson pipette. First lower the pipette in such a way that the tip of the pipette just touches the surface of the suspension, Note down the temperature and the settling time for clay plus silt from the table and start a stop clock .Till the settling time is over do not disturb the suspension. At the end of the stipulated settling time for clay and silt, lower the pipette to 10 cm depth and draw 20 ml suspension and deliver it to a weighed clean porcelain dish. This suspension contains clay plus silt. Evaporate the suspension by keeping it on a water bath and dry it in an air oven at 105°C. Cool it in a desiccator and determine the weight of clay plus silt and calculate the per cent clay plus silt.

CLAY ALONE

Shake the contents of the cylinder well and leave it undisturbed till the stipulated settling time for clay alone corresponding to the suspension temperature. Withdraw 20 ml of the suspension at the end of the period as done in the case of clay plus silt and determine the weight as clay alone after evaporating and drying and calculate the per cent clay.

COARSE SAND AND FINE SAND

Pour out major portion of the suspension from the cylinder after withdrawing sample for clay alone. While pouring out care should be taken to see that no sand fraction is lost. Then wash the sediment with water and transfer the contents to a tall form beaker. Add water to a height of more than 10 cm. Stir well and allow it to stand for 4 minutes. Then pour off the supernatant liquid. Repeat this process till the water poured off is no longer turbid. Transfer the residue to a porcelain basin, dry it in an oven and weigh as coarse sand plus fine sand. Sieve the coarse sand and fine sand in a 0.2 mm sieve. The material passing through the sieve will be fine sand while the coarse sand fraction will be retained on the sieve. Weigh it as coarse sand.

CALCULATION

CLAY + SILT

Weight of soil taken	=	20 g
Volume of suspension	=	1000 ml
Volume of suspension pipetted out	=	20 ml
Weight of empty porcelain dish	=	a g
Weight of silt + clay + dish + NaOH	=	b g
Weight of clay + silt + NaOH	=	(b-a) g
Weight of NaOH alone (Present in 20 ml of suspension)	=	0.0064 g
Weight of clay + silt alone	=	b - (a + 0.0064) g
Per cent clay + silt	=	$b-(a+0.0064) \times \frac{1000}{20} \times \frac{100}{20}$
Per cent clay + silt	=	

CLAY ALONE

Weight of empty porcelain dish	=	p g
Weight of dish + clay + NaOH	=	q g
Weight of clay + NaOH	=	(q-p) g
Weight of NaOH alone (in 20 ml of suspension)	=	0.0064 g
Weight of clay alone	=	q - (p + 0.0064) g
Per cent clay	=	$q-(p+0.0064) \times \frac{1000}{20} \times \frac{100}{20}$
Per cent silt	=	(Per cent clay + silt) - (Per cent Clay)
Per cent clay	=	
Per cent silt	=	

COARSE SAND + FINE SAND

Weight of porcelain basin	=	x g
Weight of dish + coarse sand + fine sand	=	y g
Weight of coarse sand + fine sand alone	=	y - x g

Per cent coarse sand + fine sand = $(y - x) \times \frac{100}{20}$

COARSE SAND ALONE

Weight of porcelain basin = c g

Weight of basin + coarse sand = d g

Weight of coarse sand alone = (d-c) g

Per cent coarse sand = $(d - c) \times \frac{100}{20}$

Per cent fine sand = (Per cent coarse sand + fine sand) – (Per cent coarse sand)

Per cent coarse sand =

Per cent fine sand =

RESULT

Per cent soil fraction			Texture
Sand	Silt	Clay	

INTERPRETATION

Coarse texture : Sand, Loamy sand

Medium texture : Loam, Silty loam, Sandy loam, Silty

Moderately heavy texture : Sandy clay loam, Clay loam, Silty clay loam

Fine texture : Clay, Silty clay, Sandy clay

INFERENCE

The given soil sample is coarse/ medium/ moderately heavy/ fine textured soil

Exp.No. 7 **GRAIN SIZE ANALYSIS BY USING MECHANICAL SHAKER**

Date:

AIM

To determine the grain size distribution of the given soil sample using I.S sieves.

THEORY

The grain size analysis is widely used in classification of soils. The data obtained from grain size distribution curves is used in the design of filters for earth dams and to determine suitability of soil for road construction, air field etc. Information obtained from grain size analysis can be used to predict soil water movement although permeability tests are more generally used. The grain size analysis is an attempt to determine the relative proportions of different grain sizes which make up a given soil mass.

APPARATUS REQUIRED

1) Balance (Sensitivity – 0.1%)
2) I.S sieves (I.S 460 – 1962) (4.75mm to 75 microns)
3) Mechanical sieve shake

PROCEDURE

- Take about 500g of soil sample.
- Carefully check all the sieves and remove any particles sticking to the sieve mesh.
- Sieves are arranged in the descending order of their sizes with a pan at bottom.
- The sieving operation shall be conducted by lateral and vertical motion of the sieve so as to keep the sample moving continuously over the sieve surface.
- The soil particles shall not be turned or manipulated through the sieves by hand.
- Sieving shall be continued until not more than 1 percent by mass of the residue passes any sieve during 60 seconds.
- Remove the sieves from the sieve shaker and carefully weigh the soil retained an each sieve.
- Remove the particles sticking to the sieve mesh and should be included to the weight retained.

- Tabulate the data and calculate the percentage passing as shown in the following table.

OBSERVATION AND CALCULATION

Total mass of the sample:

I.S sieve size or number (mm)	Mass retained in sieve (gm)	%retained = (mass retained/ total mass)*100	Cumulative % retained	Cumulative % finer(N)
4.75				
4.00				
3.36				
2.40				
1.46				
1.20				
0.60				
0.30				
0.15				
0.075				
pan				

GRAPH Gradation curve is obtained by plotting percentage passing on y-axis and log of sieve size on x axis using a semi-log paper. Gradation curves are the best representation of soil nature i.e. it is well graded uniformly graded or poorly graded soil. Uniformity coefficient (CU) and Coefficient of gradation (Cg) can also give us an idea of soil nature.

Where, D10, D30 and D60 are diameters for 10%, 30% and 60% passing respectively.

RESULT

The gradation curve for the given soil sample is obtained.

EXP NO. 8 **DETERMINATION OF ORGANIC CARBON**

DATE:

AIM

To estimate the organic carbon content of the given soil sample

PRINCIPLE

Organic carbon present in organic matter is oxidized by chromic acid in the presence of concentrated H_2SO_4 and Potassium dichromate. On reaction with H_2SO_4, the $K_2Cr_2O_7$ provides nascent oxygen, which combines with carbon and forms CO_2. The H_2SO_4 enables easy digestion of organic matter by rendering heat of dilution. Only a certain quantity of chromic acid is used for oxidation. The excess chromic acid left unused by the organic matter is determined by back titration with 0.5 N ferrous sulphate or ferrous ammonium sulphate using diphenylamine indicator.

$$2\ K_2Cr_2O_7 + 8\ H_2SO_4 \longrightarrow 2\ K_2SO_4 + 2\ Cr_2(SO_4)_3 + 8\ H_2O + 6(O)$$

$$3C + 6(O) \longrightarrow 3CO_2$$

REAGENTS

1. 1N Potassium dichromate
2. Concentrated H_2SO_4
3. 0.5 N Ferrous sulphate or Ferrous ammonium sulphate
4. Phosphoric acid (Ortho phosphoric acid 85%)
5. Diphenylamine indicator

PROCEDURE

Weigh exactly 0.5 g of soil (passed through 0.5 mm sieve) and transfer it to a 500 ml conical flask. Add 10 ml of 1N $K_2Cr_2O_7$ and mix well by swirling the flask. Then add 20 ml of concentrated H_2SO_4 and mix by gentle rotation for one minute to ensure complete contact of the reagent with the soil. Allow the contents to stand for 20 to 30 minutes. Keep the flask preferably on an asbestos sheet to avoid burning of table due to intense heat. Add 200 ml of distilled water to dilute the solution. Add 10 ml of ortho phosphoric acid and 1 ml of diphenylamine indicator. Titrate the solution with 0.5 N ferrous ammonium sulphate. The colour is dull green at the beginning and then shifts to a turbid blue as the titration proceeds. The end point is very sharp and at the endpoint the colour sharply shifts to a bright green colour.Run a blank also simultaneously.

CALCULATION

Weight of soil taken	=	0.5 g
Volume of 1 N $K_2Cr_2O_7$ used	=	10 ml
Volume of 0.5 N Ferrous ammonium sulphate used for blank titration	=	X ml
Volume of 0.5 N Ferrous ammonium sulphate used for sample titration	=	Y ml
X ml of $FeSO_4$ reduces	=	10 ml of 1 N $K_2Cr_2O_7$
Therefore Y ml of $FeSO_4$ reduces	=	Y/X x 10 ml
Hence actual quantity of 1N $K_2Cr_2O_7$ used for oxidation of organic matter	=	10 - (10 x Y/X) ml
1 ml of 1N $K_2Cr_2O_7$	=	0.003 g of 'C'
Therefore 10-(10 x Y/X) ml of 1N $K_2Cr_2O_7$	=	10 - (10 x Y/X) x 0.003 g of 'C'
This is present in 0.5 g of soil		
Therefore in 100g	=	10 - (10 x Y/X) x 0.003 x 100/0.5
Organic matter (surface soil)	=	Organic carbon x 1.724
Organic matter (sub surface soil)	=	Organic carbon x 2.5

RESULT

The organic carbon content of the given soil =

RATING

Organic carbon (%)	
> 0.50	Low
0.50 - 0.75	Medium
< 0.75	High

INFERENCE

The organic carbon content of the given soil sample is low / medium / high

EXP. NO. 9 ESTIMATION OF GYPSUM REQUIREMENTS

DATE:

AIM

To estimate the gypsum requirement of given soil sample

PRINCIPLE

A small quantity of the soil is treated with relatively large volume of nearly saturated gypsum solution. The loss in calcium from the solution is used as a direct measure of the gypsum required to replace the sodium from the soil.

REAGENTS REQUIRED

1. Saturated gypsum solution having Ca concentration of at least 28 m. eq/l
2. Ammonium chloride – Ammonium hydroxide buffer.
3. Eriochrome Black T Indicator.
4. Standard versenate (EDTA) solution (0.01N)

PROCEDURE

- Weigh 5 g of air-dry soil and transfer it to a 250 ml conical flask. Add 100 ml of saturated gypsum solution by means of a pipette. Stopper the flask and shake for 5 minutes by means of mechanical shaker and filter.
- Pipette out 5 ml of the filtrate into a porcelain basin, dilute to about 25 ml with distilled water. Add 5 ml of NH_4Cl, - NH_4OH buffer solution followed by few drops (about 5 drops) of Eriochrome Black T indicator. Titrate with standard versenate solution (0.01 N) until the colour changes from wine red to sky blue.
- Titrate similarly 5 ml of saturated gypsum solution separately.

OBSERVATION

0.01 N EDTA vs Ca + Mg

S. No.	Volume of aliquot taken (ml)	Burette Reading (ml)		Volume of 0.01 N EDTA used (ml)	Indicator	End point
		Initial	Final			
					Eriochrome Black T	Change of colour from wine red to sky blue

CALCULATION

Weight of the soil taken	=	5g.
Volume of gypsum solution added	=	100 ml
Volume of 0.01 N EDTA used for gypsum solution	=	A ml
Volume of 0.01 N EDTA used for 5 ml of filtrate	=	B ml
Difference	=	(A–B) ml
1 ml of 0.01 N EDTA	=	0.0002 g of Ca
Therefore (A–B) ml of 0.01 N EDTA This is present in 5 ml of filtrate	=	(A–B) x 0.0002 g of Ca
Therefore in 100 ml of filtrate This is present in 5g of soil	=	(A–B) x 0.0002 x 100/5
Therefore in 2 million kg of soil	=	(A–B) x 0.0002 x 100/5 x 2.24 x 10^6/5
	=	(A–B) x 1600 kg/ha
	=	(A–B) x 1.6 tons/ha.
In terms of gypsum requirement	=	1.6 (A–B) x 172/40
	=	6.88 (A–B) tons/ha.

Result

The gypsum requirement of the given soil sample = ----------t ha^{-1}

Assignment

A farmer wants to reclaim a sodic soil with following characteristics

Soil CEC	= 20 C mol (p^+)/ kg
Exchangeable sodium	= 5 C mol (p^+)/ kg
Bulk density	= 1.5 Mg/m^3
Expected ESP after reclamation	= 5%
Depth to be reclaimed	= 15 cm
Area to be reclaimed	= 5 ha

How much quantity of gypsum you would suggest to the farmer to complete his task?