

# Physico-Chemical Properties of Four Farm site soils in area Surrounding Rajkot, Gujarat, India

Vishal D. Joshi<sup>1\*</sup>, Narahari N. Palei<sup>1</sup>, Punit R. Rachh<sup>1</sup>

<sup>1</sup>K.N.V. Pharmacy College - Metoda, Rajkot, Gujarat, India.

*Email: vishaljoshi646@gmail.com*

*Tel no: +919898946190, Fax:- 02827287740*

**Abstract:** Rajkot is a city of Gujarat state in India and administrative headquarters of the Rajkot District, located on the banks of the Aji River and Niari River. The soil samples were collected from four farm sites of different area surrounding Rajkot. Data presentation revealed different values of the physical and chemical analysis of soil pH, Specific gravity, Bulk density, True density, particle size, moisture content, organic matter,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Cl}^-$  and  $\text{HCO}_3^-$  were studied.

**Keywords:** Soil samples, Four farm sites, physical and chemical analysis.

## Introduction

A soil is made up of a solid, mineral and organic phase, a liquid phase and a gas phase. The physical and chemical characteristics of the solid phase result in both marked variability of water contents and a varying degree of resistance to the elimination of moisture. Soil texture has an extremely significant influence on the physical and mechanical behaviors of the soil, and on all the properties related to water content and the movement of water, (compactness, plasticity, thrust force, slaking, holding capacity, moisture at different potentials, permeability, capillary movements, etc.). In soil science, for practical purposes, the pH range is reduced from 0–14 to 1–12. Soils with an extreme pH are strongly influenced by salts, resulting in very acid sulphated soils to highly alkaline carbonated soils.<sup>1</sup>

The soil samples were collected from four farm sites of Nana-mauva, Mota-mauva, Metoda and Patameghpar localized at 10-20 kilometers from Rajkot. The soil samples with three deepness i.e. surface, 10cm, 20cm were collected and soil samples were sieved (<2 mm) and mixed. The physico-chemical properties of soil samples were studied as pH analysis, Specific gravity, Bulk density, True density, Particle size analysis, Moisture content, Loss on ignition. The cations were studied as estimation of magnesium, sodium, potassium, calcium

and anions were studied as estimation of chloride, bicarbonate.

## Experimental

Samples were collected from four farm site of district Rajkot. Each sample were placed in 4 X 6 inches polythene bags. The soil samples were collected from surface, 10cm and 20cm depths by using the soil sampler. The soil samples were sieved (<2 mm) and mixed. These samples were then investigated quantitatively for physical and chemical properties.

### **pH analysis**

The pH meter was calibrated by using 4.01, 6.86, 9.18 buffer solution. The pH of 1:5 Soil: deionised water suspension was determined by calibrated pH meter at 29.7°C.<sup>2</sup>

### **Specific gravity**

Specific gravity of soil was determined by ratio of the weight in air of the given volume of dry soil to the weight in air of an equal volume of water using specific gravity bottle.<sup>3</sup>

### Bulk density

Bulk density was determined by ratio of oven dry mass of the soil to bulk volume of the soil using bulk density apparatus.<sup>4</sup>

### True density and % porosity

True density was determined by ratio of mass of the soil to volume of the liquid displaced using water pycnometer.

Percentage porosity was determined by using following formula

$$\% \square = (1 - \text{bulk density} / \text{true density}) \times 100$$

### Particle Size

Particle size was determined using sieving method. The standard sieves of different mesh numbers as per specification of National bureau of standards were used. The particle size was determined by using following formula<sup>5</sup>

$$\square_{nd}$$

$$\square_n$$

Where, n= number of particles  
d= average diameter of particle

### Moisture content

Moisture content was determined by ratio of the weight of water in the soil to weight of the dry soil. The ratio was expressed as percentage. The percentage moisture content was corrected by using moisture correction factor (MCF).<sup>6</sup>

$$\text{MCF} = \frac{100 + \% \text{ Moisture}}{100}$$

### Loss on ignition

5 to 10gm of dried soil sample was placed into tared crucible and dried for 2 hours at 105<sup>0</sup>C. Then soil was heat at 360<sup>0</sup>C for 2 hour and cool to 150<sup>0</sup>C. The loss on ignition was determined by following formula<sup>7</sup>

$$\text{LOI \%} = \frac{\text{Weight at } 105^{\circ}\text{C} - \text{Weight at } 360^{\circ}\text{C}}{\text{Weight at } 105^{\circ}\text{C}}$$

### Chemical Analysis

The soil samples were analyzed for concentrations of water soluble Ca<sup>2+</sup>, Mg<sup>2+</sup> using EDTA titration method, Na<sup>+</sup> and K<sup>+</sup> using flame photometric method<sup>8</sup>, HCO<sub>3</sub><sup>-</sup> using 0.01N H<sub>2</sub>SO<sub>4</sub> and Chloride

determination using 0.01N AgNO<sub>3</sub> by argentometric method.<sup>9</sup>

### Results and Discussion

The physico-chemical properties of soil and amounts of cations and anions of soils are given in Table-1 and Table-2 respectively.

Figure 1 shows comparison of pH, % Loss on ignition and % porosity on various level of soil and Figure 2 shows comparison of cations and anions present at various level of soil.

### Temperature and pH study

In the present study pH measured at constant temperature 29.7<sup>0</sup>C. The up and down of the pH range depends upon the available minerals/salts in the soil. The soils of the various farms are found to be slightly alkaline in nature.

### Specific gravity

The specific gravity of soil samples were found in between the range 1.92 to 2.40. The specific gravity of the soil particles lie within the range 2.65 to 2.85 soils containing organic matter and porous particles may have specific gravity values below 2.0.

### Bulk density, True density and porosity

Bulk density ranged from 0.698 to 0.970, True density ranged from 1.926 to 2.406 and percentage porosity 53.22 to 68.38 during study. The result indicates the true density of particles were two to three times more than the bulk density and the porosity also increased from surface level to deep level.

### Particle Size

The particle size range found from 453.1 to 651.9  $\square$ m. The result revealed the particle size increased from surface level to deep level.

### Moisture content

The moisture contents were found from 7.89 to 10.59 % at surface while 8.02 to 12.47% at 10 cm deepness and 8.84 to 15.54% at 20cm deepness. The result indicates the moisture content capacity is more at deep level than the surface level.

### Loss on ignition

The loss on ignition ranged from 0.665 to 3.118 % during study.

**Magnesium and Calcium**

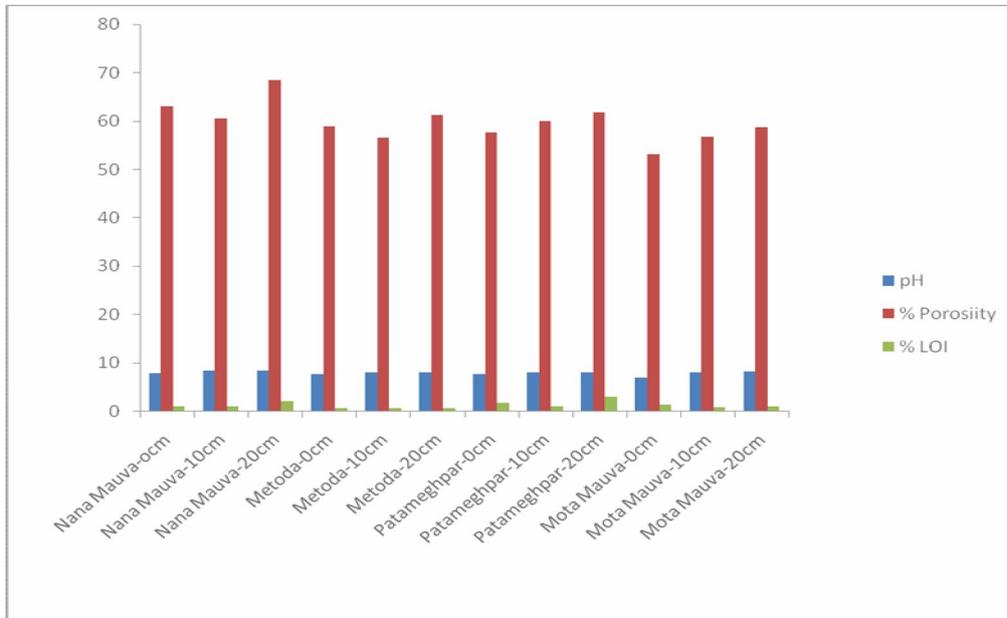
Magnesium ranged from 0.49 to 0.60 meq/L and Calcium from 0.72 to 1.04 meq/L.

**Sodium and potassium**

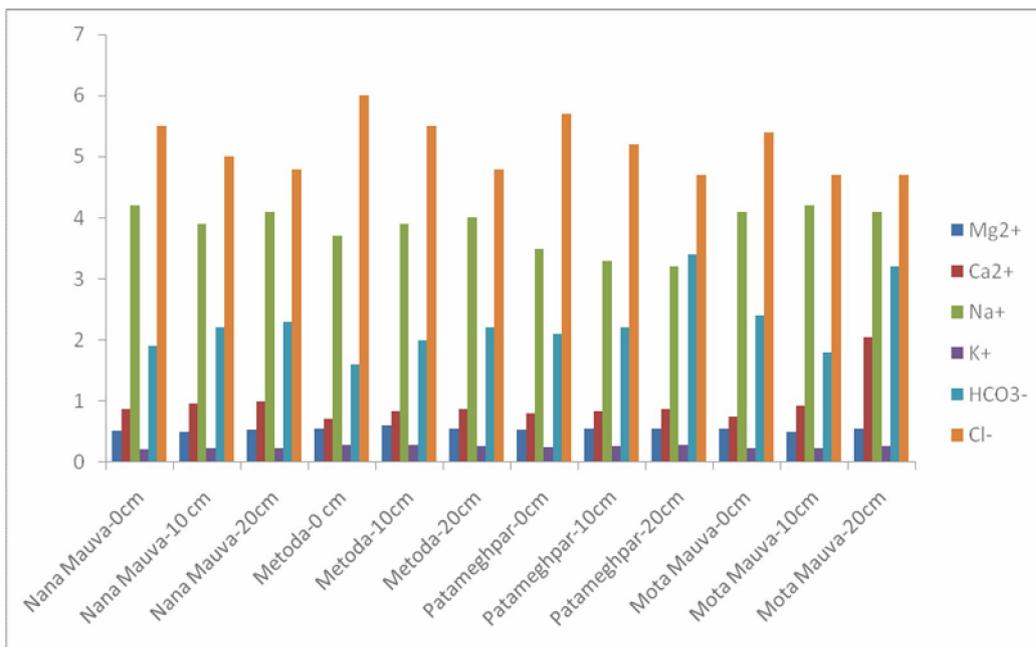
Sodium was found from 3.7 to 4.2 meq/L and potassium from 0.21 to 0.29 meq/L.

**Chloride and Bicarbonate**

Chloride was found from 4.7 to 6.0 meq/L and bicarbonate from 1.6 to 3.4 meq/L during study.



**Figure 1: Effect of pH, % Loss on ignition and % porosity on the surface , 10cm and 20cm deepness level of various farm sites**



**Figure 2: Effect of anions and cations on the surface,10cm and 20cm deepness level of various farm sites**

**Table 1: Determination of total values of the physico-chemical parameter of the soil samples**

Sample	Nana Mauva			Mota Mauva			Metoda			Patameghpar		
	0cm	10 cm	20 cm	0cm	10 cm	20 cm	0cm	10 cm	20 cm	0cm	10 cm	20 cm
Bulk Density g/cc	0.832	0.759	0.698	0.970	0.919	0.873	0.832	0.970	0.873	0.919	0.873	0.919
True Density g/cc	2.250	1.926	2.211	2.075	2.125	2.122	2.023	2.231	2.254	2.176	2.188	2.406
% Porosity	63.03	60.55	68.38	53.22	56.73	58.82	58.87	56.49	61.25	57.73	60.07	61.77
Specific gravity g/cc	2.24	1.92	2.20	2.07	2.12	2.12	2.02	2.22	2.25	2.17	2.18	2.40
pH	7.91	8.38	8.51	7.07	8.08	8.31	7.66	8.13	8.18	7.74	8.06	8.18
% Moisture content	10.59	12.47	15.54	8.02	8.02	9.66	7.89	11.49	12.72	10.11	9.30	8.83
% Loss on ignition	1.103	1.078	2.126	1.384	0.869	0.991	0.665	0.728	0.690	1.833	1.064	3.118
Particle Size $\mu\text{m}$	586.2	547.7	626.0	453.1	641.5	507.7	612.4	648.1	651.9	492.2	575.6	471.9

**Table 2 : Determination of amounts of cations and anions of the soil samples**

Sample	Cations												Anions					
	$\text{Mg}^{2+}$ Meq/L			$\text{Ca}^{2+}$ Meq/L			$\text{Na}^{+}$ Meq/L			$\text{K}^{+}$ Meq/L			$\text{HCO}_3^{-}$ Meq/L			$\text{Cl}^{-}$ Meq/L		
	0 cm	10 cm	20 cm	0 cm	10 cm	20 cm	0 cm	10 cm	20 cm	0 cm	10 cm	20 cm	0 cm	10 cm	20 cm	0 cm	10 cm	20 cm
Nana Mauva	0.52	0.49	0.53	0.88	0.96	1.00	4.2	3.9	4.1	0.21	0.24	0.24	1.9	2.2	2.3	5.5	5.0	4.8
Mota Mauva	0.56	0.50	0.55	0.76	0.92	1.04	4.1	4.2	4.1	0.24	0.23	0.27	2.4	1.8	3.2	5.3	4.7	4.7
Metoda	0.56	0.60	0.56	0.72	0.84	0.88	3.7	3.9	4.0	0.29	0.29	0.27	1.6	2.0	2.2	6.0	5.5	4.8
Patameghpar	0.54	0.56	0.55	0.80	0.84	0.88	3.5	3.3	3.2	0.25	0.26	0.28	2.1	2.2	3.4	5.7	5.2	4.7

**References**

1. Pansu M. and Gautheyrou J., Handbook of Soil Analysis-Mineralogical, Organic and Inorganic Methods, Springer, New York, 2006, 551.
2. Rayment,G.E. and Higginson F.R., Australian Laboratory Handbook of Soil and Water Chemical Methods, Inkata Press, Melbourne, 1992.
3. IS: 2720, Indian Standard Methods of Test for Soils, Part-III: Determination of Specific gravity, Indian standards institution, New Delhi, India, 1980.
4. Martin A., Physical Pharmacy, Lippincott Williams and Wilkins, Philadelphia, 1993.
5. IS: 2720, Indian Standard Methods of Test for Soils, Part-IV: Grain size Analysis, Indian standards institution, New Delhi, India, 1975.
6. ISO 11465, Soil Quality-Determination of dry matter and water content on a mass basis – Gravimetric method, International organization for standardization. Geneva, Switzerland, 1993.
7. Storer D.A., A simple high samples volume ashing procedure for determining soil organic matter, Commun. Soil Sci. Plant Anal., 1984, 15, 759-772.
8. APHA, Standard methods for the examination of water and waste water, AWWA and WPCF, 20,1998.
9. Vogel A.I., Textbook of qualitative inorganic analysis, ELBS, London, 4, 1978.

\*\*\*\*\*