



Physico-Chemical Analysis of Soil in Pre Monsoon of Jaypee Cement Industrial Area 2013-14 of Rewa City, MP, India

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Abstract

The paper present on the physico-chemical analysis of soil samples collected from ten different area of JP cement Industrial area of Rewa district, Madhya Pradesh state India. The variable parameters are correlated. Pre-monsoon variation in physical and chemical parameters like pH value, electrical conductivity, organic carbon phosphorus (p), potassium(k), cation exchange capacity, calcium, magnesium etc. Were analyzed for a period of year 2013-14 of pre-monsoon. Were soil sample is indicated by JPIAS-1 to JPIAS-10. Some parameters were found in some limits.

Keywords: Soil pollution, physico-chemical study, yearly parameters of soil Rewa Madhya Pradesh India.

Introduction

In this paper present report the study of soil for parameters of pH value, Electrical conductivity, Organic carbon phosphorus (P), Potassium(K), Cation exchange capacity, Calcium, Magnesium in a year of 2013-14 of JP cement industrial area in Rewa city (M.P.) India. Ten Soil sample are collected from different located area inside JP industrial area and ten sample's are indicated by JPIAS-1 to JPIAS-10. Pre monsoon parameters were found in some limits¹.

Material and Methods

pH Value: Preparation of Standard Buffer Solutions: Buffer solutions prepared in pH 4.0-7.0 or 9.2 in pure water. A buffer tablet is soluble in 100 ml. of distilled water to obtain buffer solution. Saturated solution of potassium hydrogen tartrate may be used which gives a pH of 3.6 at 25°C.

Preparation of Saturated Soil Paste: Prepare a soil paste in distilled water and saturate the soil paste glistens and flows slightly when the container is tilted; allow it to stand for about four hours. There should be no any types of water on the soil surface and also paste should not stiffen. The glistening soil paste is ready to determine pH.

pH in 1: 2 Soil Water Suspension: Weigh 40gm of soil in a 250 ml. flask and dissolve in 80 ml. of distilled water. Shake the mixture on the reciprocating shaker for one hour.

pH in 1 : 2 Soil and CaCl₂ Solution Suspension: Weigh 10 gm of dry soil in 100 ml. beaker and than add 20 ml. of 0.01 M CaCl₂ solution. The pH should be between 5.0 to 6.5, adjust pH with Ca(OH)₂ or HCl and the soil to absorb CaCl₂ solution

without stirring and thoroughly stir for 30 minutes and allow to settle.

Methodology: Take either saturated soil paste or 1:2 soil water/soil CaCl₂ suspension to determine the pH. On the pH meter, set the temperature compensating knob and confirm that the electrode is completely filled with the saturated KCl solution and pH meter to warm up for 15 minutes to eliminate asymmetric potential of the instrument. Place known standard buffer solution in a beaker of pH 7. Immerse glass and calomel electrode or single (combined) electrode into the buffer solution and set the instrument reading at the known pH 7 of the buffer. The buffer is removed and the electrodes are flushed with distilled water. Take another buffer solution of known pH say 9.2. Note the reading after immersing the electrodes in it. The pH meter must read 9.2. The second buffer is removed and the electrodes are again flushed with water. The electrodes are then immersed in a beaker containing soil paste or soil suspension. Read the pH and record it.

Electrical Conductivity: Reagents : Platinizing solution, 01 gm of chloroplatinic acid (H₂PtCl₆. 6H₂O) plus 12 mg. lead acetate in 100 ml of distilled water (EC < 0.001 dS/m). Cleaning solution. Mixture of one part by volume of isopropyl alcohol, one part of ethyl ether and one part of HCl (1 + 1). Standard potassium chloride (KCl) solution, 0.01 M. Dissolve 0.7 gm. of reagent grade anhydrous KCl in pure water (EC < 0.001 dS/m) and add more water to make to 1 L at 25°C. Store in a glass-stoppered borosil glass bottle. This reference solution has an EC of 1.413 dS/m at 25°C and is suitable for most solutions when the cell has a constant between one and two. For other cell constants use stronger or weaker potassium chloride solutions.

Preparation of Platinum Electrodes: Clean, new platinum-

electrodes with chromic-sulphate acid solution and platinize the electrodes before use. Immerse the electrodes in the platinizing solution and connect both to the negative terminal of a 1.5- V dry cell battery. Connect the positive side of the battery to a piece of platinum wire and dip the wire into the solution. Continue the resulting electrolysis reaction until both cell electrodes are coated with platinum black. Use a current such that only a small quantity of gas is evolved. Subsequently, clean and replatinize the electrodes whenever the readings become erratic or a sharp endpoint cannot be obtained or when visual examination shows some platinum black has flaked off. Rinse electrodes thoroughly. After use and keep immersed in distilled water when not in use.

Calibration of Cell: Rinse conductivity cell with at least three portions of 0.01 M KCL solution and set the temperature of a fourth portion to $25.0 \pm 0.1^\circ\text{C}$. Measure R (or C) of this portion and note the temperature. Repeat the measurement on additional portions of the reference KCL solution until the R value obtained remains constant with-in the required limits of precision.

Compute cell constant $K = (0.001413) (R_{\text{KCL}}) / [1+0.019 (25-t)]$,

Where R_{KCL} is the measured R (ohms) and t is measured temperature ($^\circ\text{C}$).

Measurement of Sample Conductivity: Rinse cell with one or more portions of sample and set of the final portion of sample to to $25 + 0.1^\circ\text{C}$ and measure R or C; if not practical or necessary to adjust the t of the sample to 25°C , measure t and R or C at the same t. The technique used should be the same as that employed to calibrate the cell. Record these values.

Organic Carbon: Reagents: Phosphoric acid 85 % Sodiumfluoride solution %, Sulphuric acid-96 % containing, 1.25 % Ag_2SO_4 , Standard 1N $\text{K}_2\text{Cr}_2\text{O}_7$ solution-Dissolve 49.04 gm. $\text{K}_2\text{Cr}_2\text{O}_7$ in water and dilute to 1 litre. Standard 0.5N FeSO_4 solution-Dissolve 196.1gm. of $\text{Fe} (\text{NH}_4)_2 (\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$ in 800 ml, water containing 20 ml. concentrated H_2SO_4 and dilute to 1litre of water. Diphenylamine indicator-Dissolve 0.5gm, reagent grade diphenyl amine in 20 ml of water and 100 ml. of concentrated H_2SO_4 .

Method: Measure 1.0 gm. of the prepared soil sample in 500 ml of conical flask and than add 10 ml. of 1.0 N $\text{K}_2\text{Cr}_2\text{O}_7$ solution and 20 ml. Of concentrated H_2SO_4 containing Ag_2SO_4 mix thoroughly and allow the reaction to complete for 30 minutes. Dilute the reaction mixture with 200 ml.of water and 10 ml. Of H_3PO_4 and add 10 ml. of NaF solution and 2 ml. of diphenylamine indicator. Titrate the solution with the standard FeSO_4 solution to a brilliant green colour. A blank without soil is run simultaneously.

Phosphorus: Reagents: Bray Extractant No. 1 - (0.03 N NH_4F in 0.025 N HCl) Dissolve 22.2 gm of NH_4F in 200 ml. of

distilled water and than filter and add the filtrate 18 litres of water containing 40 ml. of Conc. HCl and make up volume to 20 litres with distilled water. Molybdate Reagent.- Dissolve 1.50 gm. $(\text{NH}_4)_2 \cdot \text{MoO}_4$ in 300 ml.of distilled water and add the solution to 350 ml. 10 N - HCl solution" gradually with stirring. Dilute to 1 litre with distilled water. Stannous Chloride Solution (Stock Solution) - Dissolve 10gm $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$ in 25 ml. of conc. HCl. Add a piece of pure metallic tin and store the solution in a glass stoppered bottle. Working Solution - Dilute 1 ml. of the stock solution to 66.0 ml. with distilled water just before use. Prepare fresh dilute solution every working day.

Preparation of Ike Standard Curve: Dissolve 0.191 gm. of pure dry KH_2PO_4 in 1 litre of distilled water and this solution contains 0.10 mg. Of P_2O_5 per ml. Preserve this (with a drop of toluene) as a stock standard solution of phosphate and take the 10 ml. of this solution and dilute it to 1,000 ml. of distilled water. This solution contains 1 microgram (0.001 mg.) of P_2O_5 per ml. Take 1, 2, 4, 6, and 10 ml of this solution in separate 25 ml. measuring flask ad to each 5 ml. of the extractant solution, 5 ml. of the molybdate reagent and dilute to distilled water of about 20 ml. and than add 1 ml.of dilute SnCl_2 solution and shake well again and dilute to 25ml mark. After 10 minutes read the blue colour of the solution on the photo electric colorimeter using 660 m μ red filter. Plot the meter readings against microgram of P_2O_5 and joints the point with a straight line. Extraction: Add with a multiple dispenser 60 ml. of the Bray's extractant No. 1 to 11 conical flasks (100 ml.) in a wooden rack, each containing 5 gm. measured soil sample Shake for 5 minutes and filter.

Development of Colour: Take 5 ml. of the filtered soil extra ml. with a bulb pipette in a 25ml. measuring flask deliver 5 ml. of the molybdate reagent with a automatic pipette dilute of about 20 ml. with distilled water and shake well and than add 1 ml. of the dilute SnCl_2 solution with a bulb pipette. Fill to the 25ml mark and shake thoroughly and obtained the blue colour after 10 minutes on the photo electric colorimeter, using 660 m μ red filter after setting the instrument to zero with the blank prepared similarly but without soil.

Potassium: Reagents: Normal neutral ammonium acetate solution -Dissolve 1640 gm. of ammonium acetate ($\text{NH}_4 \text{C}_2\text{H}_3\text{O}_2$) in 20 litres of water and test with bromthymol blue or with a, pH meter. If not neutral, add either ammonium hydroxide or acetic acid to neutralize it to pH 7. Standard Potassium Solution- Dissolve 1.5851 gm. pure KCl in 1 litre of distilled water. This solution contains 1 gm. K_2O per ml . Preserve this as standard stock solution of potassium .Working Solution - Take 0, 5, 10, 15, and 20 ml of the stock. solution separately and dilute each to 1 litre with the N ammonium acetate solution add a few drops' of buty alcohol to each to improve spraying properties of the solutions. These solutions contain 0, 5, 10,15 and 20 μg K_2O ml respectively.

Method: Preparation of the standard Curve- Set up toe flame

photometer (direct reading in case of Perkin-Elmer instrument) by atomizing 0 and 20 $\mu\text{g} / \text{ml}$ K_2O solutions alternatively to 0 and 100 scale readings, respectively. Atomize intermediate working standard solutions and record the meter readings, Plot these-meter readings against the respective potassium contains and connect the points with straight line.

Cation Exchange Capacity: The cation exchange capacity of soil is traditionally determined by a basic two-stage process. The colloidal complex of the soil is first saturated with a selected cation (the saturating cation) all exchangeable cations originally associated with the complex being removed in this treatment Secondly, the saturating cation is displaced quantitatively by again selected cation (the replacing cation) and the amount displaced is measured and expressed in terms of milli equivalents per 100gm of oven-dry soil.

The first stage - saturation - is effected with a solution of a salt containing the saturating cation buffered at a definite pH (neutral to alkaline) to avoid secondary effects due to a change of hydrogen ion concentration during saturation. Acetates are often employed in concentrations of either 1.0 N or 0.6 N, these salts providing adequate exchanging power at buffered pH values and having very little Bivalent action on soil organic matter or iron compounds. Soil is subjected to a series of attacks with these solutions each attack consists of treating 1 part of soil with 4 to 6 parts of solution, with shaking or standing, followed by filtration or centrifugation to separate the phases as much as possible. The residual soil is then treated again with a fresh portion or saturating solution. After four or five of such treatments in succession, making a final ratio of soil to solution of about 1:25 or more. The soil colloidal complex is considered to be fully saturated with the selected cation.

At this point in the determination, the soil is wet with saturating solution and therefore contains saturating cation in excess of that associated with the colloids. This excess must be removed or measured. Removal is effected by washing the soil with water or a water-ethanol mixture (in which the saturating salt is soluble) about three times, taking care to avoid hydrolysis and deflocculation of the colloids As the salt solution is washed away. Measurement is possible if the saturating solution contains an indicator ion (chloride is suitable) which is not absorbed by soil then the washing process is omitted and the displacement of the saturating cation is carried out as given below, the concentration of indicator ion in the final solution being a measure of the excess saturating cation.

The second stage-displacement of the saturating cation-is effected by salt solutions containing the replacing cation which are usually of similar concentration to the saturating solution but they have different pH values and need not always be buffered. Again, the cation-saturated soil is subjected to a series of attacks with the replacing solution, as in the saturation process. The successive portions of extract are combined and made to a volume which is 26-60 times the original weight of soil and this

final solution is analyzed for the 8 strontium cation.

Leaching: Method: Transfer a weight of air-dry soil containing either 6 or 10 g of oven-dry material to a 250ml beaker and add 50 ml saturating solution, Stir, cover with a watch glass and leave overnight. Fix a filter paper into the Buchner funnel by wetting and applying gentle suction; then decant the supernatant solution from the beaker on to it, collecting the filtrate in a filter flask without suction. After the liquid has passed through, transfer the soil to the funnel with saturating solution and allow to drain. Leach the soil with 5-30 ml portions of saturating solution allowing each portion to drain through before adding the next, until 200 to 220 ml of solution has been collected. If filtration under gravity is too slow, apply gentle suction; but the leaching process should take at least one hour and preferably longer. Save the liquid if exchangeable cations are to be determined.

Wash the soil by adding 25-30 ml portions of the wash liquid, draining between each addition, until a total of 75-100 ml of liquid has passed through Transfer the well-drained soil to a 250 ml beaker with replacing solution, make the volume to about 60 ml, stir, cover with a watch glass and leave overnight. Decant the supernatant solution on to a filter paper in the Buchner funnel (using a clean filter flask) and then proceed as in the initial saturating process until about 200 ml of liquid has been collected. Transfer this liquid to a 250 ml. of volumetric flask and make to 250 ml with replacing solution.

Calcium: Calcium can be determined by EDTA titration method.

Reagents: 0.1 M EDTA solution, 8% NaOH solution and 40% ethanol, 1 N ammonium acetate solution, Mureoxide indicator.

Method: Prepare the soil extract as described in the determination of sodium and then take 50 ml of the soil extract in a conical flask and then add 1 ml. of sodium hydroxide and pinch of Mureoxide indicator. Titrate against standard EDTA solution until pink colour turns purple.

Magnesium: Reagent: 0.01 N EDTA, NH_4Cl - NH_4OH buffer. Dissolve 67.5 g ammonium chloride in 570 ml NH_3 solution and make it to 0.1L. EBT indicator.

Method: Pipette out 25 ml aliquot containing not more than 0.1 milli equivalent (me) of calcium and magnesium and then add 2 to 5 crystals of carbamate and 5 mL NH_4Cl - NH_4OH buffer. Add 3 drops of EBTT indicator and then titrate this solution with 0.01 N EDTA solution till colour changes from wine red to blue or green.

Results and Discussion

Table-1 shows parameters of pre monsoon pH value 7.78, 7.65, 6.11, 7.47, 7.80, 7.61, 7.57, 7.81, 7.69 and 7.31, Electrical conductivity 0.18, 0.2, 0.22, 0.73, 0.45, 0.42, 0.64, 0.14, 0.56

and 0.40, phosphorus (P) 8.96, 14.33, 17.21, 23.29, 14.33, 26.88, Calcium 437.21, 532.61, 453.21, 532.66, 453.41, 443.66, 19.71, 17.92, 5.37 and 14.33, potassium (K) 268, 137.2, 110.3, 534.66, 534.66, 453.73, and 432, magnesium 3310.56, 131.6, 165.2, 184.8, 112.0, 249.2, 162.4, and 159.8, Cation exchange capacity 103.600, 107.03, 105.23, 3247.21, 3559.06, 3764.21, 3200.06, 3128.6, 3223.11, 3223.11, 106.42, 102.43, 108.12, 106.4, 108.190, 102.15, and 107.45, 3426 and 358.24 etc.

Table-1
 Showing variable average value of all parameters of different soil sample of pre- monsoon-2013-14

Parameters	Unit	JPIAS -1	JPIAS -2	JPIAS -3	JPIAS -4	JPIAS -5	JPIAS -6	JPIAS -7	JPIAS -8	JPIAS -9	JPIAS -10
pH Value (series-1)	-	7.78	7.65	6.11	7.47	7.80	7.61	7.57	7.81	7.69	7.31
Electrical conductivity (series-2)	(milli mhos /cm)	0.18	0.2	0.22	0.73	0.45	0.42	0.64	0.14	0.56	0.40
Phosphorus(P) (series-3)	Kg/hect.	8.96	14.33	17.21	23.29	14.33	26.88	19.71	17.92	5.37	14.33
Pottasium (K) (series-4)	Kg/hect.	268	137.2	110.3	131.6	165.2	184.8	112.0	249.2	162.4	159.8
Cation exchange capacity (series-5)	(meq/g m)	103.600	107.03	105.23	106.42	102.43	108.12	106.4	108.190	102.15	107.45
Calcium (series-6)	Mg/kg	437.21	532.61	453.21	532.66	453.41	443.66	534.66	534.66	453.73	432
Magnesium (series-7)	Mg/kg	3310.56	3247.21	3559.06	3764.21	3200.06	3128.6	3223.11	3223.11	3426	358.24

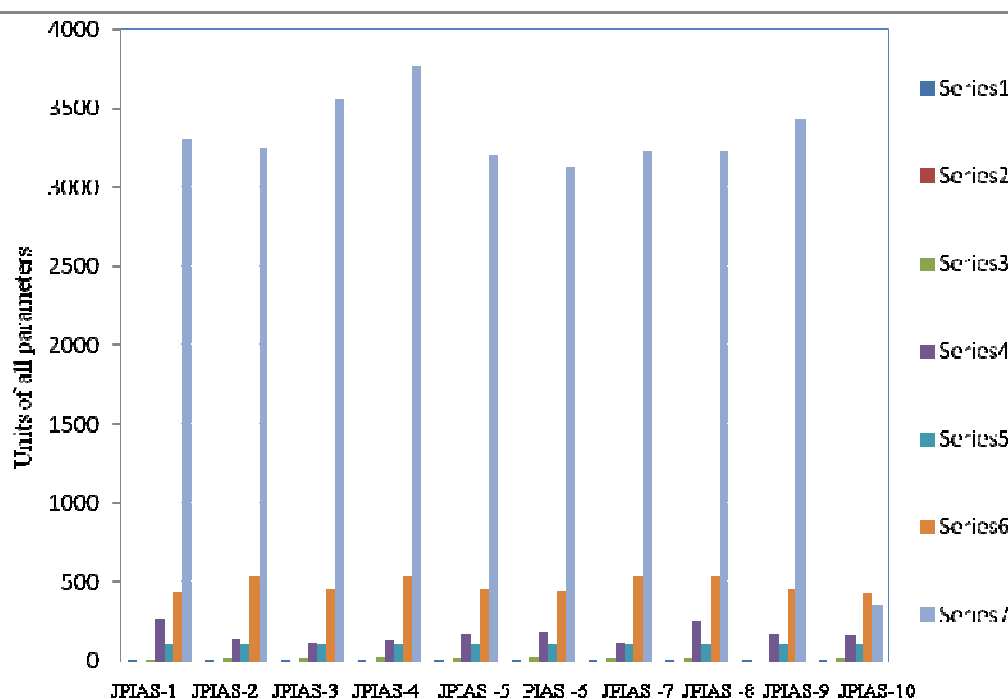


Figure-1
 Different Parameters of sample 1 to 10
 Table-2

Showing correlated average value of all parameters of soil sample of pre- monsoon-2013-14

	pH	EC	P ₂ O ₅	K ₂ O	CEC	Ca	Mg
pH	1						
EC	0.13973	1					
P ₂ O ₅	-0.11037	0.353218	1				
K ₂ O	0.523364	-0.53109	-0.4929	1			
CEC	-0.063954	-0.153761	0.319378	-0.34446	1		
Ca	0.212897	0.161257	-0.12465	0.664995	-0.02922	1	
Mg	0.017012	0.063016	-0.07871	0.42859	-0.22068	0.420245	1

Conclusion

Based on the above experimental results, the present study clearly indicates that industrial soil around Jaypee nagar industrial area Rewa district Rewa (M.P.) are contaminants. The sample of Pre-monsoon season, show concentration of contaminants, the pollution load was high in some of the sample which may be due to the disposal of effluents from surrounding industries and runoff from the agricultural field. Highly positive correlation was observed among EC, P₂O₅, Ca, Mg and very poor correlation was observed among K₂O, CEC, for Physicochemical parameters. Highly positive correlation was observed among P₂O₅, Ca, Mg, and shows very poor correlations among CEC, K₂O. The correlation which implies that, Pollution loads are increased due to industrialization. However, proper remediation measures need to be taken for sustainability²⁻⁶.

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