RESEARCH ARTICLE

ESTIMATION AND IMPACT OF FLUORIDE CONTENT CAUSING SOIL POLLUTION IN SURROUNDINGS OF NOIDA

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Received-23.02.2016, Revised-30.06.2016

Abstract: In this communication the author has carried out the estimation and impact of fluoride Content which is causing Soil pollution. Eight locations including Dadri, Kasana, Dankaur, Chiti and others have been taken for the study. The pH and organic content of the Soil in the region, ranges from 4.9-5.9 and 2.4 to 9.2% respectively. The concentration of fluoride ion ranges from 78.7 ±2.5 to 202.2 ± 1.2 in (mg/Kg dry wt). It is observed that as soils become more acidic, fluoride ion can be released in to solution and form complexes with aluminium. As soils become more alkaline negative charge increases on Soil surfaces, desorbs fluoride ions and could increase the fluoride ion concentration in solution. The impact on health may be serious, causing there by decolouration of teath, severe pain and stifness in bones.

Keywords: Fluoride, Soil, Noida, Pollution

INTRODUCTION

Fluorine has attracted much attention by environmental scientists in recent years. Small concentration of fluoride in drinking water has beneficial effect on human body if taken in a controlled quantity of less than I ppm so as to prevent dental caries. Atmospheric pollution or contaminants in fertilizers can contribute significant amount of fluoride ion to soils. However, its bioavailability depends upon the pH and other characteristics of the Soil. The bulk of the fluorine is fixed in the crystal lattices of silicate and phosphate minerals, as is clear from the abundance of 800 ppm of fluoride ion in the earth's crust as compared to 1.4 ppm in the sea. The content of fluoride ion in soil ranges from 10 to 1000 ppm. High contents of weatherable minerals lead to contamination of drinking water. Fluoride ions are readily absorbed by plants, especially from the more acidic soil. Concentrations as low as 0 ppm of fluoride in solution cultures were found to be toxic to several species of plants.

MATERIAL AND METHOD

Apparatus : Toshcon Micro-2pH/ion (Model ISE 333).

Reagents : Standard Stock solution 2.21 g AR grade NaF was dissolved in 1 litre distilled water.

Total Ionic Strength Adjustable Buffer (TISAB) 57 ml CH_3COOH, 58g NaCl, 4g Cyclohexane diamino Tetra-acetic acid (CDTA) were dissolved in 500 ml distilled water. pH was adjusted to 5 - 5.5 using 5 M NaOH solution and then the final volume was adjusted to 1 litre using distilled water.

Sodium hydroxide solution 670 g of NaOH pellets was dissolved in distilled water and diluted to 1 litre and stored in a polyethylene container.

Sample collection and processing

Soil samples were collected and processed as per standard procedure. About 0.5 g sieved (80 mesh) soil sample was taken in a Nickel crucible followed by the addition of 6 ml of NaOH solution. The sample was placed in an oven set at 105°C for 2 hours. After the sodium hydroxide is solidified, the crucible was placed in a muffle furance set at 350°C for 2 hours. Then the crucible was removed and cooled. 10 ml of distilled water was added to the sample and heated slightly so as to allow the dissociation of sodium hydroxide fusion cake. Then pH was adjusted to 8-9 by adding 1 : 1 HCl. The acidified sample is cooled, filtered and volume is adjusted to a 50 ml volume metric flask using distilled water. 25 ml of filtrate is added to 25 ml TISAB in 100 ml polyethylene beaker and fluoride ion concentration is measured using a specific ion meter coupled to a fluoride ion selective electrode and reference calomel electrode.

Estimation of ph and organic content

1. Measurement of Soil pH with Glass Electorde

Soil pH was measured as per the standard procedure. Organic sulphur content was estimated gravimetrically.

Procedure : Take 10 g of the soil and add 25 mL of distilled water. Shake the contents well after a lapse of about 30 minutes. Dip both glass electrode and the reference calomel electrode in the soil suspension. Connect the electrode to the pH meter, which has already been checked with a standard buffer solution of known pH. Switch on the current and increase or decrease the resistance in the external circuit so that the potential of the electric power equalises the potential of the cell containing soil suspension and the galvanometer needle indicates at zero. Directly read the pH of the soil from the scale. Now direct reading pH meters working either on mains or

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storage battery is commercially available. These give the potential and the pH of the solution.

2. Determination of Total Sulphur in Soil

Principle : The organic sulphur content present in soil is oxidised to sulphate by sodium peroxide followed by fusion with Na_2CO_3 in order to decompose the soil minerals. The sulphate can be determined be precipitation as $BaSO_4$.

Reagents :

(i) Granular sodium peroxide
(ii) Anhydrous sodium carbonate
(iii) Conc. HCl
(iv) Methyl red indicator
(v) 10% $BaCl_2$ solution
(vi) 95% ethyl alcohol.
(vii) Sulphuric acid.

Weigh 5 to 10 g of air dry soil of 0.5 mm mesh into a nickel crucible and add an equal amount of anhydrous Na_2CO_3. Mix well and add 2 mL of water and stir the contents to make a stiff paste. immediately add 10 g of sodium peroxide successively about 1 g at a time, inorder to prevent excessive froathing. Put the crucible containing the contents in a muffle furance at about 400-500°C for half an hour and then increase the temperature to about 900°C rapidly for about 10 minutes. Take out the crucible from the furnace and place it sideways in a big beaker and cover with distilled water. Add 5 ml of ethyl alcohol and heat it on a hot plate. Now remove the crucible along with stirring rod from the beaker. If small glassy particles still cling to the inside of the nickel crucible, then disintegrate them by adding water and boiling over a hot plate and add it to the main content. Filter by suction into a small beaker. When no more liquid can be drawn through the filter, return the residue along with filter paper to the original beaker. Add about 1 g of Na_2CO_3 and 75 to 100 mL of distilled water and heat the contents to brisk boiling. Again filter through a Buchner funnel, using suction and wash with 20 ml. portions of hot water to a total of 500 mL. Make up the volume to 1 litre by adding distilled water. The amount of sulphate in the extract can then be determined gravimetrically by precipitating as $BaSO_4$.

$$\underset{137}{Ba^{2+}} + \underset{96}{SO_4^{2-}} = \underset{233}{BaSO_4}$$

The determination of sulphate is carried out by precipitation of it as $BaSO_4$ in a hot dilute solution of the sulphate previously acidified with HCl (to avoid co-precipitation of CO_3^{2-}, PO_4^{3-} etc.) The precipitate of $BaSO_4$ is filtered, washed with hot water, dried and ignited to a constant weight. The percentage of suplhate can be calculated from the weight of the precipitate.

RESULT AND DISCUSSION

Calibration : The instrument was calibrated using known fluoride ion standard solution of concentrations in the range 0.23-230 ppm. Table-1 shows the EMF values obtained for different standard solution of fluoride. As is shown in Figure-1, the response is linear with a slope of 59.1 Table No. 2 shows the results of analysis of total fluoride ion concentration in soil samples. The curve obtained is linear, satisfying the equation $y = mx + c$. In addition to fluoride ion concentration, the other parameters namely soil pH and organic content are also measure.

The concentration of fluoride ion in the soil depends upon several factors such as fluoride concentration in the rock material from which the soil is formed, the leachability of the soil which in turn depends upon the type of soil, biological elimination from soil which depends upon the type and density of vegetation and fluoride contamination from anthropogenic activities. Fluoride ion adsorbs strongly to most soils at neutral pH and is not easily leachable. The effect of fluoride pollution of soils on plants have been discounted, primarily because fluoride ion absorbs strongly to most soils at neutral pH and is therefore assumed to be unavailable to plants. However as soils become more acidic, fluoride ion can be released into solution and form complexes with aluminum. In very acidic soils (pH < 4.0), the formation of HF could also favour increased solubility of fluoride ion. As soils become more alkaline, negative charge increases on soil surfaces, desorbs fluoride ion and could increase the fluoride ion concentration in solution[7]. The pH and organic content of the soil in region ranges from 4.9-5.9 and 2.4-9.2% respectively. Figures 2 and 3 shows the effect of pH and organic content on the fluoride ion concentration in soil. These curves do not indicate any systematic relation between pH and organic content on the soil fluoride ion. It may be noted that the variation in pH and organic content are very less in the sample studies. This leads to the conclusion that the mild variations in external chemical factors do not influence the concentration of fluoride in this soil. This may be because most of fluoride ion is attached with crystal lattice of the soil.

Table 1. Calibration of Fluoride ION Selective Electrode

Concentration (ppm)	**EMF (mv)**
0.23	+102.6
2.3	+54.2
23	– 12.2
230	– 74.3

Table 2. Concentration of Fluoride ION in SOIL.

Location	**Concentration of Fluoride ion (mg/kg dry wt.)**	**Soil pH**	**Soil Organic content (%)**
Dadri	94.6 ± 7.2	5.2	4.2
Kasana	132.3 ± 1.2	5.4	7.6
Gharbara	120.2 ± 2.2	5.9	4.6
Hasanpur	78.7 ± 2.5	5.4	6.2
Chiti	105.6 ± 3.0	5.2	2.4
Devta	178.3± 1.2	5.3	6.2
Maycha	202.2± 2.3	4.9	5.,8
Dankaur	126.3 ± 1.2	5.3	9.2
			7.2

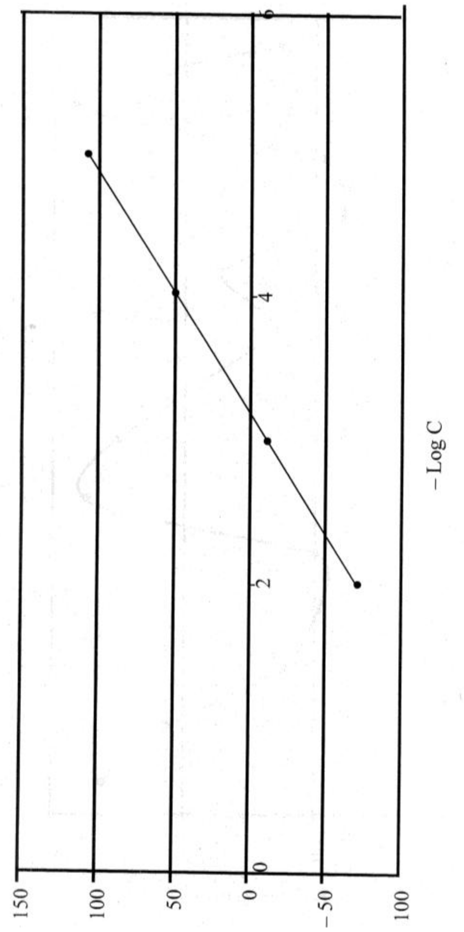

Figure 1 : Calibration Curve

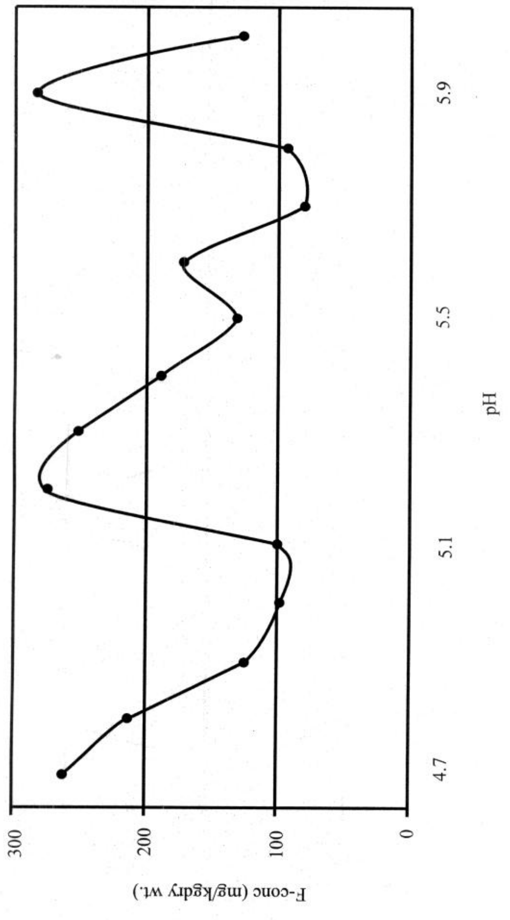

Figure 2 : Effect of Soil pH on Fluoride ion concentration

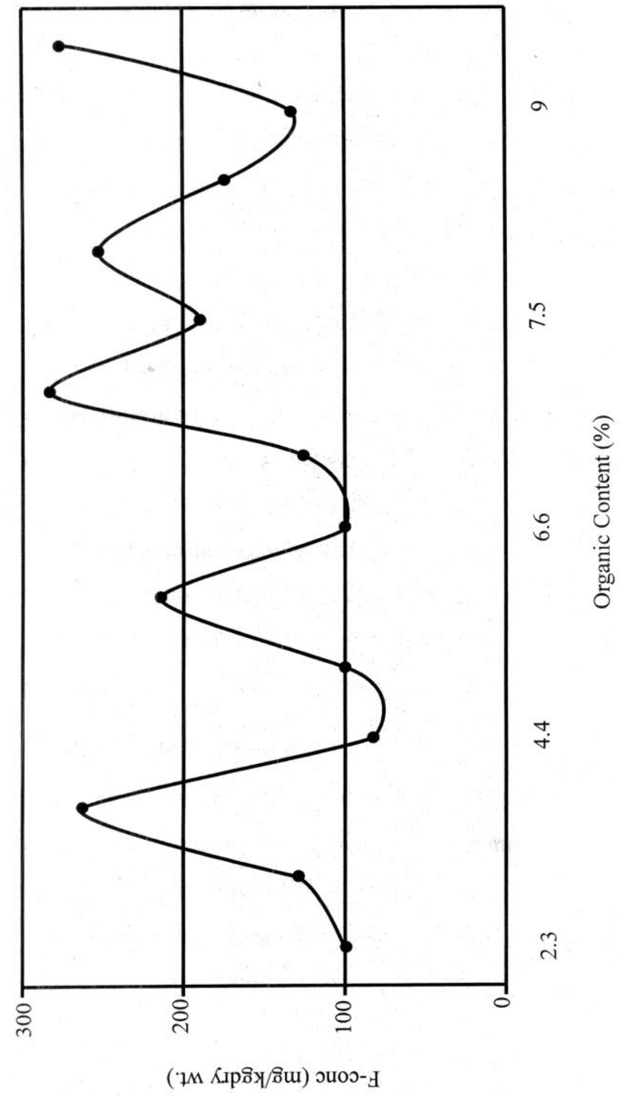

Figure 3 : Effect of Soil Organic content on Fluoride ion concentration

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