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Sediment characteristics of Tapti River, Maharashtra, India

R.B.Marathe[1] ,Y.V.Marathe[2], C.P.Sawant[2]*

[1]V.N.College,Shahada Dist. Nandurbar- 425412 (M.S.) India
[2]Center for P.G. and Research G.T.P. College Nandurbar -425412 (M.S.) India

Abstract: A baseline study of the Tapti river was conducted to determine the basic physical and chemical characteristics of the sediment. Ten stations were selected along the study area Sediment characteristics revealed sandy to loamy (muddy) sand soils with pH of 7.01 to 8.05. Values of organic carbon varied from 0.16% in the sandy soil to 0.5454%. Electric conductivity at ten stations sediment samples ranges from 3.11 to 5.05 dsm-1, Available Nitrogen in ten samples ranges from 71.8 to 244.3 Kg/ha, while phosphorous ranges from6.7 to 20.7 Kg/ha .Available potassium estimated by flame photometry varied from 168.2 to 367.0 Kg/ha. The exchangeable Ca and Mg present in Tapti river sediment collected from different stations ranges from 13.97 to 16.07 me/100 gm and 20.01 to 20.40 me/100 mg respectively.
Keywords : Physico chemical parameters ,Tapti river ,Sediment,Pollution.

1. Introduction:

The physical and chemical characteristics of any water body are of ecological significance especially in estuarine ecosystems that are prone to daily tidal physicochemical fluctuations. Studies on basic physicochemical characteristics carried out in various rivers have focused on the water quality parameters of the rivers' water columns [1-6] with little or no consideration given to the bottom or sediment characteristics. Unfortunately, river or lagoon beds which are ideal habitats for several species of organisms usually serve as a 'sink' for both domestic and industrial wastes from anthropogenic activities. Dumping of such wastes could alter the ecological state of these ecosystems. Hence baseline studies are required to determine the status of sediment structure and quality to give complimentary data on the physicochemical characteristics of these habitats [7-10].

The Tapti river originates from high range of Satpura mountain at Multai in Madhya Pradesh of central India as a small stream it passes through state Madhya Pradesh,Maharashtra and Gujrat. Large amount tributaries of varying dimensions merge their identity with this river.Tapti river respectively worshiped by millions of Indians.Tapti and its tributaries constitutes large river system in India and finaly meet Arebean sea near Surat. Number of industries located along the bank of Tapti river and discharge their effluent to river.There are long standing complaints about water pollution causing fish mortality and also serious damages to the agricultural crop resulting in extensive unemployment in region of Tapti river

Study area in present investigation of tace metals in sediment of Tapti river limited about 300 Km length streaching from surat to Shindkheda (Dist.:Dhule, Maharashtra)

2. Experimental :

2.1) Measurment of pH :

pH of the sediments was determined in laboratory by using an Elico pH meter. Before pH determination, all laboratory ware used in the experiment are washed, soacked in dilute nitric acid then rinsed with distilled water for several times A 1:2 sediments - distilled water suspension are thoroughly mixed for 30 minutes on automatic shaker machine, then pH of this suspensions was recorded. Before measuring the pH of the sediments suspension, the pH meter was standardized.First the pH insturment switch for 15-20 minutes for warm up, the temperature adjusted at room temperature, then the combined electrode deeped in the buffer solution of pH = 4.0 and sets the pH knob at pH=4.0. After satisfaction of calibration of pH meter, pH of sediments sample were taken.

2.2) Electrical Conductivity (EC):

In order to determine soluble salts in the sediments. It is preferably to keep the sediment at the field condition and measured at the field condition and measured its conductivity, to get true picture. For this purpose saturated sediment water extract was prepared.

Sediment extract is first prepared by taking 20 gms sediment into clean 100 ml beaker , add 50 ml of conductivity water then suspension is stirred for 30 minutes and allowed the suspension was filtered by using ordinary filter paper. The electrical conductivity of clear filtrate is measured by using electric conductivity bridge.

2.3) Detection of organic carbon (OC):

It was estimated by walkley and Blank titration method. The organic carbon was estimated by taking 0.5 gms of soil, in 500 ml conical flask, added to it 10 ml 1 N $K_2Cr_2O_7$, shake to mix thoroughly, then adding 20 ml conc. H_2SO_4 (Containing $AgSo_4$) allowed the reaction mixture for 30 minutes on asbestos sheet, add 200 ml distilled water, 10 ml H_3Po_4 to the flask and shake vigorously. Add 10 drop of diphenyl amine as an indicator which gives violet colour to the suspension. The contents was then titrated against 0.5 N ferrous ammonium sulphate solution till the colour change from violet through blue to bright green, there after,the blank titration run without soil in simillar process.

2.4) Available Nitrogen :

Available nitrogen was estimated by alkaline potassium permagnet method. In kjeldhal flask 20 gms of air dried crushed sediment sample was taken and add 20 ml of distill water to moisten the soil. Add 1 ml of liquid paraffin and few glass beads to avoid frothing and bumping. Further add to it 100 ml of 0.32 % $KMnO_4$ solution followed by 100 ml of 2.5 % NaOH solution. Close the flask immidiatly. Distill the contents in Kjeldhal assembly at a steady rate and collected the liberated NH_3 in receiving flask containing 20 ml Boric acid solution with mixed indicator with the absorption of ammonia, the pink colour of Boric acid solution turn to green. Distill up to 100 ml of distillate is collected in recieving flask. The distillate are then titrated against standard acid till the colour changes from green to pink.

2.5) Available Phosphorous :

It is estimated by using Olsen's method .In 250 ml of conical flask 2.5 gm of sediment sample taken and added to it 0.5 gm of Dacro-G-60 (P-free), and 50 ml of $NaHCO_3$ (0.5m) after shaking on mechanical shaker it is filtered through whatman No. 1 filter paper. Pipette out 5 ml of this filtrate in 50 ml volumetric flask then 5 ml of chloromolybdatic acid solution added,shake it slowly allow it to stand for 5 min and diluted it to 40 ml, add 10 ml $SnCl_2$ solution, shake immidiatly and make the volume. Read the intensity of blue colour measured after 10 min. and before 20 min. at 600 nm, using red filter in spectrophotometer. Found out the concentration of phosphorous in solution by referring the standard curve.

2.6) Available Potassium :

The available potassium was estimated by flame photometer. The procedure of this is, In a 250 ml conical flask 10 gm air dried sediment sample was taken, added to it 50 ml of 1 N neutral ammonium acetate solution after shaking for 10 minutes it was filtered through whatman filter paper No. 40. Then the soil is leached with 50 ml ammonium acetate a little at a time and made the volume to 100 ml with ammonium acetate solution. Feed the standard of K to the flame photometer and noted the reading using K-filter. Drawn the standard curve of flame photometer reading's against concentration. Feed the ammonium acetate extract (leachate) of sediments and noted the flame photometer readings and foundout the concentration of K from the standard curve.

2.7) Exchangeable Ca and Mg :

The exchangeable calcium and magnessium was estimated by using standard versenate (EDTA titration) method. The standard versenate method is based on fact that calcium and magnessium form stable complex with versenate at different pH. Versene (Ethylene diammine tetracetic acid, di sodium salt, EDTA) is an excellent chelating agent and can be convineantly used for the determination of calcium and

magnessium. The influence of interfering metallic ions such as copper, zinc, iron, manganese, and nickel is removed by adding chelating agent such as, cynamide which forms stable complex with Cu, Zn, Ni & Fe. Reagent such as hydroxylamine hydrochloride and sodiumbisulphate can be used to reduce the iron (Fe^{3+}) to (Fe^{2+}) state. Triethanolamine effectively chellates ferric ions. Thus, the influence of interfering ions can be overcome to enable to get clear end point of titration.

To determine calcium and magnessium in sediments, In 250 ml conical flask 10 gm of air dried sediment sample was taken, 50 ml of 1 N neutral ammonium acetate is added, after shaking for 10 min. it is filtered through whatman filterpaper No. 40, then the sediments was leached with 50 ml ammonium acetate and then made the volume to 100 ml with ammonium acetate. Then determined the individual cations in the chelate separatly and expressed the results in milliequivalant per 100 gm of sediments.

2.8) Estimation Ca and Mg :

In a porcelein dish 5 ml of NH_4OAC extract (leachate) was pipetted, 20 ml of distill water then added, about 10-15 drops of NH_4Cl- NH_4OH buffer solution is added then 3-5 drops of EBT indicator and finally titrated with 0.01 N. EDTA solution till color changed from wine red to blue.

a) Estimation of Ca :

5 ml of leachate was pipetted into purcelein dish, add to it 20 ml of distill water then 5-10 drops of 4 N NaOH to maintain pH-12 and only at this pH value the calcium complexes with EDTA and colour of the indicator changed then pinch of muroxide (50mg) indicator is added, then this content titrated with 0.01 N EDTA till the color changed from orange red to purple

3. Result and Discusion:

3.1) pH:

Lowest pH found at station 1) Surat and highest pH found at station 2) Kukarmunda (Table-1). The lower pH at station Surat may be due to the acidic discharge of effluent from nearby industrial area. Most of industries around the Tapti river at surat station are dyes, pharmaceutical,Textile industries, Sugar, Petrochemical and Pesticide industries etc .

Higher pH found at station 2) Kukarmunda. This increase in pH at station: 2) Kukarmunda may be due to deposition of Tremondous amount of sediments. This depossion of sediment due to back water of Ukai dam near Songarh. This diposited sediment may contain much calcium carbonate, magnesium carbonate, which are calcareous. On hydrolysis of these calcium carbonate and magnessium carbonate releases OH^- ion which contributes alkalinity in sediment (Table-1).

3.2) Elictrical Conductivity:

From the values given in Table -1 ,station -6 content more soluble salt and it may also contaminated with some pollutant This station has more number of ions ,it also depends on the kind of ions ,their relative charge and freedom ion to act as conductors

Conductivity or salinity depend upon the percentage ions such as chloride,sulphate phosphate ,bicarbonate,sodium ,potassium ,calsium ,magnesium etc and also lower the electrical conductivity higher will be the level of silicate. Hence station :8 must have maximum amount of silicates than other stations.

3.4) Organic Carbon

The sediments of the station : 9 (Sulwada) has contain comparatively higher organic matter than other station, and station 8 (Torkheda) sediments has lower percentage of organic carbon than other nine station (Table-1). The higher contents of organic matter in station : 9 (Sulwada) sediments is primarily attributed to the relatively higher supply of organic matter from the abundant vegetation, agricultural run-off, vegetative runoff of Satpura hill, domestic waste and industrial effluents etc(14). The higher organic matter content of these sediments compared with the sediments of station : 9 (Sulwada) would be partly due to rapid rate of deposition of organic constituents and also due to some amount of organic matter carried by a number of small stream, tributories to the Tapti river before this station : 9 (sulwada).

The sediments of the station : 8 (Torkheda) along Tapti river contain less organic matter, which is mainly due to the dilution affect by the addition of clastics by the river (14). The clastics by the rivers increase the supply of oxygen in the station : 8. It is also evident from result of that low organic carbon may be due to course sandy nature of the sediments, as the organic carbon variation is largly controlled by the fine fraction of the sediment.

Table 1.: Physico-chemical characteristics of Tapti river sediments from different stations.

Sr. No.	Sampling Stations	pH	Organic Carbon %	EC (dsm^{-1})	Exchangeble (me/100gm)		Available Kg/ha		
					Ca	Mg	N	P	K
1	Surat	7.01	0.380	3.99	15.00	20.11	170.2	190.0	367.2
2	Kukarmunda	8.05	0.272	4.05	14.47	20.12	121.2	12.2	305.2
3	Hatoda	7.80	0.380	4.35	15.49	20.01	170.2	20.1	291.8
4	Nimbhora	8.02	0.218	3.96	15.67	20.40	97.6	11.9	305.6
5	Pisawar	7.58	0.326	2.35	15.79	20.25	146.5	20.7	228.8
6	Prakasha	7.23	0.218	5.05	16.09	20.16	97.6	9.8	168.2
7	Sarangkheda	7.72	0.218	3.05	13.97	20.17	97.6	6.7	170.6
8	Torkheda	7.39	0.16	3.11	14.98	20.18	71.8	12.1	313.4
9	Sulwada	7.09	0.5454	4.28	14.07	20.19	244.3	9.8	185.7
10	Sukhawad	7.05	0.272	3.79	15.98	20.15	121.2	20.1	358.2

3.5) Available Nitrogen

In the present study available nitrogen concentration in ten sample ranges from 71.8 to 244.3 kg/ha (Table - 1). Significant difference were recorded in most of sample station. High concentration of available nitrogen were observed at sample station : 9 (Sulwada) this is due to domestic drainage nitrogenous fertilizers used by cultivators, industrial discharge, and also through more decomposition and immoblization processes of nitrogenous organic, inorganic matter.Low concentration of available nitrogen is observed at station : 8 (Torkheda) and it is attributed to lower use of fertilizer by cultivations, low Industrial discharge less decomposition and immobilization processes of nitrogen.

3.6) Phosphate

Phasphate concentration in sediments are ranges from 6.7 to 20.7 kg/ha. (Table - 1). Among these ten stations of sediment, station : 5(pisavar) has maximum amount of available phosphorous this is attributed to high pollutant which discharged through streams from various tributories to the Tapti river. These discharge may contain fertilizers pesticides, insecticides, herbicides used by cultivators in their field and this agricultural run-off to the tributory's, industrial discharge and also due to decomposition & mobilization of phosphatic rocks. Station : 7 (Sarangkheda) has minimum amount of available phosphorous in the sediments of Tapti river. The lower concentration of phosphorous may be attributed to higher pH value of the sediment because at very lower and very high pH value of sediments or soil, considerable decreases the available phosphorous.

3.7) Potasium

Available K in all the sites ranges from 168.2 to 367.0 kg/ha (Table-1) At the most of the stations there are significant difference in available potassium recorded. The higher concentration of available potassium found at station : 1 (Surat) and lower concentration is found at station : 6 (Prakasha). Some of the stations are lower in available potassium, whereas others station are sufficient. High concentration of available potassium at station 1 (Surat) may be due presence of minerals of weather and release potassium ion, these ions are adsorbed onto the cation exchange sites. The lower concentration of available potassium at station: 6 (Prakasha) may be due less minerals weathering & hence lower rates of release of potassium to the sediments.

3.8) Calcium and Magnesium:

The present study of sediments for exchangeable calcium and magnessium are ranges from 13.97 to 16.09 me/100 gm of sediment sample. The calcium content was lower at station : 7 (Sarangkheda) i.e : 13.97 me/100 gm soil, and high calcium content at station : 6(Prakasha) ie. : 16.09 me / 100 gm are recorded calcium content in all sample station found to be lower than that of magnessium content (Table - 1). Magnessium values varied between 20.01 to 20.40 me/100gm of sediment sample. Magnessium content was lower at station : 3 (Hataoda) and higher at station : 4 (Nimbhora). Magnessium content in all stations are very close to each other than in calcium content.

The higher concentration of exchangeable calcium and magnessium may be due to the amount of exchangeable and solutions form of calcium & magnessium in sediment samples. It is also attributed weathering of minerals and their deposition in sediments.

4) Conclusion:

Highest pH of sediments are found at station : 2 ie. : Kukarmunda and lowest pH of sediments found at station : 1 ie. Surat The avarage pH of all sample found to be pH = 7.53 which found toward alkaline in nature. The lowest pH at Surat station attributed to acidic effluent dicharge from nearby industries which located on the bank of Tapti river The higher pH at Kukarmunda station due to tremondous deposition of sediment due to back water of Ukai dam. Electrical conductivity of these ten sediment samples ranges form 3.11 to 5.05 dsm^{-1} The highest electrical conductivity was recorded at station: 6 (Prakasha) and lowest electrical conductivity at station : 8 (Torkheda). higher conductivity is indications of richer ionic and more charged species lower electrical conductance is the indications of highly silicates material. Organic carbon in ten samples of sediment from different stations ranges form 0.16 to 0.5454 %, lower organic percentage are observed at station : 8 (Torkheda) The higher percentage are observed at sation :9 (Sulwada). The average organic carbon content in all these ten stations sediment samples is 0.298 %. In the present study of sediments sample of Tapti river. The available nitrogen concentration in ten sampling stations ranges from 71.8 to 244.3 Kg/ha. The lower available nitrogen concentration are observed at station : 8 (Torkheda) Higher available nitrogen contents are recorded at station : 9 (Sulwada). The available potassium was estimated by flame photometry. It is observed that available potassium ranges from 168.2 to 367.0 Kg/ha. Lower concentration of available potassium observed at station : 6 (Prakasha), It may be due to less minerals weathering. Higher concentration of available phosphate is observed at station 1(Surat), this rich in potassium attributed to rich weathering of minerals and their by release of potassium ions which adsorbed on cation exchange sites of the minerals. As compaired to other metal potassium observed significantly. The avarage available potassium is 269.45 Kg/ha. In the present study of Tapti river sediments, it is observed that the exchangeable Calcium ranges from 13.97 to 16.07 me/100 gm. The lower concentration of exchangeable calcium observed at station: 7 (Sarangkheda).

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