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Investigational Studies on Quantity of Salinity in Netravati River Estuary Sand-Coastal Karnataka

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Abstract—

The salt water mixes with fresh water and forms brackish water. The brackish water contains some quantity of salt, but not equal to sea water. Salinity determines the geographic distribution of the number of marshes found in estuary. Hence salinity is a very important environmental factor in estuary system. Sand is one major natural aggregate, required in construction industry mainly for the manufacture of concrete. The availability of good river sand is reduced due to salinity. The quality of sand available from estuarine regions is adversely affected due to this reason. It is the responsibility of engineers to check the quality of sand and its strength parameters before using it for any construction purpose. Presence of salt content in natural aggregates or manufactured aggregates is the cause for corrosion in steel. In this study the amount of salinity present in estuary sand was determined. Three different methods were used to determine the salinity in different seasonal variations. The sand sample collected nearer to the sea was found to be high in salinity in all methods. It can be concluded that care should be taken before we use estuary sand as a construction material due to the presence of salinity.

Keywords— salinity, estuary, brackish water, sand, marshes.

I. INTRODUCTION

In the construction industry there is a shortage of availability of good river sand. Generally river sand is extracted from river bed and transported. Due to the revolution in construction industry, the rate of river sand extraction gradually increased. Finally the people started extracting the sand from estuaries. Estuaries are the area where river and sea meets. Dakshina Kannada and Udupi districts are situated in Coastal belt of Karnataka. Netravati, Gurupura, Gangoli, Sitanadi, Aghanashini, Kali and Sharavati are the important rivers flowing through this coastline and joins the Arabian sea. The people living on the bank of these rivers are dependent on fishing, sand extraction from river bed, lime shell collection etc. For many decades, the people have been extracting sand and selling them in nearby areas. In estuary, the water has more salinity due to tidal effects, temperature changes, shortage of inflow etc. Estuary is also the place which is known to be the best for marine life like fishes and aquatic plantations. Since the extraction of sand is rapidly growing in the estuary area, it is depleting the life of aquatic animals and plants. Now a days the extracted sand from this estuary is widely used in construction industry in costal part of Karnataka and Kerala state. The degree of salinity in estuary changes due to the environmental conditions. The river containing fresh water is lighter than sea water, so it has a tendency to stay above the seawater. If the estuary is shallow, the salt and freshwater will mix and the salinity change is gradual. An estuary is continuously varying and tends to collect sediments. Sediments can found in rivers, streams and brackish marshes located inland. Salt marshes and sand dunes are located near the mouth of the estuary. Sediments may consist of animal, plant matter, mud or sand.The intensity of tides, precipitation and dry periods affects the degree of salinity in an estuary. In sea the average salinity is 35 ppt. Pycnodine is the zone where fresh water changes to salt water. This study is to determine the quantity of salinity present in the estuary sand and distribution of salinity across the Netravati estuary.

II. STUDY AREA

The study area for present research work was located in coastline of Karnataka. The Netravati estuary situated in Dakshina Kannada is about 3222 km^2 catchment area. A total of ten location samples with an interval of one km were taken to determine the quantity of salinity in estuary sand. The locations were marked as L1, L2, L3, L4, L5, L6, L7, L8, L9 and L10. L1 is at estuary point and the rest of the locations are located at an interval of one km away from the sea respectively. In selected study area people were extracting the sand for construction work. The study area comes in Coastal Regulation Zone (CRZ). The details of sample collected locations are given below.

Table I Sand Sampled Locations

location	Latitude / longitude	location	Latitude / longitude
L1	N 12^O50.023" / E 74^O 50.532"	L6	N 12^O50.514" E 74^O 52.912"
L2	N 12^O50.001" E 74^O 51.058"	L7	N 12^O50.260" E 74^O 53.123"

L3	N 12^{O}50.027” E 74^{O} 51.919”	L8	N 12^{O}50.390” E 74^{O} 53.413”
L4	N 12^{O}50.056” E 74^{O} 52.314”	L9	N 12^{O}50.26” E 74^{O} 52.200”
L5	N 12^{O}50.442” N 12^{O}50.442”	L10	N 12^{O}50.10” E 74^{O}52.000”

Fig. 1 sand sample collected locations

III. MATERIALS AND METHODOLOGY

A. Samples

The sand samples were extracted from Netravati river estuary in the month of April, June and October. Generally in coastal line of Karnataka-Mangaluru monsoon starts in the month of June and ends in the month of September. These samples are considered as pre monsoon, monsoon and post monsoon. All collected estuary sand samples were stored in plastic bags and transported to laboratory for determination of quantity of salinity. The sand samples in plastic bags were marked as S1, S2, S3, S4, S5, S6, S7, S8, S9 and S10 which were collected at L1 to L10 locations respectively.


Fig. 2 sand sample collection in Netravtai Estuary by motor boat


Fig. 3 sand sample collection

B. Determination of salinity

The salinity test was conducted on collected sand sample by three different methods.

i) Salinity by electrical conductivity

Salinity is measured by passing an electric current between two electrodes in a sand sample. The electrical conductivity or EC of a sand or water sample is influenced by the concentration of dissolved salts. Salts increase the ability of a solution to conduct an electrical current. So a higher the value of Electrical Conductivity indicates a high salinity level. Salinity is measured in terms of DeciSiemens per metre (dS/m). $EC_{1:5}$ test procedure is adopted to find the salinity. In this method, one part sand was mixed with five parts of distilled or deionised water. After mixing the sample and allowing the sediment to settle for a few hours, then electrical conductivity of the solution was tested. Depending on the texture of sample the conversion factor was multiplied.

Table III Conversion factor on texture of sample

Texture	Multiplication factor
Sand	17
Sandy Loams	13.8
Loams	9.5
Clay loams & light clay	8.6
Medium & heavy clay	7

ii) Salinity by Titration method

This method determines the presence of salinity in terms of chloride ion by titration with silver nitrate solution. The sample is clearly washed with distilled water and kept for a day then it was titrated with silver nitrate solution. Difference in volume was noted and chloride content present in estuary sand was determined by formula. The chloride content present in sample was measured in mg/L.

iii) Salinity by evaporation method

Experimental analysis was carried out by using evaporating dish and salinity was determined in terms of grams. When water was evaporated, the salt remained as the residue. The ratio between the evaporated water and the residue is the salinity. To ensure that water is evaporated completely, infrared light source can be used after the residue remains. New developing techniques are aimed to determine the salinity with high sensitivity and accuracy.

IV. RESULTS AND DISCUSSION

A. Salinity of Netravati estuary sand by Electrical conductivity

i) In pre monsoon

Table IV salinity of netravati estuary sand

Sample	Salinity in mg/L
S1	560.21
S2	498.2
S3	476.2
S4	285.3
S5	272.4
S6	236.4
S7	184.3
S8	168.57
S9	139.24
S10	138.05

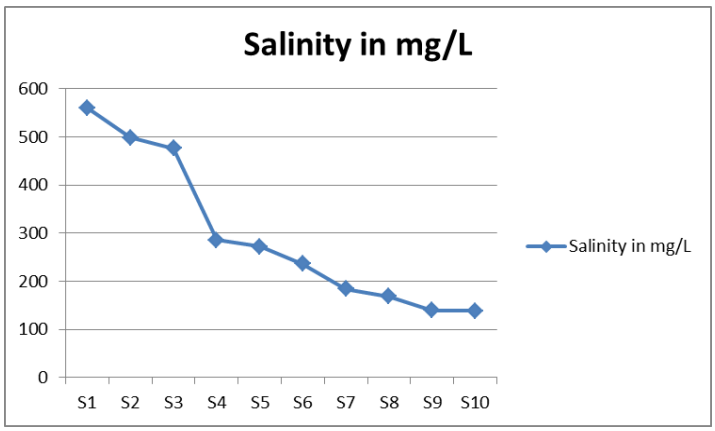

Fig. 4 variation of salinity with location

ii) In monsoon

Table V Salinity Of Netravati Estuary Sand

Sample	Salinity in mg/L
S1	321.2
S2	321.0
S3	301.4
S4	232.2
S5	241
S6	202.1
S7	174.2
S8	128.4
S9	98.4
S10	96.1

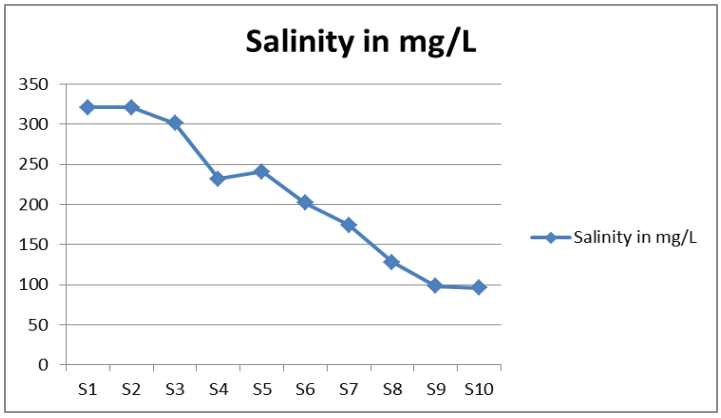

Fig. 5 variation of salinity with location

iii) Post monsoon

Table VI Salinity Of Netravati Estuary Sand

Sample	Salinity in mg/L
S1	512
S2	448
S3	448
S4	268.8
S5	256
S6	204.0
S7	192
S8	140.8
S9	126.2
S10	115.2

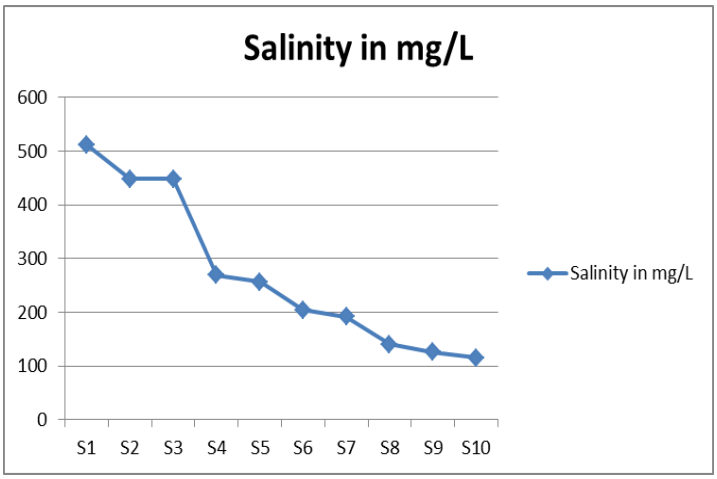

Fig. 6 variation of salinity with location

B. Salinity of Netravati estuary sand by Titration method

Table VII Salinity Of Netravati Estuary Sand

Sample	Salinity in mg/L (Premonsoon)	Salinity in mg/L (monsoon)	Salinity in mg/L (Post monsoon)
S1	94.62	51.20	87.65
S2	85.29	47.25	82.16
S3	82.64	41.352	80.14
S4	79.54	37.64	76.25
S5	72.67	34.21	72.51
S6	65.24	28.64	64.16
S7	59.21	25.11	54.26
S8	57.68	21.08	53.102
S9	51.20	20.145	47.81
S10	48.25	18.27	40.21

Graph IV variation of salinity with location

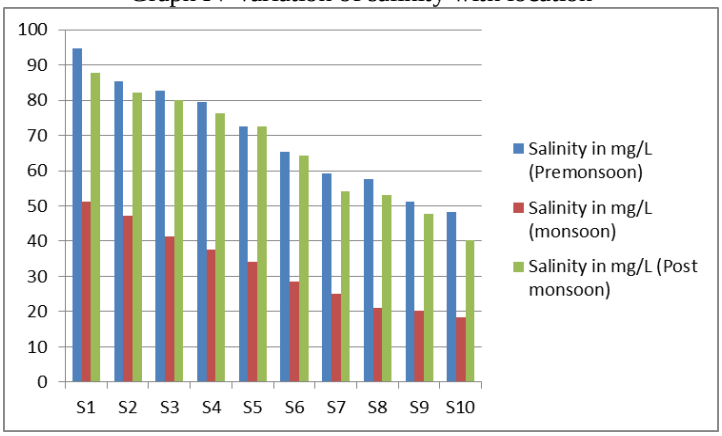

Fig. 7 variation of salinity with location

C. Salinity of Netravati estuary sand by Evoparation method

Table VIII Salinity Of Netravati Estuary Sand

Sample	Salinity in gms (Premonsoon)	Salinity in gms (monsoon)	Salinity in gms (Post monsoon)
S1	1.64	0.7	1.21
S2	1.52	0.61	1.02
S3	1.48	0.59	0.78
S4	1.35	0.54	0.76
S5	1.06	0.52	0.64
S6	0.79	0.41	0.60
S7	0.74	0.39	0.58
S8	0.61	0.24	0.55
S9	0.59	0.22	0.56
S10	0.43	0.20	0.48

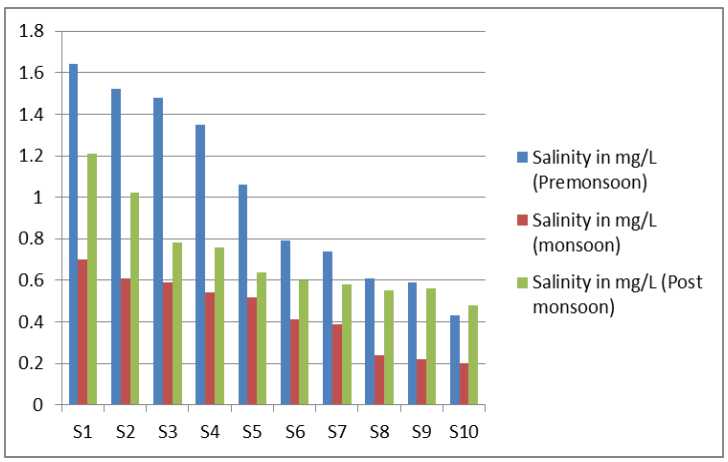

Fig. 8 variation of salinity with location

V. CONCLUSIONS

It has been observed from the result that the salinity in Netravati estuary sand is more in pre monsoon due to the low quantity of river water intrusion. The sea water intrusion may depend on discharge of water from river to sea, tidal height, rain fall, temperature. In pre monsoon season less discharge of river water. In monsoon season the estuary sand has less salinity when compared to all seasons due to high discharge from river. It can be concluded that care should be taken before the use of estuary sand for construction work.

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