Journal of Advances in Developmental Research (IJAIDR)
E-ISSN: 0976-4844 ● Website: www.ijaidr.com ● Email: editor@ijaidr.com

Physico-Chemical Characteristics of Saltpans in Naigaon, Palghar District, Mumbai, Maharashtra, India

Dr. Shailesh A. Tawade[1], Rinku R. Choudhary[2], Meenakshi Prakash Borate[3]

[1,2,3]Sir Sitaram and Lady Shantabai Patkar College of Arts and Science and V.P. Varde College of Commerce and Economics

Abstract

An ecosystem is a community of living organism in association with the nonliving components of their environment. Salt pan is one of the ecosystems with hypersaline extreme environment. It can be natural as well as man-made. Quality and quantity of salt depends on physico-chemical disturbances. Factors like high evaporation, dry wind, high temperature, and low rainfall rate are helpful for good salt production. Biological system is in admirable harmony with production of saltern. Many birds, animals and microorganism are found in and around salt pan. The physicochemical features and biological systems are essential for the proper functioning of saltpans. This present study evaluates the physico-chemical parameters of brine from various sites of the different saltpans in Naigaon. For the purpose of further assessing and monitoring these kinds of ecosystems, this study provides baseline data on the physico-chemical parameters.

Keywords: Marine, saltpan, physico-chemical

1. Introduction

There are 5,300 acres of salt pan land in Mumbai from which only 25 acres are used for development; the remaining acres are wetlands (Aggarwal, 2019). Salt pans are large naturally formed land which is covered with salt and other minerals. These wetlands provide an experimental method of intense environmental factors like high and low temperatures, pH, salt concentration, low nutrient concentration, water supply. Conditions of high levels of radiation, hazardous heavy metals, poisonous compounds (organic solvents) and a high gradient in the biodiversity of primary and secondary producers are also subject of concern (Satyanarayana *et al.*, 2005). Halophiles are one which grows in extreme condition within NaCl presence (Aljohny, 2015). Its application has been largely seen in food and pharmaceutical industries, also for production of enzymes, cosmetic products and polymers (Manukandan *et al.*, 2018). Environmental conditions and physical parameters affect microorganism qualitatively and quantitatively. The physical and chemical environment is important for many of the processes taking place in both biotic and abiotic ecosystems. Physico chemical study is important for understanding the organism and its habitat (Patadia and Dave, 2015). Based on the concentrations of different physical and chemical materials, such as nutrients and trace elements, the energy transfer level from phase to phase and the production of organic matter for direct use by species can be established. As a result, there is a distinct interrelationship between physico-chemical and microbiological elements (Patadia and Dave, 2015). It is interesting to research as many of these varying degrees as possible, because the creatures inhabiting them can also be somewhat different. This brought in interest in studying the physico chemical parameters salt pan and its environment.

In Mumbai, the land at mouth of these estuaries is low lying inter tidal and annually undergoes drought, brine, water logged. The locals of these regions manoeuvre these lands particularly during November to May for production of crude solar salt.

The aim of the study was to find the physico-chemical parameters of waters of saltpans from various sites of the saltpans in Naigaon. Naigaon is a neighborhood of Vasai Virar city which is a part of Mumbai metropolitan region. The station is surrounded by salt pans and mangroves. Since many years lot of destruction has taken place which has affected the flora and fauna of salt pan.

Materials and methods

Selection of location:

The villages of Naigaon in the Vasai Taluka of Palghar District, India, were surveyed to see whether they were engaged in traditional salt production. The study on saltpans were conducted in the villages of Naigaon from Palghar District, Maharashtra.

Satellite image of study area: Naigaon West
(*Source: Google Earth*)

Photograph of study location showing saltpans

Collection of samples:

The water samples for the present study were collected in sterilized polythene cans and were carried immediately to the laboratory. Physico-chemical parameters like pH, temperature, total solid, organic content, salinity, acidity, chlorinity were studied. On the site water temperature, salinity and pH were monitored.

Physico-chemical properties:

The physico-chemical parameters investigated were temperature, total solid, organic content, salinity, acidity, chlorinity. The rest of the parameters were also analysed in the laboratory by standard methods (APHA, 2005) and they are expressed in respective units.

Temperature: The temperature of water and sediment samples was recorded using a thermometer.
pH: The pH of water and sediment samples was measured by a pH meter.
Turbidity: Turbidity of water samples was measured using Nephelometer
Salinity: Salinity of the water were measured by an Argentometric method
Alkalinity: Alkalinity of water and sediments were measured by titration method.
Total hardness: Total hardness was estimated by EDTA titrimetric method.

TSS and TDS: The total dissolved solids were measured by a Standard filtration and Evaporative method.
Dissolved Oxygen (DO): Dissolved Oxygen was estimated by Winkler Titration Method
Biological Oxygen Demand: Biological Oxygen Demand was estimated by Winkler Titration Method
Chemical Oxygen Demand: Chemical Oxygen Demand was estimated by titration method

Results and discussion:

Table 1.: The physico-chemical characteristic of water sample

Parameter		Mean ±Sd	Co variance
Temperature	Winter	25 ±0	0
	Summer	35 ± 3	8.57
pH	Winter	8.334 ±0.489	5. 87
	Summer	7.77 ± 0.5813	7.48
Conductance (ms) (μS/cm)	Winter	0.420 ± 0.184	43.89
	Summer	14.6 ± 0.8944	6.13
Total solid (gm/L)	Winter	33.02 ± 20.25	61.34
	Summer	36.01 ± 0.6635	1.84
Salinity (mg/L)	Winter	28286.75 ± 17397.33	61.5
	Summer	1916.4 ± 54.1692	2.83
Acidity	Winter	240 ± 219.08	91.29
	Summer	5502.08 ± 2222.681	4.88
Alkalinity	Winter	361.65 ± 192.579	53.25
	Summer	3025 ± 1349.39	44.61
Total suspended solid (gm/L)	Winter	2.8 ± 3.283	117.26
	Summer	0.115 ± 0.0242	21.04
Total dissolved solid (gm/L)	Winter	39.02 ± 26.64	68.29
	Summer	0.215 ± 0.1325	61.63
DO (mg/L)	Winter	21.84 ± 15.94	73.02
	Summer	0.3595 ± 0.2872	80
BOD (mg/L)	Winter	0.58842 ± 0.4479	76.19
	Summer	0.7255 ± 0.4261	58.77
COD (mg/L)	Winter	0.1 ± 0	0
	Summer	12.6 ± 9.99	79.29

Table 2.: Pearson Correlation Coefficient Matrix for Winter

Parameter \ Comparison	pH	Cond.	Total Solid	Salinity	Acidity	Alkalinity	TSS	TDS	DO	BOD	COD

pH	**1.0000**	0.5942	**0.6832**	**0.4911**	-0.1263	-0.0931	0.2186	0.1677	0.0426	0.0527	0.0163
Cond.	0.5942	**1.0000**	0.6454	0.1181	0.1065	**0.7993**	0.2209	0.1971	0.2340	0.2285	0.2361
Total Solid	**0.6832**	0.6454	**1.0000**	**0.4811**	0.2114	0.1277	0.1904	0.1791	0.1374	0.1583	0.1749
Salinity	**0.4911**	0.1181	**0.4811**	**1.0000**	-0.1127	-0.0422	0.1832	0.1547	0.1286	0.1424	**0.7100**
Acidity	-0.1263	0.1065	0.2114	-0.1127	**1.0000**	0.1975	0.0084	0.0843	0.0999	0.1165	0.1400
Alkalinity	-0.0931	**0.7993**	0.1277	-0.0422	0.1975	**1.0000**	0.0069	**1.0000**	0.0621	0.0938	0.1076
TSS	0.2186	0.2209	0.1904	0.1832	0.0084	0.0069	**1.0000**	0.2137	0.1003	0.1221	**0.7100**
TDS	0.1677	0.1971	0.1791	0.1547	0.0843	**1.0000**	0.2137	**1.0000**	0.0602	0.0715	0.0933
DO	0.0426	**0.2340**	0.1374	0.1286	0.0999	0.0621	0.1003	0.0602	**1.0000**	0.2477	0.2624
BOD	0.0527	0.2285	0.1583	0.1424	0.1165	0.0938	0.1221	0.0715	0.2477	**1.0000**	**0.7101**
COD	0.0163	0.2361	0.1749	**0.7100**	0.1400	0.1076	**0.7100**	0.0933	0.2624	**0.7101**	**1.0000**

Table 3.: Pearson Correlation Coefficient Matrix for Summer

Parameter \ Comparison	**pH**	**Cond.**	**Total Solid**	**Salinity**	**Acidity**	**Alkalinity**	**TSS**	**TDS**	**DO**	**BOD**	**COD**
pH	**1.0000**	0.1924	**0.8176**	**0.6357**	-0.0983	-0.1098	0.1956	0.1802	0.0898	0.1277	0.0983
Cond.	0.1924	**1.0000**	0.2023	0.1024	0.0897	0.1523	0.1846	0.1756	0.2325	0.2113	0.2013
Total Solid	**0.8176**	0.2023	**1.0000**	**0.6053**	0.1754	0.4623	0.2223	0.2110	0.1131	0.2340	0.2361
Salinity	**0.6357**	0.1024	**0.6053**	**1.0000**	0.7101	0.7101	0.1985	0.1874	0.1973	0.2035	0.1749

Acidity	-0.0983	0.0897	0.1754	**0.7101**	**1.0000**	0.2340	0.7101	0.2113	0.2035	0.2101	0.2035
Alkalinity	-0.1098	0.1523	0.4623	**0.7101**	0.2340	**1.0000**	0.1749	0.2013	0.1749	0.2035	0.2361
TSS	0.1956	0.1846	0.2223	0.1985	0.7101	0.1749	**1.0000**	0.2361	0.2035	0.2361	0.2361
TDS	0.1802	0.1756	0.2110	0.1874	0.2113	0.2013	0.2361	**1.0000**	0.2361	0.2361	0.2361
DO	0.0898	**0.2325**	0.1131	0.1973	0.2035	0.1749	0.2035	0.2361	**1.0000**	0.2361	0.2361
BOD	0.1277	0.2113	0.2340	0.2035	0.2101	0.2035	0.2361	0.2361	0.2361	**1.0000**	0.2361
COD	0.0983	0.2013	0.2361	0.1749	0.2035	0.2361	0.2361	0.2361	0.2361	0.2361	**1.0000**

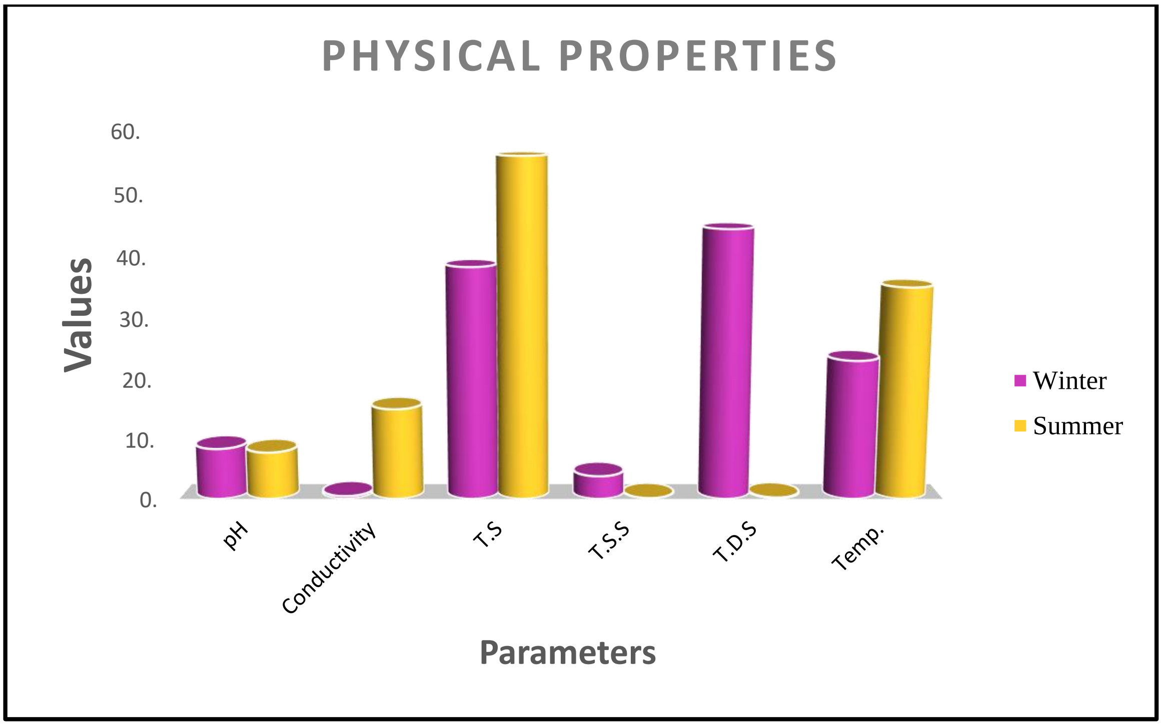

Fig 1: Graph of Physical properties

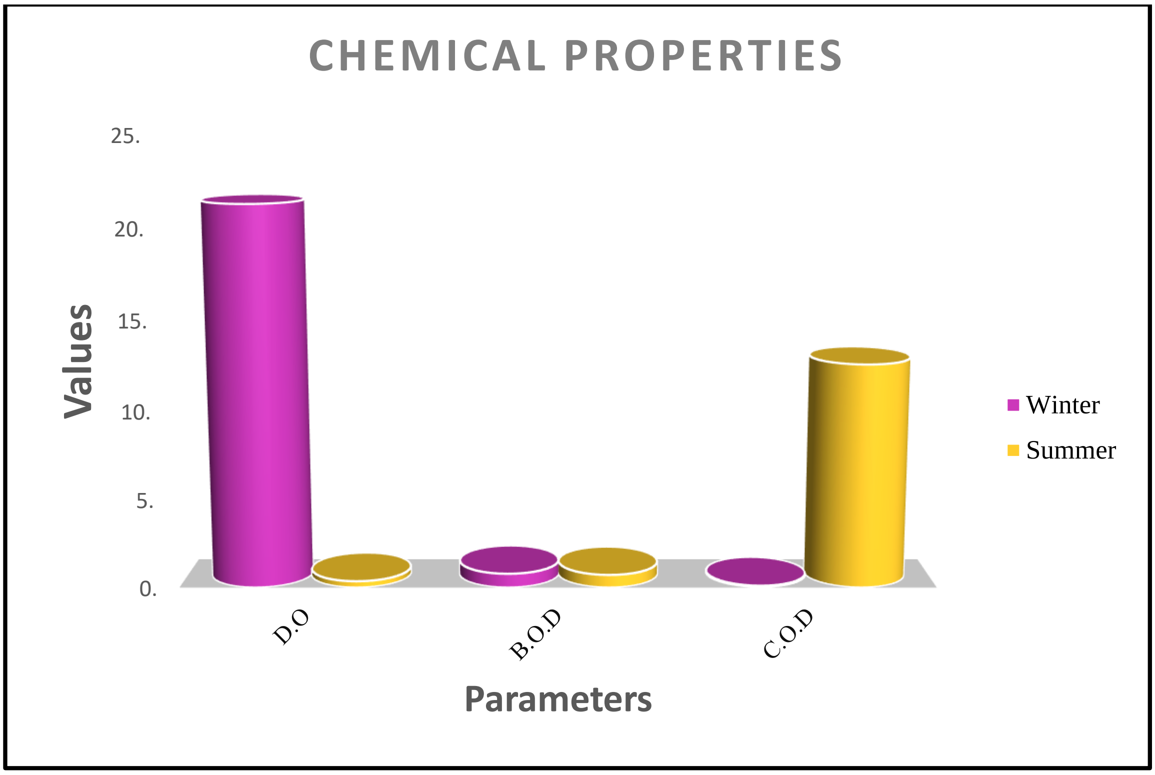

Fig 2: Graph of Chemical properties

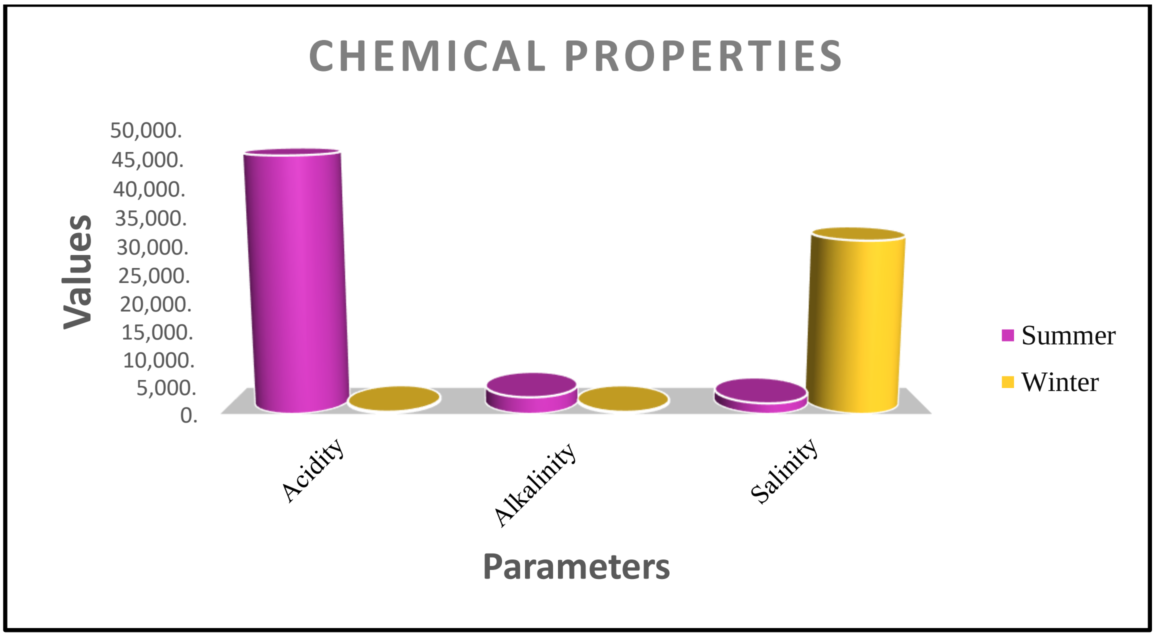

Fig 3: Graph of Chemical properties

Many biotic and abiotic processes depend on the physical and chemical environment. Based on concentrations of various physical and chemical constituents such as nutrients and trace elements, the energy conversion level from phase to phase and the production of organic matter for direct utilization by organisms can be found out. Thus, as there is a distinct interrelationship existing between physico-chemical and microbiological components of the aquatic ecosystem (Venugopalam and Paulpandian, 1989; Kennedy, 1995).

The water parameters showed varied significance between winter and summer seasons.
During winter, the temperature was relatively stable at 25°C, whereas in summer it increased to 35°C with a variability of ±3°C. The pH levels in winter were around 8.334 with a standard deviation of 0.489, while in summer, the pH dropped to 7.77 with a higher variability (±0.5813). Conductance, which measures the water's ability to conduct electricity, was significantly lower in winter at 0.420 ms (with a standard deviation of 0.184), but it rised to 14.6 ms in summer (±0.8944). Total solid content in winter was 33.02 g/L with a standard deviation of 20.25, compared to 36.01 g/L in summer with much lower variability (±0.6635). The salinity also showed a drastic change, being very high in winter at 28286.75 mg/L (±17397.33) but dropping to 1916.4 mg/L (±54.1692) in summer. Acidity levels was quite low in winter at 240 mg/L (±219.08), but they spike dramatically to 5502.08 mg/L in summer with a variability of ±2222.681. Similarly, alkalinity was much higher in summer at 3025 mg/L (±1349.39) compared to 361.65 mg/L in winter (±192.579). Total suspended solids were higher in winter at 2.8 g/L (±3.283), while in summer, this value dropped significantly to 0.115 g/L (±0.0242). Total dissolved solids showed a similar pattern, with 39.02 g/L in winter (±26.64) and only 0.215 g/L in summer (±0.1325). Dissolved oxygen (DO) was abundant in winter at 21.84 mg/L (±15.94) but almost negligible in summer at 0.3595 mg/L (±0.2872). Biological oxygen demand (BOD) was slightly higher in summer at 0.7255 mg/L (±0.4261) compared to 0.58842 mg/L in winter (±0.4479). Chemical oxygen demand (COD) was essentially zero in winter but a rise was observed to 12.6 mg/L in summer (±9.99).

Patadia and Dave, 2015 carried out the similar study. Similarly, pH of water and sediment samples at Newport was between 7-8.3 and at Nari 6-7.6. Turbidity levels varied significantly, ranging from 6 to 33 NTU at Newport and from 5 to 21 NTU at Nari. Salinity in the water and sediment at Newport ranged between 20% and 330%, while at Nari it ranged from 38% to 310%. Alkalinity levels in water samples at both locations ranged from 450 mg/L to 5817 mg/L, while in sediment samples, it ranged between 0.002 mg/kg and 0.013 mg/kg. The hardness of water samples was between 14 g/L and 132 g/L at both sites. For sediment samples, hardness ranged from 2133 g/kg to 18,000 g/kg. Total dissolved solids (TDS) at Newport ranged from 75 g/L to 330 g/L, with sediment samples ranging from 20 g/L to 90 g/L. At both sites, chloride concentrations in water samples ranged from 30 g/L to 221 g/L, whereas in sediment samples, it ranged from 0.001 g/kg to 0.08 g/kg (Patadia and dave,2015).
Selvarajan *et al.*'s 2017 saltpan analysis revealed that the water samples had an alkaline pH of 8.8. The water samples had a salinity of 12.8%. The two most prevalent ions were sodium (42.6 g/L) and chloride (75.8 g/L), with calcium (1028 mg/L) coming in second. All elemental elements except strontium (31 mg/L), selenium (0.58 mg/L), and boron (0.22 mg/L) were found at amounts below the detection limit. Compared to total iron (1.51 mg/L), total sulphur (1925 mg/L) was much greater.

Conclusion:

The present study reveals considerable seasonal variations in the physico-chemical parameters of saltpan water, indicating that certain relationships, such as conductivity with alkalinity and pH with Total Solid content, exhibit varying strengths across summer and winter. Winter conditions often show stronger correlations between conductivity and alkalinity, as well as salinity and COD, while summer conditions emphasize correlations between salinity with acidity and alkalinity, and moderate correlations between DO and BOD.

Understanding these seasonal patterns is crucial for effective environmental management and ensuring water quality standards are maintained throughout the year, emphasizing the need for comprehensive data collection across different seasons to capture these dynamic relationships accurately. The changes in the properties of the saltpan water may be due to the discharge from surrounding areas, highlighting the importance of seasonal comparative studies to maintain the status and management of the saltpan for the conservation of this fragile and unique ecosystem.

References

1. Aggarwal, M. (2019, October 28). Salt pans save Mumbai from floods: So why are they under threat? *Mongabay-India*.
2. Aljohny, O. (2015). Halophilic bacterium: A review of new studies. *Bioscience Biotechnology Research Asia, 12*(3).
3. American Public Health Association (APHA). (2005). *Standard methods for the examination of water and wastewater* (20th ed.). WEF and AWWA, USA.
4. Kennedy, A. C., & Smith, L. (1995). Soil microbial diversity and the sustainability of agricultural soils. *Plant and Soil, 170*, 75–86.
5. Manikandan, P., Gnanasekaran, A., & Senthilkumar, P. K. (2018). Screening and characterization of protease-producing halophilic bacteria from the saltpan area Vedaranyam, Tamil Nadu. *International Journal of Pharmacy and Biological Sciences, 8*(4), 160-168.
6. Patadia, M., & Dave, B. (2015). Analysis of physico-chemical parameters of salt pans at Newport and Nari situated around Bhavnagar coast. *Journal of Ecobiotechnology, 7*.
7. Satyanarayana, T., Raghukumar, C., & Shivaji, S. (2005). Extremophilic microbes: Diversity and perspectives. *Current Science, 89*, 78–90.
8. Selvarajan, R., Sibanda, T., Tekere, M., Nyoni, H., & Meddows-Taylor, S. (2017). Diversity analysis and bioresource characterization of halophilic bacteria isolated from a South African saltpan. *Molecules, 22*(4), 657.
9. Venugopalam, V. K., & Paulpandian, A. L. (1989). Methods in hydrobiology. In *CAS in Marine Biology*. Annamalai University Publications, India. pp. 1-134.