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SURFACEWATER CONTAMINATION ASSESSMENT IN INDUSTRIAL PARK MAHAD M.I.D.C. RAIGAD, MAHARASHTRA

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ABSTRACT

The surface water quality in Mahad M.I.D.C.'s industrial area was analyzed; water from study area is used for domestic purposes, so the quality of surface water must be assessed. A few industries discharge their wastewaters into a nearby nalas and river. Throughout the year, water samples were obtained from nalas and river located across the industrial area at one-month interval. To determine the effect of industrial wastes on surface water, the following parameters were estimated: pH, EC, Na^+, K^+, Cl^-, Ca^{2+}, Mg^{2+}, HCO_3^-, TH, TA, PO_4^{3-}, SO_4^{2-}, and NH_3-N. The findings indicate that in the current analysis, the majority of the physicochemical parameters of water samples were below the permissible level of drinking water quality.

KEY WORDS : Surface water, Factory wastes, Pollution.

INTRODUCTION

The Environmental pollution has also been a cause of worry in India on a lot of different levels (Paul *et al.*, 2012). Sewage or contaminants from factories can percolate through the soil layer and enter the water resources, creating a polluted layer that disrupts natural ground water quality by altering its chemical properties. If waste water is used for irrigation, it has an effect on soil fertility and crop health. The physico-chemical analysis of groundwater and soil every where reveal the effect of toxic chemicals on soil health and ground water contamination.

MATERIALS AND METHODS

The research area Mahad is located on the Arabian Sea, south of Mumbai, in Maharashtra's coastal Kokan area. The selected area's geographical coordinates are Latitude 18°6'12"N and Longitude 73°28'40"E, with an elevation above mean sea level (metres) of approximately 177.5m. Water samples were collected in MIDC (Maharashtra Industrial Development Corporation) sites in the Mahad, district of Raigad. A variety of factories such as fertilizer, agrochemicals, acid, dyes, paints, machine tools materials, and resins are located in the area of study. Fifteen water samples were obtained using the methodology of APHA (1998). Trivedy and Goel (1986), and physico-chemical parameters were analysed using the appropriate standards. Chemicals and reagents of AR grade are used. The solutions are made with doubled distilled purified water.

RESULTS AND DISCUSSION

The physicochemical characteristics of ground water in the industrial area Mahad MIDC, Maharashtra, varied throughout the year (August-2018 to July-2019). Tables 1 show the outcome of the water quality status.

pH

The pH is an acidity or water alkalinity indicator. The available macro and micronutrients for plants are considered to be linked to pH (Ladwani *et al.*, 2012). The water pH ranged from 6.66 to 8.20, with an average of 7.16 during the period of one year. Laterite soil, however, is acidic in nature and so it is acidic in nature. During the monsoon season, some chemicals and metals percolate through rain water and settle in ground water, resulting in water with a low pH value (Walakira, 2011), which may be attributed to the discharge of acidic industrial effluents into the well water (Sunil *et al.,* 2011). In same way the pH values reported by I. Touzani (2020) are ranged from 7 to 7.87 with an average value of 7.42. Ramprasad (2020) found that the pH value of the river sample on the upstream side was 7.97 ±0.23 and on the downstream side was 8.16±0.38.

Electrical conductivity (EC)

The capacity of a material to conduct electricity is referred as its electrical conductivity. Water conductivity is a more or less linear property of dissolved ion concentration (Kumar *et al.,* 2012). During the study period electrical conductivity of water ranged from 0.04 to 0.52 dSm^{-1} with a mean value of 0.16 dSm^{-1}. As a result, during the year, all samples obtained were in the excellent and decent water grades. The electrical conductivity increases during the monsoon and winter seasons due to an increasing number of ions, which is confirmed by the salinity value (Ramesh *et al.,* 2014), and decreased during the summer due to a rise in the rate of precipitation (Kataria *et al*., 1994). Similarly, Yasin *et al*. (2020) found that all surface waters do not surpass the norms, although the threshold value for spring waters has been increased. Few samples have been surpassed the limit and the electrical conductivity value observedwas 619.8 $mS.cm^{-1}$

Total hardness (TH)

Hardness is generally caused by the calcium and magnesium ion present in the water. Polyvalent ions of some other metal like strontium, iron, aluminium, zinc and manganese, etc. can cause the hardness. Total hardness observed during the period of one year was minimum of 24.55 ppm to 64.74 ppm with mean 43.64 ppm but Subhash Prasad Singh *et al.* (2020) observed that the 2.38 % of pre- and post-monsoon water samples were found to have Concentration of total hardness greater than the BIS permissible limit of 300 ppm to 600 ppm. TH levels were calculated in the range of 55 ppm to 635 ppm with a median of 137.5 ppm during pre-monsoon and 105 ppm to 1290 ppm with a median of 215 ppm during post-monsoon.

Total alkalinity (TA)

It is a measure of the capacity of water to neutralise a strong acid. In the study area the Total alkalinity ranged from 21.90 to 139.8 ppm having average value of 71.11ppm unlike Subhash Prasad Singh *et al.* (2020) noted that the Total Alkalinity (TA) levels higher than the BIS permissible limit of 200 ppm to 600 ppm were found in 2.38 % of pre- and post-monsoon water samples, respectively. The concentrations of TA were measured. Measured between 45 ppm and 980 ppm with a 65 ppm to 955 ppm and a median value of 122.5 ppm during the pre- and post-monsoon periods, with a median of 155 ppm.

Bicarbonates (HCO_3^{2-})

During the study period, very little carbonate concentrations were found in some water samples. The bicarbonate concentration in surface water ranged from 23.51 to 160.4 mg l^{-1}, with an average value of 67.30 mgl^{-1}. Because of the dilution effect of rain water, the concentration of bicarbonate is lower during the monsoon season (Prasath *et al*., 2013). The data showed that the concentration of bicarbonate in groundwater samples was less than the maximum permissible limit.

Phosphate (PO_4^{3-})

Phosphorous remains in the form of phosphates. The released phosphate after treatment with the acid can be determined by colorimetrically (Trivedy *et al*., 1986). In the MIDC area the phosphate concentration was ranged from 0.02 ppm to 0.21 ppm having average value 0.10ppm during year. Similarly, the Daya river water quality evaluation indicated the range of phosphate from 0.2ppm to 3.9 ppm with an average 1.06ppm (Agrawal, 2020)

Chloride (Cl^-)

Chlorides enter ground water from both natural and anthropogenic causes, such as weathering processes and inorganic fertilizer leaching, dumps or landfills, liquid wastes, and so on (Yadav *et al.,* 2014). The variation of chloride concentration in surface water sources ranged from 112.5 to 299.30 mg l^{-1}, with an average value of 181.95 mg l^{-1}, the values are found below the allowable level for drinking water. Similarly, Anuradha Gogi *et al*., (2020) found that the chloride ion concentration in Dikowa river water ranged from 49 to 62 mg/l and average value of 54.6 mg/l.

Sulphate (SO_4^{2-})

Sewage treatment plants and industrial discharges from tanneries, pulp mills, and textile mills are

Table 1. Variation in the physicochemical properties of water during the period of August-2018 to July-2019 August-2018 to July-2019

Parameters		Statistical data	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
pH	Mean	7.16	7.29	7.29	7.17	7.15	7.17	7.11	7.13	7.01	7.03	7.3	7.07	7.25
	Min.	6.66	7.08	7	7	7.01	7.07	7	7	6.66	6.79	6.75	6.7	7.1
	Max.	8.20	7.5	7.65	7.33	7.25	7.24	7.22	7.54	7.35	7.3	8.2	8	7.51
EC (dSm^{-1})	Mean	0.16	0.187	0.165	0.143	0.162	0.168	0.181	0.167	0.145	0.123	0.149	0.173	0.177
	Min.	0.04	0.039	0.037	0.041	0.041	0.041	0.061	0.055	0.054	0.042	0.047	0.045	0.071
	Max.	0.52	0.399	0.411	0.342	0.472	0.462	0.451	0.515	0.354	0.274	0.443	0.524	0.512
TH (ppm)	Mean	43.64	28.16	31.39	32.74	34.26	41.03	46	51.1	52	56.84	55.94	60.84	33.35
	Min.	24.55	24.55	25.64	30.51	32.64	36.4	43.24	47.9	48.93	51.54	52.58	58.25	29.84
	Max.	64.74	32.05	33.85	34.75	36.94	45.61	49.86	54.83	55.51	60.1	58.85	64.74	38.41
TA (ppm)	Mean	71.11	34.66	37.9	42.63	57.59	61.61	72.35	77.2	90.91	98.41	108.96	129.99	41.12
	Min.	21.90	21.9	27.41	32.64	44.73	51.32	55.64	59.61	72.85	83.51	87.49	118.5	24.1
	Max.	139.80	47.34	44.81	50.67	70.17	75.46	89.98	89.62	109.9	128.4	128.5	139.8	54.82
Bicarbonate (ppm)	Mean	67.30	55.71	52.96	55.93	59.17	69.02	72.5	75.28	93.86	73.89	76.08	75.08	48.17
	Min.	23.51	34.15	25.21	38.15	34.15	37.42	49.83	44.96	47.42	42.51	47.15	51.26	23.51
	Max.	160.40	90.51	84.54	78.15	90.19	109.8	122.4	101	144.2	160.4	150.2	111.5	83.13
Phosphate (ppm)	Mean	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.04	0.05	0.01
	Min.	0.01	0.01	0.011	0.012	0.013	0.013	0.013	0.019	0.023	0.026	0.031	0.039	0.008
	Max.	0.13	0.019	0.017	0.13	0.017	0.018	0.021	0.027	0.032	0.036	0.048	0.05	0.015
Chloride (ppm)	Mean	181.95	172.02	171.00	180.5	199.00	196.30	196.40	182.40	179.03	185.40	182.90	180.90	157.5
	Min.	112.50	122.30	131.20	156.3	125.20	152.80	162.30	135.40	145.61	125.50	119.90	115.10	112.5
	Max.	299.30	250.60	230.10	225.1	290.20	290.30	254.20	299.30	290.51	295.80	280.60	276.60	261.1
Sulphate (ppm)	Mean	18.29	1.04	1.83	4.03	9.37	15.64	19.89	25.53	30.04	32.72	38.23	40.49	0.63
	Min.	0.24	0.56	0.99	2.89	6.74	10.12	18.51	22.14	23.51	28.61	33.42	38.17	0.24
	Max.	44.22	1.52	2.51	5.40	11.24	19.05	23.46	31.23	33.51	36.65	42.08	44.22	1.21
Ammonia (Nitrogen)	Mean	0.10	0.06	0.07	0.12	0.14	0.16	0.17	0.17	0.12	0.09	0.05	0.03	0.03
(ppm)	Min.	0.02	0.05	0.06	0.08	0.10	0.14	0.14	0.16	0.10	0.07	0.03	0.02	0.03
	Max.	0.21	0.08	0.09	0.16	0.17	0.20	0.19	0.19	0.17	0.10	0.21	0.05	0.04
Sodium (ppm)	Mean	8.33	6.68	5.86	6.95	8.31	8.30	7.07	7.15	6.99	11.53	13.03	10.23	7.91
	Min.	2.10	2.20	2.10	4.10	5.10	5.30	4.50	3.20	3.00	8.80	9.10	2.90	2.60
	Max.	29.20	18.50	17.40	15.90	17.90	17.90	15.00	14.30	12.00	21.40	29.20	22.00	18.50
Potassium (ppm)	Mean	0.42	0.50	0.40	0.40	0.50	0.40	0.50	0.40	0.40	0.40	0.30	0.40	0.40
	Min.	0.00	0.20	0.10	0.20	0.20	0.10	0.20	0.10	0.20	0.00	0.00	0.10	0.20
	Max.	0.90	0.80	0.90	0.70	0.90	0.70	0.90	0.80	0.70	0.80	0.80	0.70	0.70
Calcium (ppm)	Mean	26.41	28.69	24.51	17.56	22.45	20.96	22.27	23.59	27.44	29.39	33.30	33.06	33.70
	Min.	9.54	16.10	13.40	9.54	10.60	13.20	9.70	11.30	13.40	14.20	23.54	13.30	25.90
	Max.	73.41	66.00	65.26	42.60	61.42	45.29	50.27	70.64	73.41	53.10	52.00	60.40	55.40
Magnesium (ppm)	Mean	3.08	3.12	2.89	2.51	2.24	2.37	2.60	3.44	3.43	3.62	3.50	3.69	3.59
	Min.	0.15	1.20	0.65	0.25	0.42	0.15	0.52	1.72	1.43	0.37	0.40	0.20	1.03
	Max.	9.99	8.00	7.44	6.93	7.14	9.99	9.07	8.04	8.11	7.84	6.76	8.55	7.86

examples of point sources. Sulphates are often carried into water bodies through runoff from fertilized agricultural lands. The range observed during the one year in the industrial areas surface water for sulphate concentration was 0.24 ppm to 44.02 ppm having average 18.29 ppm. Previous study done by Subhash Prasad Singh *et al*. (2020) indicates that the sulphate concentration in surface water ranged from 0.8 ppm to 261.56 ppm.similarly, the Ramprasad (2020) observed the sulphate content of the river water samples 394 ±17.5 ppm in the upstream side and 512.8 ±11.2 ppm in the downstream side.

Ammonia (Nitrogen)

Ammonia levels that exceed the recommended limits can be harmful to aquatic life. Although the ammonia molecule is a necessary nutrient for life, excess ammonia can accumulate in the organism and cause metabolic changes or increases in body pH. It is a sign of pollution caused by the overuse of ammonia-rich fertilisers. The ammonia concentration in the study area was observed in the range of 0.02 ppm to 0.21 ppm with an average of 0.10 ppm. Similarly, Ajit Kumar Vidyarthi *et al*. (2020) observed variation in Ammonia-Nitrogen values was ranged from BDL to 0.838 ppm with an average of 0.220 ppm.

Sodium (Na^+)

Sodium is a highly soluble chemical element that can be found in natural surface water. Sodium concentrations in surface water ranged from 2.10 to 29.20 ppm, with a mean value of 8.33 ppm. Owing to low water levels and high evaporation, there is a peak in sodium concentration in water during the summer (Yadav *et al*., 2014). The sodium concentration in the ground water samples in this analysis is below the maximum allowable limit.

Potassium (K^+)

During the period of one year the potassium concentration was ranged from 0.0 ppm to 0.90 ppm with mean value of 0.42 ppm. Similarly, Ramprasad *et al*. (2020) reported the potassium concentration in river Cauvery was 4.24 ± 2.88 and 8.12±5.2 in upstream and downstream respectively. Likewise, the potassium observed in water at Jaipur district with mean value was 242.64 ppm before monsoon and 6.73 ppm after monsoon (Subhash Chand Jat, 2020).

Calcium (Ca^+)

During the study period the calcium concentration in surface water ranged from 9.54 to 73.41 mg l^{-1}, with a mean value of 26.41 mg l^{-1}. The data revealed that the calcium content in water samples was below the maximum allowable level. Due to industry runoff, low water levels, and high evaporation, higher calcium concentrations in water were observed during the summer season (Deshmukh, 2014). Similarly, the calcium concentration reported by Kulkarni (2020) was ranged from 10 ppm to 57.71 ppm in Panchaganga river of Maharashtra.

Magnesium (Mg^+)

Magnesium concentrations in water ranged from 0.15 to 9.99 mg l^{-1} with an average value of 3.08 mg l^{-1}. The calcium content in the water samples used in this analysis was below the legal tolerance level for drinking water. Higher magnesium concentrations in ground water during the summer season may be attributed to polluting factories located near water sources, low water levels, and high evaporation (Deshmukh, 2014). Similarly, Magnesium concentration observed at Cauvery river by Ramprasad *et al*. (2020) ranged from 179.2 ± 12.8 188.7 ± 15 in upstream water and downstream water.

CONCLUSION

An environmental risk assessment of water contamination, in particular industrial areas is extremely significant for agricultural and non-agricultural purpose because it is seriously influenced by industries and anthropogenic activities, that further influence on soil and human health. In this investigation it is found that the no physicochemical parameter exceeds the permissible limits of WHO and BIS hence the water from water bodies selected to the study purpose is safe for irrigation. Yet long-term research on surface water pollution needs to be monitored in the study area.

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