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Heavy Metal Concentration in Surface Water around the Industrial Area M.I.D.C. Mahad, Maharashtra, India

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ABSTRACT

The surface water quality in Mahad M.I.D.C.'s industrial area was analysed; it is used for irrigation and domestic purposes, so the quality of water must be assessed. Rapid industrialization and growing urbanization are the predominant factors responsible for the progressive stress on the area's water. As a result, in light of this serious issue, the current study was undertaken to assesses surface water pollution caused by heavy metals. Throughout the year, water samples were obtained from Nalas and river located across the industrial area at one-month intervals. Using an Atomic Absorption Spectrophotometer, the heavy metals iron, copper, zinc, manganese, nickel, chromium and cobalt were determined (Perkin Elmer make model No. Aanyst 200). A comparison of surface water with WHO (1993) and BIS (1991) recommendations reveals that the majority of water samples contain heavy metal concentrations below the maximum permissible level.

Key words: *Surface water, Heavy metal, Industrial waste*

Introduction

Water is an essential component of life and is needed by all biotic populations. Water is never completely clean in a chemical sense (Agale *et al*., 2013). Water contains very few impurities, but rapid industrialization, overpopulation, uncontrolled use of chemicals resulting in water contamination, and contamination of water disrupt the aquifer's equilibrium (Ramesh *et al.,* 2014). Drinking water should be free of radioactive elements, living and non-living organisms and excessive amounts of minerals that may be harmful to one's health. Some metals are present in the body naturally and are essential for human health. Iron, for example, prevents anaemia, and zinc is a cofactor in more than 100 enzyme reactions. They are known as trace metals because they are found in low concentrations (Harte *et al*., 1991). In certain cases, industrial effluents or waste percolate through the subsoil and enter the water table, creating a polluted pool that degrades the natural water quality by altering its chemical composition When contaminated water is used for irrigation, the soil quality and crop health suffer.

Materials and Methods

The Mahad M.I.D.C. research area is situated on the Arabian Sea, south of Mumbai, in the coastal Kokan area of Maharashtra. The geographical coordinates of the chosen region are Latitude 18°6'12"N and Longitude 73°28'40"E, with an elevation above mean sea level (metres) of approximately 177.5 m. Water samples were collected at M.I.D.C. (Maharashtra Industrial Development Corporation) sites in Mahad, Raigad district. The study area contains a number of factories producing fertiliser, agrochemicals, acid, dyes, paints, machine tools materials, and resins. Fifteen water samples were collected and metals were determined using the required standards as per APHA (1998), Trivedy and Goel (1986) methodologies. AR grade chemicals and reagents are used. Double distilled water is used for the preparation of the reagents.

Results and Discussion

The physicochemical characteristics of water in Mahad MIDC, Maharashtra, varied over the course of the year (August-2018 to July-2019). Table 1 demonstrate the results of the water quality assessment.

Iron

During the study period the iron concentration in surface water ranged from 0.027 to 0.65, with a mean value of 0.083 mg l^{-1}. Similarly, the Al-Khuzaie *et al*. (2020) observed that the iron concentration ranged from 0.271-0.603 mg l^{-1} likewise the Iron concentration in Mula-Mutha river at Pune observed was 1.57 to 11.49 mg l^{-1}(Dnyandeo Gorakhe, 2020). Owing to leaching of industrial wastes during the rainy season and the natural occurrence of iron oxides in laterite soil, higher concentrations of iron in water were observed during the monsoon and winter (Thomas *et al.,* 2011).

Copper

Copper toxicity to marine life is determined by the alkalinity of the water, with lower alkalinities being more toxic to aquatic fauna (Train, 1979). The copper concentration in surface water ranged from BDL to 0.071 mg l^{-1}, with a mean of 0.059 mg L^{-1}, according to the report. Likewise, the copper was ranged from 0.0088ppm to 0.0716ppm in Almuthana Province, Iraq (Hussain Ali Shaheed, 2019), In addition to this the Matta Gagan (2020) reported the Copper concentration at all the study stations BDL in Bijnor District, Uttar Pradesh, India

Zinc

During the summer, the concentration of zinc in surface water ranged from 0.024 to 0.091 mg l^{-1}, with a mean value of 0.05 mg l^{-1}, likewise the concentration of Zn in Mahi Estury in Gujarat India was ranged from 0.02 mg l^{-1} to 0.63mg $L^{-1}$with mean value of 0.170 mg l^{-1}. Similarly, Pallavi Sharma (2020) found that the Zinc in water of Brahmhaputra Asam was ranged from 2 ppb to 270 ppb with an average of 46.91ppb. The zinc concentration was lower during the monsoon season due to the dilution effect of rain water and higher during the summer and winter due to water depletion leading to higher metal concentrations and concentration effect (Thomas *et al.,* 2011).

Manganese

Manganese concentrations in surface water ranged from 0.012mg l^{-1} to 0.091 mg l^{-1}, with a mean value of 0.042 mgl^{-1}, recently the Mn concentration analysed by the Mohana *et al*. (2020) found to have average values 0.605 mg/l and 0.526 mg/l during pre-monsoon and post-monsoon periods. Manganese concentrations in water are higher in the summer and gradually decrease before the winter season, according to the current analysis. Manganese compounds can be found in nature as a solid in the soil and as small particles in the water. These are normally deposited in the form of dust particles on the ground. Industrial practises and fossil fuel combustion increase manganese concentrations in the air Owing to anthropogenic activities such as industrial effluents, old plumbing, and household waste (Warmate, 2011), as well as discharge of adjacent industries such as tanneries, chemical processing, and a considerable volume of specific matter in the river, chromium was stored as adsorbed ions (Mandol *et al.,* 2011).

Nickel

Nickel is primarily used in the manufacture of stainless steel, nonferrous alloys, and super alloys, which are all directly emitted from the steel industry. Nickel concentration in surface water ranged from BDL to 0.35 mg l^{-1} with a mean value of 0.042 mg l^{-1}. Dnyandeo Gorakhe (2020) observed the Ni concentration in the range of 0.009 ppm to 0.59 ppm. Owing to the presence of water-soluble salts (Kumar *et al.,* 2001) and the leaching effect of heavy metals, the majority of water samples contain nickel concentrations in water above the allowable level for drinking (BIS, 1991; WHO, 1984). (Bharti *et al*., 2013). In general, a low pH favours the concentration of exchangeable and soluble nickel (Parth *et al.,* 2011).

Chromium

The variation of chromium in water ranged from BDL to 0.051 mg l^{-1} with a mean value of 0.034 mg l^{-1}. Similarly, the Dnyandeo Gorakhe (2020) analysed

Table 1. Month-wise metals concentration of surface water around Mahad MIDC, Maharashtra

Metal	Statistical	Data	August	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July
Fe(ppm)	Mean	0.083	0.118	0.069	0.071	0.065	0.0762	0.079	0.091	0.104	0.072	0.059	0.112	0.076
	Min.	0.027	0.056	0.046	0.042	0.034	0.046	0.051	0.061	0.046	0.027	0.036	0.042	0.055
	Max.	0.65	0.65	0.083	0.083	0.111	0.121	0.124	0.134	0.164	0.105	0.112	0.4	0.091
Cu(ppm)	Mean	0.059	0.05647	0.103	0.073	0.064	0.066	0.069	0.08	0.079	0.016	0.035	0.03	0.035
	Min.	BDL	BDL	BDL	0.034	BDL	0.034	0.034	0.034	0.03	BDL	BDL	BDL	BDL
	Max.	0.71	0.52	0.71	0.104	0.11	0.097	0.094	0.104	0.094	0.05	0.096	0.051	0.22
Zn(ppm)	Mean	0.050	0.047	0.048	0.053	0.057	0.051	0.05	0.05	0.048	0.051	0.047	0.046	0.05
	Min.	0.024	0.03	0.034	0.041	0.041	0.034	0.029	0.034	0.024	0.041	0.04	0.034	0.037
	Max.	0.091	0.075	0.06	0.063	0.085	0.079	0.091	0.074	0.085	0.062	0.079	0.063	0.071
Mn(ppm)	Mean	0.042	0.035	0.027	0.046	0.019	0.031	0.032	0.034	0.037	0.075	0.086	0.048	0.036
	Min.	0.012	0.023	0.019	0.013	0.012	0.015	0.017	0.019	0.023	0.062	0.081	0.021	0.024
	Max.	0.091	0.061	0.042	0.081	0.027	0.061	0.058	0.061	0.055	0.084	0.091	0.089	0.061
Ni(ppm)	Mean	0.040	0.034	0.035	0.032	0.036	0.03	0.028	0.035	0.053	0.052	0.049	0.054	0.041
	Min.	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	Max.	0.35	0.075	0.061	0.061	0.056	0.051	0.051	0.051	0.35	0.082	0.084	0.088	0.072
Cr(ppm)	Mean	0.034	0.026	0.023	0.061	0.026	0.028	0.028	0.031	0.031	0.043	0.041	0.036	0.029
	Min.	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.021	0.022	BDL	BDL
	Max.	0.51	0.05	0.046	0.51	0.052	0.055	0.044	0.06	0.061	0.084	0.081	0.061	0.054
Co(ppm)	Mean	0.010	0.004	0.007	0.006	0.005	0.009	0.012	0.013	0.011	0.013	0.028	0.007	0.003
	Min.	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	Max.	0.074	0.005	0.015	0.009	0.008	0.051	0.051	0.042	0.016	0.04	0.074	0.021	0.006

the metal concentration From Mula-Mutha River, Pune and reported that the concentration ranged from 0.096 mg l^{-1} to 0.762 mg l^{-1}.

Cobalt

During the period of one year the concentration of cobalt in surface water ranged from BDL to 0.074 mg l^{-1} with a mean value of 0.010 mg l^{-1}. Likewise, the study conducted by P. Mohana (2020) indicates average value of Cobalt concentration 0.011ppm in pre-monsoon and 0.088 ppm in post-monsoon similarly the Akansha Patel (2021) reported the range of Cobalt in ganga river from 10.50 µg l^{-1} to 20.77 µgl^{-1}.

Conclusion

According to the analytical results, the majority of the water samples contained heavy metal concentrations below the permissible limit, whereas nickel concentrations were above the permissible limit in water, as per BIS and WHO guidelines. However, this study stresses the importance of routine water quality monitoring to determine pollution activity on a regular basis such that effective management measures can be implemented in time to reduce pollution intensity.

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