Tuijin Jishu/Journal of Propulsion Technology
ISSN: 1001-4055
Vol. 44 No. 6 (2023)

An Experimental Investigation of Peenya industrial area Water Quality Index in Bangalore, Karnataka, South India

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Abstract: -Greater Bangalore is the fastest industrialization zone in India. In Bangalore, Peenya area is known for industries. Hence it has another name as Peenya Industrial Area. This area is famous for manufacturing automobile, electronic and chemical equipment parts. Hence maximum water consumption in Bangalore is at Peenya Industrial Area. Water used for washing of raw materials after and during production process will be discharged as effluents. Hence the effluents from the industry are reaching groundwater. In this paper an attempt is made to check the quality of drinking water by conducting test with respect to water quality index (WQI) and proportion of heavy metals in contaminated water. The value of water quality index obtained is 138.94. The obtained value comes under "Poor Water Category" as per water quality classification based on WQI value, which is not suitable for drinking purpose. The results of heavy metal analyses were compared with Bureau of Indian Standard (BIS) values. Almost all the water samples have concentration within the permissible limits or BDL. The reason for this might be due to closing and shifting of industries during recent years. Industries shifted from Peenya industrial area to Dabaspet industrial area in Tumkur District. Only in two places (sample number P1 and P10) the concentration of chromium (0.29 mg/lit and 0.34 mg/lit) is above the permissible limits. Hence it is not suitable for domestic purpose in above places.

Keywords*:Water Quality Index, Heavy Metals, Drinking Water, Domestic purpose, Permissible Values.*

1. Introduction

As per the vision of the visionaries, India should be converted from developing country to developed country. As a part of it, rapid industrialization is necessary in metropolitan cities. Hence in Bangalore, Peenya area is reserved as industrial belt which manufactures mechanical, electrical and chemical industries related missionaries and materials. During manufacturing various chemicals and heavy metals were required in presence of potable water as an accelerator. The wastewater generated from these industries during the above process has to be checked with drinking water as well as potable (domestic) water standards as per Water Quality Index Analysis (drinking water) and Bureau of Indian Standards (BIS) Guidelines (potable water).

Some of the researchers have done limited works in Peenya area to assess water quality, Ramesh et al., (2012) conducted groundwater quality assessment test in Peenya Industrial area and concluded that some of the tested bore wells contain hexavalent chromium and some of the waste discharge from the industry contains toxic lead.

Nagaraja Gupta and Sadashivaiah (2014) conducted water quality assessment in Peenya industrial area and concluded that 90% of the water is unfit for the drinking purpose due to rapid industrialization.

Ramakrishnaiahet al., (2009) assessed the ground water contamination and developed the table indicating WQI value versus water quality. Lower WQI value indicates excellent water quality and vice versa with higher WQI value. Water quality index can be calculated using equation 1 to 4.

$$W_i=\frac{wi}{\sum_{i=1}^{n} wi} \quad (1)$$

$q_i = (C_i / S_i) \times 100$ (2)

$SI_i = W_i . q_i$ (3)

$WQI = \sum SI_i$ (4)

From the above review of literature, it is found that some of the researchers analysed the quality of Peenya Industrial area discharge water, but none of the above paper has not done extensive study for assessing quality of drinking water as per water quality index and very few researchers highlighted one or two heavy metal impact on contaminated water. Hence this paper clearly analyses quality of Peenya industrial area discharge water for both drinking as per water quality index and potable(domestic) water from heavy metal analysis as per BIS.

2. Study area

Peenya industrial area situated in Peenya in Bangalore is in the State of Karnataka, South India established by Karnataka Small Industries Development Corporation in the year 1970s. The Peenya Industrial Area covers 40 sq. km with more than 2000 industries. For the present investigation 18 critical points were identified for water sampling locations which are indicated in study area map (Figure 1).

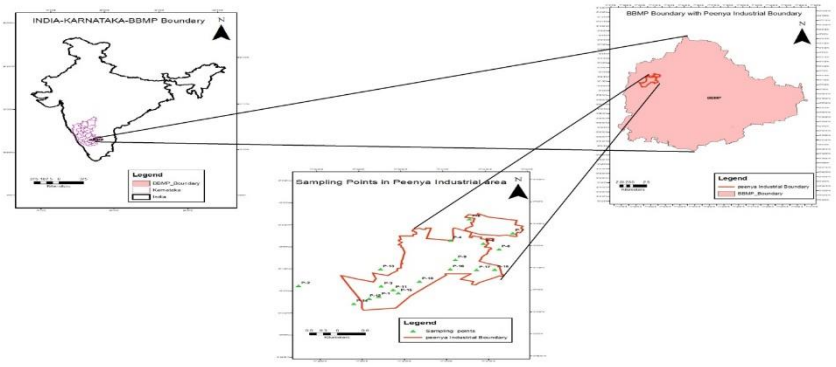

Figure 1Study area with sampling points

3. Methodology

A thorough reconnaissance survey was carried out by the researcher and critical disposal points were identified. Finally, 18 most affected water polluted areas were finalized for collection of water from bore wells. The collected samples were subjected to water quality analysis to determine pH, TH, calcium, magnesium, specific conductance (S), chloride, TDS, alkalinity, nitrate, iron, sulphate and sodium and also to determine the heavy metal concentration in water, cadmium, lead, nickel, mercury, zinc and chromium. The soluble salts water quality index was also determined by Ramakrishnaiah et al., (2009)

The values obtained for heavy metals in water, the obtained results were compared with the BIS.

4. Results and Discussions

Water tests were conducted in the laboratory as per BIS procedure and by using WQI equation corresponding values were determined. From laboratory tests on water, the following results were arrived.

$$WQI = \frac{\sum Qn.Wn}{\sum wi} = \frac{SI}{\sum wi} = \frac{131.344}{0.9453} = 138.944 \quad (5).$$

Table 2 indicates the actual drinking water results according to BIS and Table 3 indicates the actual potable (domestic) water test results of the present study and both the results were compared with BIS values. From standard specifications it was observed that (From Eq-5) WQI=138.94 and results falls in the category of poor drinking water standards as per Ramakrishnaiah et al., (2009) (Table- 1). Table -3 values of the study area are compared with BIS recommend values and it is very clear that most of the heavy metal values have concentration within the permissible limits or BDL. The reason for this might be due to closing and shifting of industries during recent years. Only in two places the chromium (Hexavalentform) has concentration above the permissible limits in Sample number P1 and P10 with values of 0.29 mg/lit and 0.34 mg/lit respectively. Industries shifted from Peenya industrial area to Dabaspet industrial area in Tumkur district. The cause for the excess chromium contamination might be due to the presence of the electroplating industries. This may be due to heavy industrialization and disposal of industrial wastewater into open drainage without proper treatment. Hence it is also observed that water is not only poor for drinking but also not suitable for potable (domestic) purpose.

Table 1.Water quality classification based on WQI value (Ramakrishnaiah et al., 2009).

WQI Value	Water Quality
<50	Excellent
50-100	Good water
100-200	Poor water
200-300	Very poor water
>300	Water unsuitable for drinking

Table 2.Drinking water quality standards recommended by BIS and Relative weight

Chemical Parameters	Indian standards(BIS10500-1991)	Weight (w_i)	Average values	Relative weight (W_i)	Quality rating scale (q_i)	Sub-index (SI)
pH	6.5-8.5	4	8.24	0.1081	96.94	10.48
Total Hardness (TH) as CaCo3.	300 (mg/lit)	2	779	0.0540	259.67	14.02
Calcium as Ca.	75 (mg/lit)	2	278	0.0540	370.67	20.01
Magnesium as Mg.	30 (mg/lit)	2	120	0.0540	400	21.6
Specific Conductance(S).	500 µhmos/cm	2	1348	0.0540	269.6	14.56
Chloride(Cl)	250 (mg/lit)	3	366	0.0810	146.4	11.86
Total Dissolved Solids (TDS)	500 (mg/lit)	4	1018	0.1081	203.6	22
Alkalinity	250 (mg/lit)	3	323	0.0810	129.2	10.47
Nitrate as NO3.	45 (mg/lit)	5	8	0.1351	17.72	2.4
Iron(Fe)	0.3 (mg/lit)	4	0.055	0.0810	18.33	1.49

Sulphate (SO4)	200 (mg/lit)	4	53	0.0810	26.5	2.14
Sodium (Na)	200 (mg/lit)	2	12	0.0540	6	0.324
		$\sum w_i=37$		$\sum W_i=0.9453$		$\sum SI=131.344$
Water Quality Index (WQI) of the study area=138.94						

Table 3.Analysis data of Heavy Metals in ground water of the study area

Sl No	Sample Numbers	Cadmium (mg/lit)	Lead (mg/lit)	Nickel (mg/lit)	Mercury (mg/lit)	Zinc (mg/lit)	Chromium (mg/lit)
Permissible Limits as per BIS-10500:1991)		0.01	0.05	0.20	0.001	15	0.05
1	P1	0.006	< 0.010	0.014	BDL	0.01	0.29
2	P2	BDL	<0.010	0.003	BDL	0.013	0.01
3	P3	BDL	<0.010	BDL	BDL	0.005	BDL
4	P4	BDL	<0.010	BDL	BDL	0.14	BDL
5	P5	BDL	<0.010	BDL	BDL	0.013	BDL
6	P6	BDL	<0.010	0.009	BDL	0.022	BDL
7	P7	BDL	<0.010	BDL	BDL	0.016	BDL
8	P8	BDL	<0.010	0.011	BDL	0.011	BDL
9	P9	0.002	<0.010	0.004	BDL	0.282	BDL
10	P10	0.008	<0.010	0.013	BDL	0.023	0.34
11	P11	BDL	<0.010	0.007	BDL	0.024	0.011
12	P12	BDL	<0.010	0.005	BDL	0.012	BDL
13	P13	BDL	<0.010	BDL	BDL	0.011	BDL
14	P14	BDL	<0.010	0.01	BDL	0.02	0.007
15	P15	BDL	<0.010	BDL	BDL	0.238	BDL
16	P16	0.002	<0.010	BDL	BDL	0.057	BDL
17	P17	BDL	<0.010	BDL	BDL	0.005	0.006
18	P18	BDL	<0.010	0.007	BDL	0.012	BDL

5. Conclusion:

From the above investigation, the following conclusions were drawn.

1. From WQI analysis, it is found that all water samples collected in Peenya industrial area is not good for drinking purpose.

2. From heavy metal analysis, it is found that heavy metal concentration exceeds the BIS limits in two water samples (P1 and P10). Hence that location water is also not fit for potability (domestic).

3. A proper waste disposal as well as waste segregation is to be managed in each industry to minimize accumulation of heavy metals in disposed wastewater.

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