# ASSESMENT OF WATER QUALITY IN PEENYA INDUSTRIAL AREA, BANGALORE

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## Abstract

The rapidity of industrialization that has recently become the need of the hour, for a developing country like India has *turned into a major source of groundwater contamination. Huge inputs of pollutants from the industries have been taking the pollutant levels beyond the prescribed tolerable limits. The industries that induce the pollutants into the surface and groundwater sources from their activities do not strictly regulate their pollutant to safe limits.*

*Many industries discharge their effluents without any proper treatment into nearby open pits or pass them through unlined channels, which move towards the low lying depressions on land, resulting in the contamination of groundwater and surface water sources. The industrial effluents, if not treated to remove or bring pollutant concentration level below standards specified, can pollute and cause serious damage to the surface and groundwater resources.*

*The present study aims at evaluating the chemical characterization of Surface and Ground-water present in Peenya industrial area, Bangalore city in India. Surface and Groundwater samples from 40 distinct locations in the industrial area were collected. Analytical procedures as described in the Standard methods for the examination of water and wastewater were implemented for chemical analysis of these samples and the results were compared with the Bureau of Indian Standards (IS 10500) guideline values for potable water, in order to evaluate the possibility of health hazards in the study area.*

*The results reveal that most of the study area is highly polluted, because of the excessive concentration of one or more water quality parameters such as pH, Total Hardness, Total Dissolved Solids, Dissolved Oxygen, Salinity, Alkalinity, Acidity and Electrical Conductivity. It is evident that more than 50 percent of water samples are non potable as per Bureau of Indian standards (IS 10500).*

***Keywords:*** *Industrial area, Pollutants, Chemical Characteristics, BIS standards, Potability.*

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## 1. INTRODUCTION

The industrialization has become essential for the economical development of the country like India. The major source for the water pollution is the effluents released from the industries, which are percolated into ground through damaged effluent storage tanks, damaged pipe lines and channels conveying effluents to disposal points or treatment plants. If effluents are discharged on to open fields

Some industries which are not having effluent treatment plants are disposing their effluents into public sewers or open land in their premises itself. This activity of the industries is increasing the underground water pollution. Some industries dump their solid waste in open fields, which on decomposition releases the lechate which percolates into ground causing ground water pollution.

In the study area considered, peoples are using contaminated water for various purposes and are facing different health problems. Hence, the present study aims at assessment of water quality in the area considered and suggesting mitigate measures for the problems related to water pollution.

## 2. DETAILS OF STUDY AREA

### 2.1 Location

Bangalore city lies between Latitude $12^0 52^1 21^{11}$ to $13^0 6^1 0^{11}$ and East Longitude $77^0 0^1 45^{11}$ to $77^0 32^1 25^{11}$ covering over an area of approximately 400 sq.km. The study area taken, that is Peenya Industrial area, is covered in part of the Survey of India Topo sheet No. 57 H/9. The area covering about 40 sq.km lies to the Northern part of Bangalore city and houses more than2100 industries dominated by chemical, leather, pharmaceutical, plating, polymer and allied industries. This industrial area was established in late 1970s.

## 2.2. Details of Sampling Points

- Forty sampling points were selected in the study area, based on the hazardous ambient environment condition and the activities taking place around it, to carry out studies.
- Out of 40 samples collected 34 samples are from sub-surface source (Bore wells and hand pumps, ) and samples from No. 35 to 40 i.e., 6 samples are from surface source (Tanks in study area).
- The details of co-ordinates of each of the forty sampling points is as shown below**:**

LOCATIONS OF SAMPLING SITES

| Sample station | Latitude | Longitude |
|---|---|---|
| 1 | 13◦02'40.12"N | 77◦ 31' 30.62"E |
| 2 | 13◦02'21.07"N | 77◦ 31' 36.24"E |
| 3 | 13◦02'17.31"N | 77◦ 31' 50.09"E |
| 4 | 13◦01'25.55"N | 77◦ 31' 20.48"E |
| 5 | 13◦02'07.11"N | 77◦ 30'30.56 "E |
| 6 | 13◦02'11.73"N | 77◦ 30'35.64 "E |
| 7 | 12◦59'19.31"N | 77◦ 29' 39.12"E |
| 8 | 12◦59'23.24"N | 77◦ 29'38.03"E |
| 9 | 13◦00'38.78"N | 77◦ 30'24.23"E |
| 10 | 13◦00'30.29"N | 77◦ 30'19.99"E |
| **Sample station** | **Latitude** | **Longitude** |
| 11 | 13◦00'30.03"N | 77◦ 30'13.78"E |
| 12 | 13◦00'55.45"N | 77◦ 30'17.34"E |
| 13 | 13◦00'50.25"N | 77◦ 30'21.80"E |
| 14 | 13◦00'33.65"N | 77◦ 30'14.86"E |
| 15 | 13◦01'30.49"N | 77◦ 31'05.46"E |
| 16 | 13◦01'25.79"N | 77◦ 31'05.28"E |
| 17 | 13◦02'16.39"N | 77◦ 31'15.33"E |
| 18 | 13◦02'03.43"N | 77◦ 30'44.29"E |
| 19 | 13◦01'39.08"N | 77◦ 31'20.01"E |
| 20 | 13◦00'34.43"N | 77◦ 31'29.93"E |
| 21 | 13º 01' 23.43"N | 77º 29' 54.29"E |
| 22 | 13º 01' 63.31"N | 77º 29' 53.75"E |
| 23 | 13º 01' 00.27"N | 77º 29' 54.49"E |
| 24 | 13º 01' 11.38"N | 77º 30' 03.09"E |
| 25 | 13º 06' 58.70"N | 77º 30' 26.73"E |
| 26 | 13º 02' 25.10"N | 77º 30' 44.40"E |
| 27 | 13º 02' 20.65"N | 77º 30' 46.40"E |
| 28 | 13º 00' 42.33"N | 77º 30' 30.51"E |
| 29 | 13º 01' 20.14"N | 77º 30' 40.92"E |
| 30 | 13º 00' 48.08"N | 77º 30' 52.52"E |
| 31 | 13º 01' 11.76"N | 77º 31' 28.01"E |
| 32 | 13º 02' 33.79"N | 77º 31' 52.78"E |
| 33 | 13º 02' 14.20"N | 77º 31' 42.01"E |
| 34 | 13º 02' 19.19"N | 77º 31' 39.72"E |
| 35 | 13º 02' 19.33"N | 77º 32' 03.53"E |
| 36 | 13º 02' 25.89"N | 77º 31' 18.24"E |
| 37 | 13º 02' 41.27"N | 77º 31' 16.39"E |
| 38 | 13º 00' 46.51"N | 77º 29' 05.12"E |
| 39 | 12º 59' 20.78"N | 77º 29' 21.11"E |
| 40 | 12º 59' 27.43"N | 77º 29' 35.91"E |

## 2.3. Topography

Topography of Bangalore is a ridge trending NNW–SSE. The Western part of the area is characterized by a dissected topography with ridges and valleys exposing hard rock, due to occurrence of rapid head-ward erosion of the Arkavathi River and its tributaries.

The eastern part of the city is a level plain. The western part of the drainage of this ridge flows and joins the Arkavathi while the Eastern plains drain towards the South Pinakini**.** The highest point in the city is 924 m above Mean Sea Level near Triveni Engineering Works (Peenya Industrial Area) and the lowest around 800 m near Jevarana Doddi (Bangalore University).[20]

## 2.4 Climate

The mean annual rainfall of Bangalore City is 859.6 mm. Most of it is received during the southwest monsoon between June and September and during northwest monsoon. Statistically September is the wettest and January the driest month of the year.

Air temperature varies between a minimum of 14°C and maximum of 34°C. The lowest temperature ever recorded was 7.8°C and the highest 38.9°C. April is the hottest month of the year while December to January marks the coldest period. The lowest relative humidity of 30% is noticed during the month of March and the highest between June and October, reaching up to 85%.

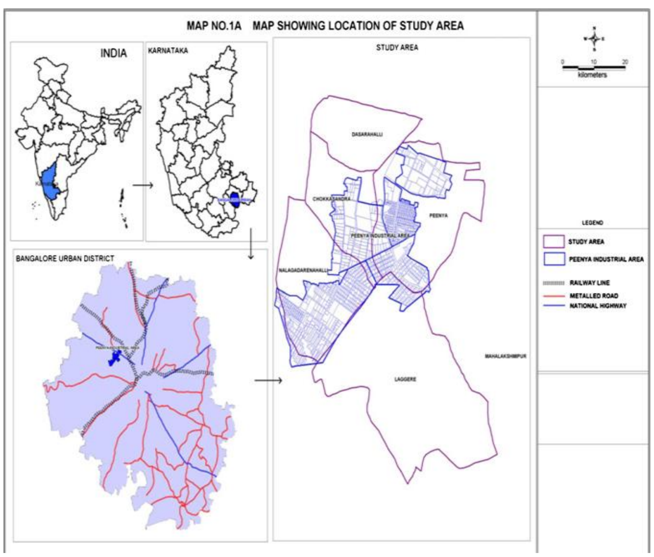
Surface winds have seasonal character with westerly components predominating in July and easterly components in

October. High-wind-speed averages of about 17 km/h are observed during July under westerly winds and low-wind-speed averages of 8 to 9 km/h between April and October.

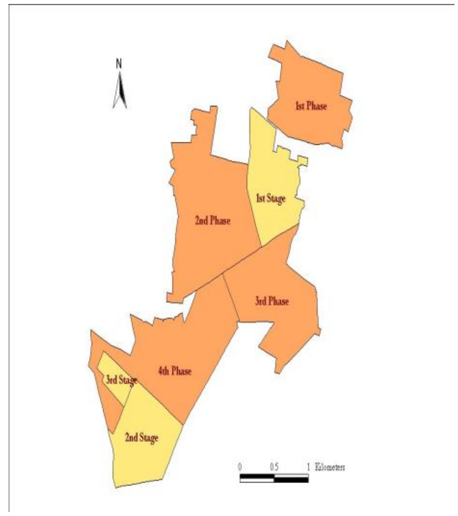
### 2.5. Soil and Drainage

Geologically Peenya Industrial Area belongs to Achaean era. Gneiss, granite and dykes are the major rock types, the former two being found in varying depths. The area is nearly evenly flat with only gentle slopes and valleys. Predominantly red soil is found in the area overlaying granite and gneiss from which it is derived. The soil is moderately to severely eroded and excessively drained. It varies from gravelly to sandy with some clay here and there.

The drainage pattern is governed by granitic ridge, running north-northeast to south-southeast almost through the middle of the taluk. The eastern side of the drainage is made up of a network of nallas, flowing generally from west to east with storage tanks along the path, ultimately feeding the South Pinakini River on the western side. The western *nallas* generally flow from east to west, draining off into Arkavati River.[13]




LOCATION OF STUDY AREA




LAYOUT OF PEENYA INDUSTRIAL AREA

| | |
|---|---|
| COORDINATES: | **Latitude : $12^0 52^1 21^{11}$ to $13^0 6^1 0^{11}$**<br>**Longitude : $77^0 0^1 45^{11}$ to $77^0 32^1 25^{11}$** |
| COUNTRY | INDIA |
| STATE: | KARNATAKA |
| CITY: | BANGLORE |
| TIME ZONE: | IST (UTC+5:30) |

### 3. METHODOLOGY

The parameters such as pH and electrical conductivity, D.O were determined in the field at the time of sample collection. The other characteristics including metals were determined immediately in the lab. as per the standard methods for examination of water and wastewater (APHA 2002).The results obtained were evaluated in accordance with the norms prescribed under 'Indian Standard Drinking Water Specification IS 10500 (1991) of Bureau of Indian Standards (1991).

### 4. RESULTS AND DISCUSSIONS

The samples collected from both surface and sub-surface sources are analyzed by using standard procedure for water and wastewater (APHA 2002).The results obtained were evaluated in accordance with the norms prescribed under 'Indian Standard Drinking Water Specification IS 10500 (1991) of Bureau of Indian Standards (1991).

The obtained results are tabulated in tables 1 and 2 shown below. The results obtained are compared with the allowable values prescribed by IS 10500 and the results are graphically represented as shown in figures.1-10.

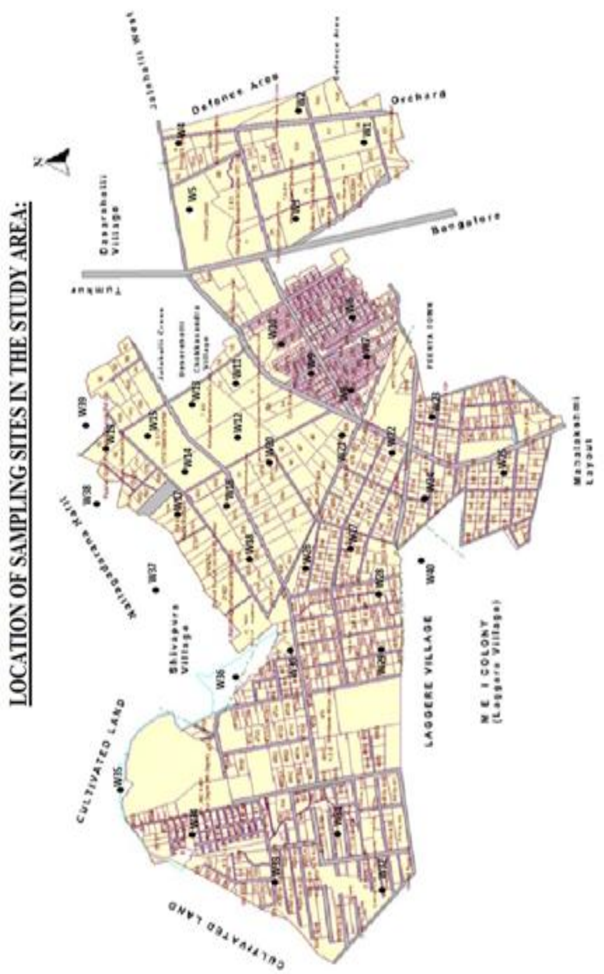



**Table 1** Results of chemical analysis of sub-surface water samples

| Sample No. | $P^H$ | Turbidity, NTU | Total Hardness mg/ltr. as | ACIDITY | T.D.S as mg/ltr. | D.O in mg/ltr. | Conductivity milli mhos |
|---|---|---|---|---|---|---|---|
| 1 | 7.4 | 1 | 556 | 48 | 836 | 0.2 | 2.25 |
| 2 | 6.92 | 1.5 | 568 | 100 | 960 | 0.5 | 2.6 |
| 3 | 7.99 | 1.2 | 284 | 24 | 165 | 2.35 | 5.6 |
| 4 | 7.3 | 1 | 784 | 68 | 722 | 3.26 | 19.1 |
| 5 | 6.85 | 1.4 | 548 | 92 | 118 | 4.1 | 33.6 |
| 6 | 10 | 0.6 | 240 | 0 | 257 | 4.2 | 77.3 |
| 7 | 7.46 | 0.9 | 684 | 28 | 295 | 4.1 | 9.88 |
| 8 | 7.34 | 0.6 | 768 | 56 | 104 | 5.1 | 28.4 |
| 9 | 7.78 | 1 | 400 | 48 | 590 | 4.9 | 15.9 |
| 10 | 6.2 | 1.4 | 748 | 152 | 336 | 4.9 | 99.1 |
| 11 | 7.2 | 6 | 632 | 92 | 104 | 5.1 | 28.5 |
| 12 | 6.75 | 1.6 | 1128 | 84 | 155 | 4.9 | 42.3 |
| 13 | 6.95 | 0.8 | 1220 | 92 | 161 | 4.7 | 42.6 |
| 14 | 7.05 | 0.3 | 1024 | 88 | 116 | 4.4 | 30.5 |
| 15 | 6.9 | 0.7 | 708 | 52 | 455 | 4.5 | 25.9 |
| 16 | 6.5 | 0.2 | 1016 | 76 | 118 | 5 | 31.1 |
| 17 | 6.85 | 0.75 | 620 | 52 | 750 | 4.5 | 20.5 |
| 18 | 7.1 | 45 | 460 | 32 | 605 | 4.2 | 17.3 |
| 19 | 7.7 | 0.5 | 600 | 80 | 760 | 5.2 | 20.5 |
| 20 | 6.65 | 0.65 | 1440 | 124 | 140 | 3.3 | 37.5 |
| 21 | 7.4 | 0.85 | 620 | 80 | 825 | 4.2 | 6.4 |
| 22 | 7.05 | 0.55 | 680 | 68 | 106 | 4 | 6 |
| 23 | 7.09 | 0.65 | 688 | 72 | 885 | 3.9 | 5.9 |
| 24 | 7.2 | 0.45 | 664 | 64 | 890 | 4.1 | 5.9 |
| 25 | 7.89 | 0.36 | 216 | 20 | 215 | 4.2 | 6.1 |
| 26 | 7.9 | 0.55 | 200 | 20 | 164 | 4.1 | 6.1 |
| 27 | 6.94 | 0.65 | 800 | 84 | 829 | 3.7 | 6.9 |
| 28 | 7.09 | 0.25 | 504 | 52 | 576 | 4.2 | 5.9 |
| 29 | 7.45 | 0.35 | 616 | 60 | 862 | 3.9 | 6.3 |
| 30 | 7.2 | 0.45 | 260 | 24 | 108 | 4.1 | 6 |
| 31 | 6.9 | 0.7 | 520 | 48 | 551 | 4.1 | 6.6 |
| 32 | 6.95 | 0.85 | 728 | 68 | 683 | 4.2 | 6.3 |
| 33 | 7.13 | 0.95 | 840 | 52 | 891 | 5 | 4.6 |
| 34 | 7.25 | 1 | 820 | 80 | 828 | 5.6 | 4.8 |
| 35 | 7.25 | 7 | 740 | 28 | 157 | 3.5 | 41.3 |
| 36 | 7.25 | 8 | 1260 | 64 | 185 | 3.6 | 48.6 |
| 37 | 7.2 | 10 | 1920 | 128 | 140 | 2.2 | 35.8 |
| 38 | 7.1 | 12 | 480 | 24 | 368 | 4.3 | 4.1 |
| 39 | 7.6 | 15 | 612 | 36 | 705 | 5.2 | 6.6 |
| 40 | 6.2 | 13 | 2188 | 180 | 121 | 5.3 | 5.2 |

**Table 2** Results of chemical analysis of sub-surface water samples

| Sample No. | Salinity | Alkalinity as mg/ltr | Temp $^0C$ | Chloride as mg/ltr | Copper mg/ltr | Iron mg/ltr |
|---|---|---|---|---|---|---|
| 1 | 1.19 | 128 | 27.5 | 296 | 0.006 | 0.17 |
| 2 | 1.35 | 132 | 27.8 | 354 | 0.009 | 0.172 |
| 3 | 0.23 | 52 | 27.5 | 62 | 0 | 0.09 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | 0.95 | 124 | 28.2 | 212 | 0.022 | 0.06 |
| 5 | 1.16 | 140 | 28.2 | 176 | 0.003 | 0.164 |
| 6 | 4.01 | 186 | 28.4 | 200 | 0.745 | 387 |
| 7 | 0.39 | 64 | 28.3 | 134 | 0.013 | 0.4 |
| 8 | 1.36 | 110 | 28.4 | 378 | 0.006 | 0.175 |
| 9 | 0.79 | 88 | 28.4 | 224 | 0.005 | 0.55 |
| 10 | 4.88 | 56 | 28.4 | 1232 | 0.63 | 0.313 |
| 11 | 1.35 | 128 | 28.4 | 442 | 0.005 | 0.35 |
| 12 | 2.01 | 128 | 28.4 | 696 | 0.006 | 0.17 |
| 13 | 2.44 | 148 | 28.4 | 880 | 0.005 | 3.9 |
| 14 | 2.22 | 128 | 28.4 | 420 | 0.013 | 0.244 |
| 15 | 1.54 | 96 | 28.4 | 400 | 0.02 | 0.3 |
| 16 | 1.29 | 56 | 28.4 | 568 | 0.01 | 0.08 |
| 17 | 1.55 | 100 | 29.6 | 256 | 0.004 | 0.075 |
| 18 | 0.96 | 104 | 28.3 | 176 | 0.007 | 0.175 |
| 19 | 0.77 | 102 | 28.3 | 276 | 0.006 | 0.1 |
| 20 | 0.96 | 130 | 28.4 | 650 | 0.009 | 0.27 |
| 21 | 1.71 | 80 | 28.4 | 278 | 0.009 | 0.215 |
| 22 | 1.06 | 120 | 28.4 | 398 | 0.01 | 0.124 |
| 23 | 1.35 | 176 | 28.4 | 322 | 0.01 | 0.289 |
| 24 | 1.14 | 336 | 28.4 | 310 | 0.011 | 0.25 |
| 25 | 1.16 | 204 | 28.4 | 102 | 0.013 | 0.65 |
| 26 | 0.29 | 72 | 28.5 | 70 | 0.024 | 3 |
| 27 | 0.21 | 144 | 28.4 | 292 | 0.03 | 4.2 |
| 28 | 1.04 | 116 | 28.4 | 186 | 0.015 | 0.5 |
| 29 | 0.76 | 104 | 28.4 | 372 | 0.03 | 0.601 |
| 30 | 1.12 | 60 | 28.3 | 76 | 0.029 | 0.35 |
| 31 | 0.15 | 64 | 28.4 | 144 | 0.01 | 0.572 |
| 32 | 0.7 | 124 | 28.4 | 216 | 0.03 | 0.605 |
| 33 | 0.86 | 360 | 28.3 | 344 | 0.009 | 0.397 |
| 34 | 1.14 | 156 | 28.3 | 300 | 0.004 | 0 |
| 35 | 1.97 | 114 | 28.4 | 826 | 0.014 | 6 |
| 36 | 2.44 | 116 | 28.4 | 1000 | 0.006 | 4 |
| 37 | 1.69 | 110 | 28.4 | 578 | 0.5 | 108 |
| 38 | 0.45 | 136 | 28.2 | 148 | 0.155 | 37 |
| 39 | 0.89 | 100 | 28.2 | 378 | 0.023 | 5 |
| 40 | 1.15 | 196 | 28.2 | 314 | 0.002 | 7 |

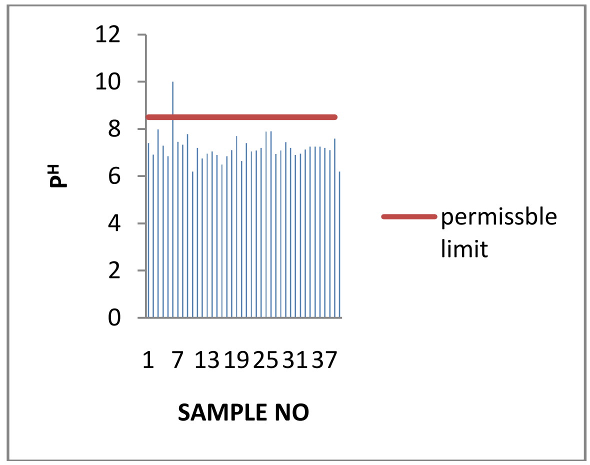



**Fig.1**

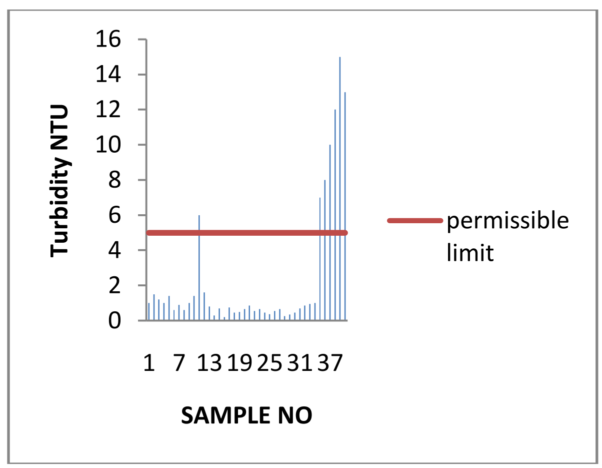



Fig.2

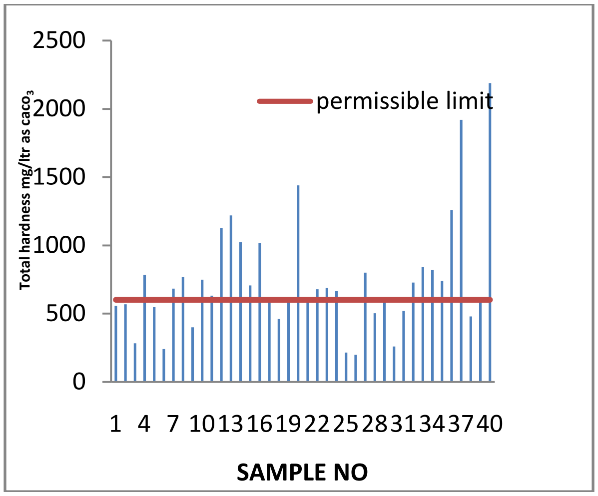



Fig.3

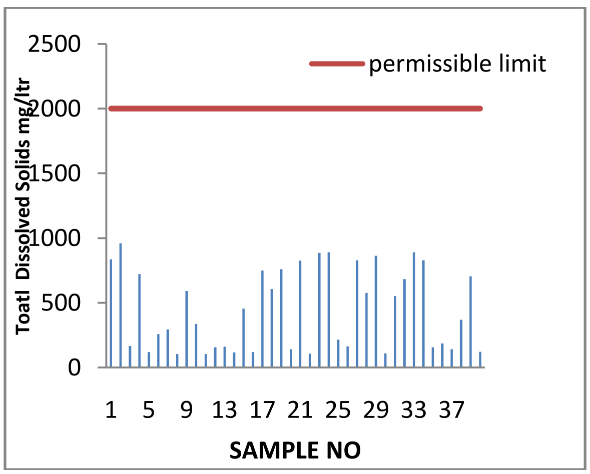



Fig.4

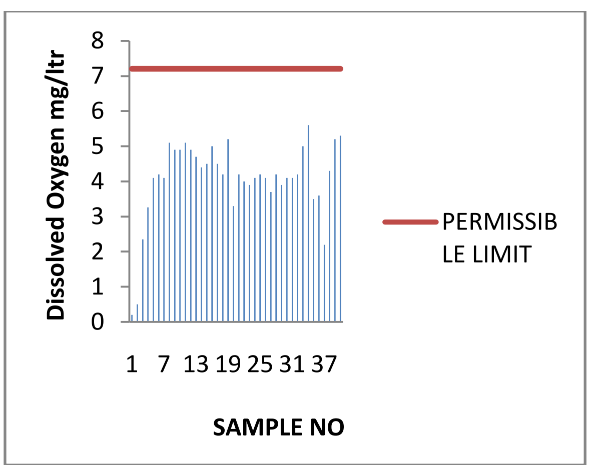



Fig.5

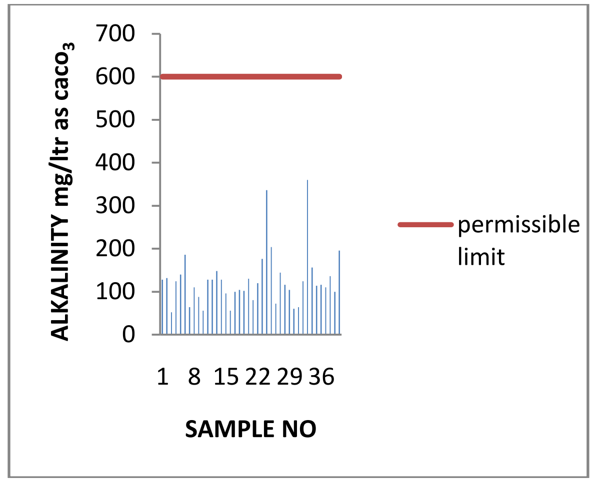



Fig.6

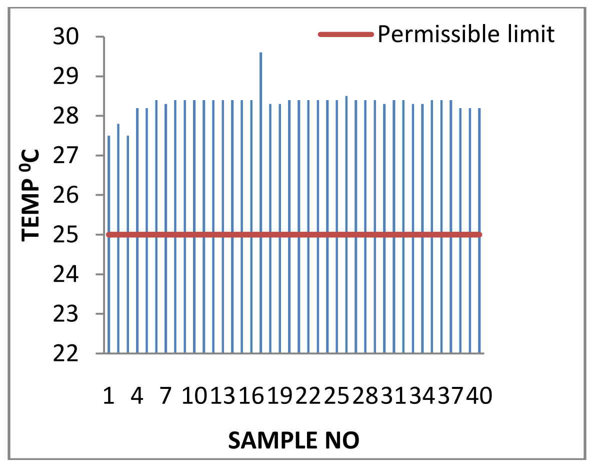



Fig.7

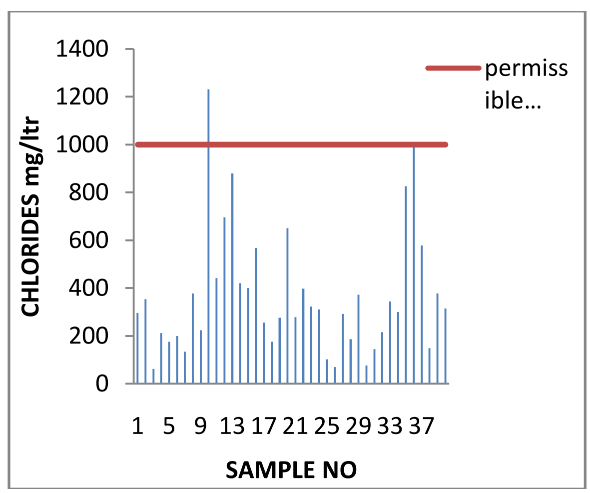



Fig.8

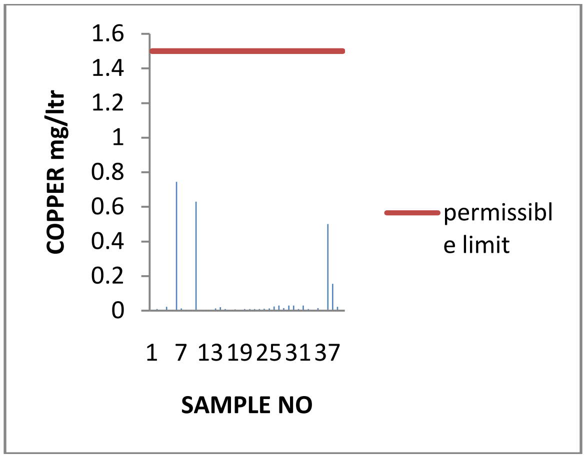



**Fig.9**

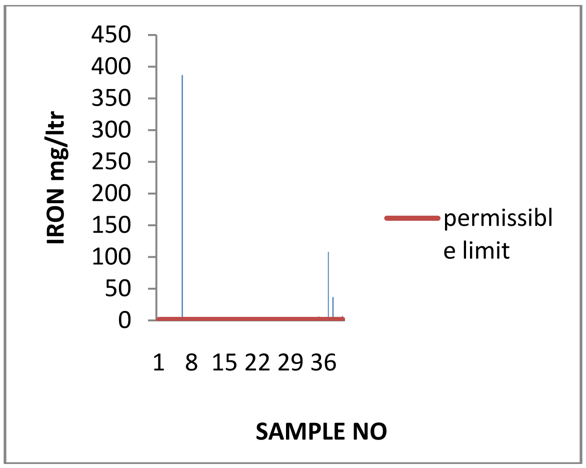



**Fig.10**

## 5. DISSCUSSIONS

Thirty four groundwater samples (1 to 34) were collected from the bore-wells which included hand pumps, piped water supply schemes and six other samples were collected from ponds and lakes in and around the study area (35 to 40).The results of the chemical analysis are presented in Table. 1 and Table 2.Where as table 3 shows the critical parameters along with the permissible limits for these parameters.

Out of the 40 samples analyzed for chemical characteristics, 36samples (90%) were found to be Non-potable as per prescribed limits from IS:10500. At least more than one parameters such as Odor, Taste, pH, turbidity, D.O, Total Hardness, Acidity, Total dissolved solids, Salinity, Electrical conductivity, Alkalinity, Temperature, Chlorides, Copper, Iron .The main constituents constituting for the non -portability of the samples are total hardness, chlorides, iron ,l which accounted for 60% and 70% of unsafe samples respectively.

The reasons pollution and effects of various parameters are discussed below .

**Table 3** Critical parameter of water as per IS : 10500

| Sl. No. | Parameter | Desirable limit | Permissible limit | Number of samples exceeding Permissible limits | Percentage of samples Exceeding the limits.(%) |
|---|---|---|---|---|---|
| 1 | Odor | Agreeable | Agreeable | 6 | 15 |
| 2 | Taste | Agreeable | Agreeable | 40 | 100 |
| 3 | PH | 6.5-8.5 | No Relaxation | 1 | 2.5 |
| 4 | Turbidity, NTU, max | 1 | 5 | 6 | 15 |
| 5 | Total Hardness as CaCo3 | 200 | 600 | 25 | 62.5 |
| 6 | Alkalinity | 200 | 600 | 0 | 0 |
| 7 | Dissolved solids | 500 | 2000 | 0 | 0 |
| 8 | Chlorides | 250 | 1000 | 2 | 5 |
| 9 | Iron | 0.3 | 1 | 10 | 25 |
| 10 | Copper | 0.05 | 1.5 | 0 | 0 |
| 11 | Dissolved Oxygen | 5 | 7.2 | 0 | 0 |

- **Odor** of sub surface water is agreeable but 6 surface water samples out of 40 samples are non-agreeable due to decomposition of organic matter and not fit for domestic and other purpose.

- **Taste** at all point of sample collection (100%) is non-agreeable hence objectionable.

- **$P^H$** is ranging from 6.5-8.5 for normal portable water or drinking water but 2.5% of tested sample is exceeding the limit. It indicates that water not suitable for domestic purpose. $P^H$ also indicates suitability water or waste water can be used for domestic purpose or for irrigation purpose. But this 2.5% can't be used for both purposes because of high $P^{H.}$. Only 1 sample out of 40 samples has lower and only 1 sample out of 40 samples has higher $P^H$ which indicates that water sample are bitter in taste hence unfit for drinking purpose and higher ph in water causes cancer in human beings.

- **Turbidity** 6 out of 40samples (15%) as higher value than limit which causes undesirable taste and odor in water. Turbidity measurements help to find amount of chemicals for waste water treatment purpose.

- **Total hardness** constituting to 60% of non portability of samples has shown maximum, minimum and average concentrations of 2188, 200 and 744.6mg/l as CaCO3 respectively. The High value of hardness in the study area studied can definitely be attributed to the disposal of untreated or improperly treated sewage and industrial wastes.

  Hard water affects the water pipes and boilers by forming scales inside them and corrodes them. Continues compulsion of hard water affects the cardiovascular system and causes heart attacks in human beings. But if we complete remove hardness from water it will be flat taste which coverts water into acidic in nature and causes corrosion. Hard water when mixed with soap forms precipitate adheres to surface of tubes, sinks, utensils, stain clothes & dishes.

- **Chlorides** as maximum limit of 1000mg/liter out of 40 samples 2sample exceeds this limit (5%). Chlorides when exceeds 250mg/liter imparts salt to water, corrode concrete. When water containing magnesium chloride causes corrosion and problems in boilers and presence of chlorides requires desalting which is not cost effective.

- **Dissolved Oxygen** as a limit of 5 to 7.2 mg/ltr and not even single sample is crossing the limit decreases due the decomposition of organic matter in water. Due to decreases of D.O in water its does not taste good to drink and its effects the waste water treatment. High valve of D.O in water causes corrosion of steel & iron.

- **Acidity** is water is high due to the industrialization. High acidity effects the aquatic life in water and corrosion of reinforced steel when water used for concrete, this high value of acidity make water unfit for drinking. And by knowing the acidity value it is easy to determine method for removal of carbon-di-oxide from water.

- **Total Dissolved Solids** as maximum limit of 2000mg/liter not even one exceeds this limit but its minimum limit is 500mg/liter when this limit is exceeds water palatability decreases and may cause gastro intentional irritation. T.D.S causes aesthetically displeasing color, taste and odor. But when T.D.S exceeds 3000mg/liter causes distress in livestock. By knowing T.D.S value we can indentify if the water can be used for drinking, agriculture and industrial purpose. It reduces the growth of oxygen producing plant in water.

- **Alkalinity** as limit of 600mg/liter causes bitter taste to water, corrosion of pipes and water distribution system. Alkalinity in water is caused by the release of waste water containing high caustic from industries.

- **Copper** as limit of 0.05 to 1.5 mg/liter out of 40 samples not even one sample exceeds limit. Copper is extremely used in electrical equipment and industrial machinery. If copper limit is exceeds the limit causes astringent taste, discoloration and corrosion of pipes, fittings and utensils. In human beings it affects mucous membrane, Chronic copper causes Wilson's diseases. Long term exposure to copper cause irritation of nose, mouth, eyes and headaches

- **Iron** as limit of 0.3 to 1 mg/liter 10out of 40 samples (25%) is exceeding maximum limit. Iron imparts both color and taste to drinking water and iron is required in water within permissible limit for growth of children and for human beings. But if iron exceeds the limit it imparts bad taste and color to drinking water which is aesthetically displeasing which have adverse affect on domestic usage and water supply structures. Iron is important to human being for blood but if the quantity exceeds the limit it will be toxic to human health.

## 6. CONCLUSIONS

The analysis of groundwater and the surface water samples from the peenya industrial area has shown that almost 90% of the samples are unfit for drinking purpose. The analyzed data clearly indicates that the groundwater is getting polluted at an alarming rate due to rapid industrialization. The investigations along with the oral discussions held with the health centre officials and general public of the area, clearly points out that the serious contamination of the groundwater and surface water in the vicinity of the industries and the ill-health faced by the localities. From the perspective of improving the quality of groundwater and surface water in the area and protecting the people from the troubles of groundwater and surface water contamination, and it is absolutely essential to initiate measures to check the pollution of industrial effluents through strict enforcement of legislation for industries, setting up effluent treatment plants.

Replacing of the damaged pipelines and lining of sewer drains is necessary to prevent the leakage of sewage in pipes and seepage through unlined channels and to prevent the mixing or leaking of sewage with groundwater. Water treatment facility shall be designed in order to provide potable water to the residents of the area. To meet the ever increasing need of Potable groundwater and surface water, the best way is to collecting the groundwater by protecting it from pollution and augmenting it with the groundwater resources by recharging it through rainwater harvesting.

This study is carried out during pre monsoon season. Further this study can also carried out during monsoon and post monsoon also.

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