TITLE OF THE PROJECT
Assessment of water quality from Peerwadi well of Uran Beach, Dist - Raigad

FINAL PROJECT REPORT
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University Grants Commission (UGC)
Bahadur Shah Jafar Marg,
New Delhi-110002
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A Scientific Research Report prepared & submitted by Mrs. R. F. Inamdar, Associate Professor in Chemistry, Karmaveer Bhaurao Patil College, Vashi, Navi Mumbai. (M.S)

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Mrs. R. F. Inamdar
(Principal Investigator)
Declaration

I Mrs. R.F. Inamdar hereby declare that Final Project Report of the Minor Research project entitled “Assessment of water quality from Peerwadi well of Uran Beach Dist.: Raigad.” submitted to the University Grant Commission Bahadur Shah Zafar Marg. New Delhi – 110002, is a bonafied work done by me in the laboratory of Karmaveer Bhaurao Patil College, Vashi, Navi Mumbai, and no part of this has framed for the award of any Degree, diploma or other similar titles of other organization or university.

Mrs. R. F. Inamdar
(Principal Investigator)

Ref.: - Assessment of water quality from Peerwadi well of Uran Beach Dist.: Raigad.
Date: - 20/10/2014.
1. **Introduction:**

Uran with the population of 23,251 is located on west coast of India near Mumbai on east side; Uran is surrounded by rural areas with plenty of flora and fauna. Presently coastal belt of Uran is under heavy process of industrialization resulting in increased population pressure without proper sanitation. All human anthropogenic wastes are directly released into nearby coastal water without any treatment. Number of Industries including Oil and Natural Gas Corporation Limited (O.N.G.C), LPG Plant, Grind Well Norton Ltd., MSEB Gas Turbine Power Station, Bharat Petroleum Corporation Ltd., (BPCL), Jawaharlal Nehru Port (JNPT), NHAVA Sheva International Container (NSICT), Container Freight Station (CFS). The Effluents of these industries are released into the nearby coast of Uran and lot of land is used for establishing the industries by destroying habitats.

2. **Objective of the Study:**

Aim of proposed project is:

a) To evaluate existing Physical variables of water.

b) To evaluate existing chemical variables of water.

c) To Assess the Occurrence of Heavy metals.

d) Survey of water borne diseases from the local community.

e) Remedial measures of control of water borne diseases.

3. **Study Area Description:**

See the below given Map of the project
Map Showing Location of Study Area
4. Methodologies:
   i. Monthly assessment of physical variables of water.
   ii. Monthly assessment of chemical variables of water.
   iii. Monthly survey of water borne diseases from the local community.

II. Organization of work element

Phase I:

Literature survey, Planning and collection of the requirement for the project work.

Phase II:

Experimental work involving physical and chemical variables of water.

Phase III:

Monthly Assessment of heavy metals of water.

Phase IV:

Preparation and submission of the report, Publication of the research paper.

III. Time Schedule of Activities:

Phase I – Two Months

Phase II & III – Twenty Months

Phase IV – Two Months

IV. Suggested plan of actions for utilization of research outcome expected from the project:

Result of the present investigation will be helpful in the better understanding of Bapusheth wadi well water with respect to –

   i. Physical variables of water.
   ii. Chemical variables of water.
   iii. Occurrence of heavy metals in water of Bapusheth wadi well.
   iv. Water borne diseases from the local community.

V. Year Wise plane of work and targets to be achieve.

   I. 1st Two Months: literature Survey.
   II. 2nd Ten Months : Experimental work involving physical and chemical variables of water
   III. 3rd Ten Months : assessment of heavy metal of water.
   IV. 4th Two Months: Preparation & Submission of project Report.
5. **Results and Discussion**

**Temperature**: water temperature showed a noticeable seasonal trend with lowest value (28°C) recorded in winter and highest (32°C) in summer.

![Temperature Vs Month of collection of samples](image1)

**Conductance**: Conductance indicates presence of number of ions and its mobility. Its value is found to be highest (0.0655) in May and lowest (0.039) in Oct.

![Variation of conductance with the month of sample collection](image2)
**pH:** The increase in pH value during summer and decrease in winter is due to presence of carbonate & bicarbonate ion concentration and consumption of CO$_2$ with expected pH. It is below the range of permissible value.

**TS:** In rainy season the Total Solid content of water is maximum. In summer it is minimum. TS contents in water sample 34. To 44 mg/l All values are found to the below standard limit by WHO9 - ISO12
**CO₂**: CO₂ value showed a maximum November 2012 1760mg/l and minimum October 2012 440 mg/L.

**Chlorinity**: Chlorinity in well water sample is 0.6000 to 0.1500mg/l All values were found blow standard limit by WHO9 - ISO12
**Salinity**: Salinity contents in water samples range 0.147 to 0.4444 mg/l all values were below standard limit by WH O9 - ISO12

![Bar graph showing variation of salinity with month of sample collection]

**Acidity**: Acidity of liquid is capacity to donate $H^+$ ion. Acidity present due to free $CO_2$. Acidity value is lowest in Dec. (32) and highest in the month of May (64).

![Bar graph showing variation of acidity with month of sample collection]
**Alkalinity:** Alkalinity indicates the concentration of carbonates & bicarbonates in water. It is found to be lowest (200 ppm) in October and highest (272 ppm) in November.

![Variation of Alkalinity with month of sample collection](chart)

**Total Hardness:** It is the measure of capacity of water to react with soap. It is due to presence of $\text{Ca}^{+2}$, $\text{Mg}^{+2}$ & $\text{OH}^-$ ions in water. The values are within the permissible range.

![Variation of Total Hardness (ppm) with month of sample collection](chart)
**Ca Hardness**: Ca hardness value is lowest in the month of January. (24.08 mg/L) and highest in the month of October. (60.92 mg/L). All the values are within the permissible limit.

![Variation of Ca Hardness ppm with month of sample collection](image)

**Mg Hardness**: Its value is lowest in Dec. (0.461 ppm) and highest in the month of March (0.9234 ppm). All the values are within the permissible limit.

![Variation of Mg Hardness ppm with month of sample collection](image)
**BOD** – BOD value is lowest in Month of May and is highest in month of January 2013. It is within the permissible limit.

![BOD Graph]

**TDS** – TDS in water sample ranges from **24 to 38 mg/L**. All values found below standard limit by WH O9 ISI 12

![TDS Graph]
**COD**: COD value is lowest in month of April, May, June and is highest value in month of January 2013.

**TSS**: In rainy season the Total Suspended Sold content of water is maximum in August. In Winter, TSS Value is minimum in month of April.
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<td>CO₂</td>
<td>440 mg/litre</td>
<td>1760 mg/litre</td>
<td>1100 mg/litre</td>
<td>660 mg/litre</td>
<td>880 mg/litre</td>
<td>4200 mg/litre</td>
<td>1730 mg/litre</td>
<td>.1325 mg/litre</td>
<td>.1197 mg/litre</td>
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<td>.6144 mg/litre</td>
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<td>.2737 mg/litre</td>
<td>.646 gm/litre</td>
<td>.5760 gm/litre</td>
<td>.1482 gm/litre</td>
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<td>204 ppm</td>
<td>212 ppm</td>
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<td>248 ppm</td>
<td>256 ppm</td>
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<td>260 ppm</td>
<td>255 ppm</td>
<td>250 ppm</td>
<td>260 ppm</td>
<td>245 ppm</td>
<td>295 ppm</td>
<td>228 ppm</td>
<td>232 ppm</td>
<td>220 ppm</td>
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<td>Ca Hardness</td>
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<td>.4168 mg/litre</td>
<td>.24048 mg/litre</td>
<td>.5450 mg/litre</td>
<td>.6092 mg/litre</td>
<td>.5130 mg/litre</td>
<td>.5230 mg/litre</td>
<td>.56112 mg/litre</td>
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<td>.7047 mg/litre</td>
<td>.4517 mg/litre</td>
<td>.8505 mg/litre</td>
<td>.8262 mg/litre</td>
<td>.9234 mg/litre</td>
<td>.7776 mg/litre</td>
<td>.3019 mg/litre</td>
<td>.8505 mg/litre</td>
<td>.7533 mg/litre</td>
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<td>C.O.D.</td>
<td>468 mg/litre</td>
<td>24 mg/litre</td>
<td>1200 mg/litre</td>
<td>360 mg/litre</td>
<td>800 mg/litre</td>
<td>1200 mg/litre</td>
<td>36 mg/litre</td>
<td>40 mg/litre</td>
<td>80 mg/litre</td>
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<tr>
<td>B.O.D</td>
<td>1216.8 mg/litre</td>
<td>67.2 mg/litre</td>
<td>3120 mg/litre</td>
<td>9360 mg/litre</td>
<td>2080 mg/litre</td>
<td>3120 mg/litre</td>
<td>1008 mg/litre</td>
<td>123 mg/litre</td>
<td>1132 mg/litre</td>
<td>2464 mg/litre</td>
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</table>
**Discussion:**

The values of physico-chemical Parameters were within the WHO limit. The values of Chlorides are more in the months of October, and November. The value of salinity is more in summer season. The pH value is not within permissible limit. It is less than 7 indicate that water is acidic and which is not suitable for drinking. The water is acidic due to release ONGC plant wastes water which flows towards the Peerwadi well. The value of heavy metals Cu, Pb, Cd, Cr, Hg, are ND by means values are less than 0.01 ppm. It is suggested that before using the water for domestic purposes it should be properly treated.
Summary

Work done in year August 2012 to August 2013:-

1) Literature survey and setup of project was done as per schedule of the project
2) During the present investigation (25/10/2012 to 25/08/2013) sample slides is selected on
the west coast of India, near Arabian Sea. Uran is surrounded by rural areas which have rich
flora and fanta. Presently coastal belt of Uran is under heavy process of industrialization
resulting in increase in the population without proper sanitation.

The $pH$ was measured by battery operated pocket table Philips pH meter. Temperature
of surface water was measured by using a centigrade thermometer. Total solids (TS) and
Total dissolved solids (TDS) were determined by weighing the residue left after evaporation
of 100 ml unfiltered and filtered water samples respectively. Total suspended solids (TSS)
were calculated by subtracting value of TDS from TS. Biochemical oxygen demand (BOD)
and Carbon dioxide ($CO_2$) were determined by titrimetric method. Chemical oxygen
demand (COD) was estimated by open reflux method whereas salinity was estimated by
argentometric method.

$\textbf{pH}$: An acidic pH (4.4 to 6.6) was observed in pre monsoon of 2012. The increase in pH value
during summer (5.5 to 6.5) and decrease in winter (4.4 to 5.5) is due to presence of carbonate
and bio-carbonate and consumption of $CO_2$ with expected pH. It is below the range of
permissible value.

$\textbf{Temperature}$: During winter season temperature was ($28^\circ C$ - $32^\circ C$) and during it was ($30^\circ C -$ $32^\circ C$) while in rainy season it was ($31^\circ C$ - $32^\circ C$) Observed water temperature showed a
noticeable seasonable trend with lowest value ($28^\circ C$) recording in winter season and highest
($32^\circ C$) in summer.

$\textbf{Conductance}$: Conductance indicates the presence of number of ions and its mobility. Its value
is found to be highest (0.0655 S) in May and lowest (0.039 S) in October.

$\textbf{Total solids (TS)}$: In rainy season total solid content of water is maximum (40.00 gm.) & in
summer it is minimum (39.36 gm.).

$\textbf{Total dissolved Solids (TDS)}$: High level of TDS (24.96 to 38.4 gm.) was observed in
winter season. Low level of TDS (27.52 to 37.76 gm.) in summer season.
**Total Suspended Solids (TSS):** TSS content in winter season is maximum and minimum in Rainy season.

**Carbon Dioxide:** CO₂ value showed a maximum in winter season 440 to 1760 mg/litter and minimum in summer season (880 mg/L to 1100 mg/L).

**Chlorinity:** Chlorinity of water sample 6000 to 1500 mg/litter. All values were found below slandered limit by WHO 9 ISO 12.

**Salinity:** Salinity content in water sample is maximum in summer season (0.247to 0.453 gm. /L) and minimum in Rainy season (0.1325 to 0.4240 gm. /L).

**Acidity:** Acidity of liquid is capacity to donate H⁺ ion. Acidity present due to free CO2. Acidity value is lowest in December - 32 ppm and Highest in the month of May 64 ppm.

**Alkalinity:** Alkalinity indicates the concentration of carbonates and bi carbonate in water it is found to be lowest in October. 200 ppm and highest in November 272 ppm.

**Total Hardness:** Total Hardness maximum in winter season (250 to 1325 ppm) and minimum in summer season (228 ppm. to 295 ppm).

  a) **Ca-Hardness:** Ca- Hardness is lowest in month of January and highest in the month of March i.e. 60.92 mg/l.

  b) **Mg - Hardness:** It is lowest in December. (0.461 ppm) is highest in the month of March i.e. (0.9234 ppm).

**Biochemical Oxygen demand (BOD):** BOD Value is lowest at the month of May (123.2mg/L) and highest value in the month of January 2013 (9360 mg/L).

**Chemical Oxygen Demand (COD):** COD Value is lowest in the month of April (36mg/L) is highest in the month of June (46.8mg/L)
Work done in year 24/08/2013 to 24/06/2014: To assess the occurrence of heavy metals (From 24/08/2013 to 24/06/2014) Peerwadi Well, due to rapid industrialization and urbanization in Uran area, the riverine and estuarine ecosystem becomes contaminated to a great extent. To evaluate these contaminations the study was undertaken to determine the distribution of heavy metals such as Cu, Pb, Cd, Cr, and Hg in sediments of Peerwadi well. The prime aim of this study was to detect concentration of heavy metals in Peerwadi well. In these contest, sediments sample collected in study area are analysed using Inductive Coupled Plasma Atomic Emission Spectrometry (ICP-AES). Tracks of heavy metals was observed by using statistical program on analysis results in month of April, May, June, July 2014 ND by means less than 0.01 ppm Meticulous care must be taken to avoid any ground contamination.
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Two paper published under minor research projects


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ASSESSMENT OF HEAVY METAL CONTAMINATION IN GROUNDWATER FROM PEERWADI WELL OF URAN, NAVI MUMBAI RAUPHUNNISA F. INAMDAR\textsuperscript{a} AND PRABHAKAR R. PAWAR\textsuperscript{b}

\textsuperscript{ab}
Veer Wajekar Arts, Science and Commerce College, Mahalan Vibhag, Phunde, Tal.–Uran, Raigad, Navi Mumbai, Maharashtra, India

ABSTRACT

In the present study, groundwater from Peerwadi well, Uran was analyzed for contamination of heavy metals from April 2014 to July 2014. The metals analyzed include Copper, Lead, Mercury, Chromium and Cadmium, among which values obtained for Cu ranges from 0.013 mg/l to 0.028 mg/l, which falls below the maximum permissible limit of 2.0 mg/l by the World Health Organization (WHO). Other heavy metals analyzed (Pb, Hg, Cr and Cd) were not detectable from the sample water. Occurrence of Cu in groundwater could be attributed to the discharge of Cu containing industrial waste in the coastal ecosystem of Uran from the maritime activities of JNPT and also to the disposal of sewage and municipal waste. This indicates that Peerwadi well water is not polluted in any way and is fit for human consumption and other domestic purposes. Presence of trace concentration of Cu in water reveals that frequent monitoring of well water for contamination by heavy metals is recommended to avoid the human health risk and precautionary measures should be immediately taken to avoid the future consequences.

KEYWORDS: Groundwater, Heavy Metals, Peerwadi Well, Anthropogenic Inputs, Jawaharlal Nehru Port, Uran,

\textsuperscript{1} Corresponding author
Pollution

Water covers about 70 percent of the globe’s surface, but most of it is saltwater. Freshwater covers only 3 percent of the earth’s surface and much of it lies frozen in the Antarctic and Greenland polar ice. Freshwater available for human consumption comes from rivers, lakes and subsurface aquifers. These sources account for only one percent of all water on the earth. Six billion people depend on this supply and a significant portion of the world’s population is facing water shortages (Mebrahtu and Zerabruk; 2011, Musa et al.; 2013).

Groundwater is an important issue in water supply systems, so preservation and purification of ground water have a critical role in any community. Over the last few decades, competition for economic development, associated with rapid growth in population and urbanization, has affected the groundwater quality due to over exploitation and increasing demand for agriculture, domestic and industrial water supply, as well as improper sewage flow and solid waste disposal. The effluents discharged from industries and urban sewage finds their way into surface water bodies. These water bodies in turn act as recharge source for groundwater, thus making it vulnerable (Marbooti et al.; 2015).

Increase of industrialization and urbanization gradually decreases the groundwater quality due to unsustainable use of water resources. Groundwater may be contaminated by different contaminants which have an impact on the health and economic status of the consumers. Contaminants such as bacteria, viruses, heavy metals, nitrates and salt have found their way into water supplies due to inadequate treatment and disposal of waste, industrial discharges, and over-use of limited water resources. Improper solid waste management contributes large quantities of pollutants percolated into groundwater table that have been continuously introduced into ecosystems (Reddy et al.; 2012).

More than 100,000 chemicals are released into the global environment every year as a consequence of their production, use and disposal. Chemical substances discharged into the environment may be of natural origin or of anthropogenic origin. The presence of heavy metals in the environment has grown because of its large employment in some industrial and agricultural activities. Heavy metals are metallic chemical element that has a relatively high density and is toxic or poisonous at low concentrations in plants, animals and humans. Approximately 30 metals and metalloids are potentially toxic to humans. These elements affect cells and living organisms in various ways and are xenobiotic and highly toxic. Heavy metals are not biodegradable and persistent in the environment for long periods, cause serious eco-toxicological problems. They are dangerous because they tend to bioaccumulate (Chiarelli and Roccheri; 2014).

Heavy metals can be divided into four major groups based on their health importance (1) Essential metals such as Cu, Zn, Co, Cr, Mn and Fe, (2) Nonessential metals such as Ba, Al, Li and Zr, (3) less toxic metals such as Sn and As and (4) highly toxic metals such as Hg, Cd and Pb (Vaishaly et al.; 2015).
The traces of metal ions play an important role in human life. The essential heavy metals (Cu, In, Fe, Mn and Mo) play biochemical and physiological functions in plants and animals. Two major functions of essential heavy metals are, participation in redox reaction and direct participation, being an integral part of several enzymes (Vaishaly et al.; 2015). Heavy metals such as Cr, Zn, Co and Cu are vital for normal function of all organisms for smooth body functions and growth of the body. Cobalt is a metallic constituent of vitamin B₁₂ where as Manganese is an activator of enzymes in the body (Mahar et al.; 2013). Standards set by World Health Organization for heavy metals in groundwater are Cu 2.0 mg/l, Pb 0.01mg/l, Hg 0.001mg/l, Cr 0.05 mg/l and Cd 0.0005 mg/l.

Human exposure to heavy metals occurs through three primary routes, i.e. inhalation, ingestion and skin absorption (Olafisoye et al.; 2013). Heavy metals may enter the human body via food, water, air, or absorption through the skin in agriculture, industrial, or residential settings. Heavy metals become toxic when they are not metabolized by the body and accumulate in the soft tissues. Health risks of heavy metals include reduced growth and development, cancer, organ damage, nervous system damage, and in extreme cases, death. Exposure to some metals, such as mercury and lead, may also lead to autoimmunity (Malassa et al.; 2014).

Heavy metals "can bind to vital cellular components, such as structural proteins, enzymes, and nucleic acids, and interfere with their functioning." Long-term exposure to heavy metals can have carcinogenic, central and peripheral nervous system and circulatory effects (Rajeswari and Sailaja; 2014). It may result in slowly progressing physical, muscular and neurological degenerative processes, muscular dystrophy, multiple sclerosis, gangrene, diabetes mellitus, hypertension and ischemic heart disease (Fernandez-Luqueno et al.; 2013). The bio-toxic effects of heavy metals exhibit specific signs of their toxicity like gastrointestinal (GI) disorders, diarrhoea stomatitis, tremor, hemoglobinuria, ataxia, paralysis, vomiting and convulsion, depression, and pneumonia. The nature of effects could be toxic (acute, chronic or sub-chronic), neurotoxic, carcinogenic, mutagenic or teratogenic (Verma and Dwivedi; 2013).

Coastal environment of Uran has been under considerable stress since the onset of Jawaharlal Nehru Port (JNPT, an International Port), Oil and Natural Gas Commission (ONGC), LPG Distillation Plant, Grindwell Norton Ltd., Gas Turbine Power Station (GTPS), Bharat Petroleum Corporation Limited (BPCL) Gas Bottling Plant, DP World, Container Freight Stations (CFS), reclamation, sedimentation, tourism etc. These activities affect the terrestrial and coastal ecosystem of Uran coast, Navi Mumbai (Pawar; 2013).
Although many studies have been undertaken to evaluate the heavy metals in groundwater in India, no scientific studies have been carried out on the heavy metal contamination in groundwater of Uran, Navi Mumbai; hence, the present study is undertaken. Objective of the study is to evaluate the impact of anthropogenic inputs on quality of groundwater with respect to heavy metals.

**MATERIALS AND METHODS**

**Study Area**

Geographically, Uran (Lat. 18° 50'5" to 18°50'20" N and Long. 72°57'5" to 72°57'15" E) with the population of 28,620 is located along the eastern shore of Mumbai harbor opposite to Coloba. Uran is bounded by Mumbai harbor to the northwest, Thane creek to the north, Dharamtar creek and Karanja creek to the south, and the Arabian Sea to the west. Uran is included in the planned metropolis of Navi Mumbai and its port, the Jawaharlal Nehru Port (JNPT). Average annual precipitation at Uran is about 3884 mm of which about 80% is received during July to September. The temperature range is 12–36°C, whereas the relative humidity remains between 61% and 86% and is highest in the month of August.

Peerwadi well is located about 210 mt away from the Peerwadi coast of Uran and was built up in 1945. The well is with 20 ft in diameter and 40 ft in depth, of which 25 ft is built up with stones. It has safety wall of about 3.6 ft in height at the surface. It is the only source of freshwater for livelihood of the local community. Well water is lifted by traditional Indian method using rope and bucket or other suitable utensils by nearby population of about 600 people of the Nagaon village, Uran till today. Municipal waste water canal and canal of Oil and Natural Gas Commission (ONGC) are passing from nearby the well (Fig. 1).
Many times during the year, local population claims that taste of water from the Peerwadi well of Uran differs from the normal and has repellent odour. Hence during present investigation, heavy metal contamination in groundwater of Peerwadi well is assessed to investigate impact of anthropogenic inputs on it.

**Sampling Strategy and Analysis**

The present study was carried out from April 2014 to July 2014. Water samples were collected in clean, sterilized and plain polyethylene containers. The containers were thoroughly cleaned with 1:1 HNO$_3$ and rinsed several times with distilled water, then dried in electric oven. After this, the containers were completely filled with water before they were corked to avoid trapping of air bubbles. The collected samples were labeled, sealed and transported to the laboratory and preserved in refrigerator at a temperature of about 4°C until analysis. The samples were tested for the occurrence of heavy metals such as Copper (Cu), Lead (Pb), Mercury (Hg), Chromium (Cr) and Cadmium (Cd). The laboratory analysis was made using Inductively Coupled Plasma Atomic Emission Spectroscopy at Sophisticated Analytical Instrument Facility, Indian Institute of Technology, Powai, Mumbai - 400 076.
RESULTS AND DISCUSSION

Results of the analysis of the heavy metals in the water samples of Peerwadi well is presented in Table 1, wherein, only one metal is investigated in the laboratory and the result of other metals analyzed were not detectable. The metals analyzed include Copper, Lead, Mercury, Chromium and Cadmium, among which values obtained for Cu ranges from 0.013 mg/l to 0.028 mg/l, which falls below the maximum permissible limit of 2.0 mg/l by the WHO. Results of other heavy metals analyzed (Pb, Hg, Cr and Cd) from the samples are not detectable.

The analysis shows that Peerwadi well water is not polluted in any way. This is because the result showed that the heavy metals analyzed were within the acceptable and desirable limits set by the WHO and were considered fit for human consumption and other domestic purposes. During present study, the minimum and maximum Cu concentration of were found to be
This study shows that heavy metal pollution of groundwater is an issue of environmental concern. In the present study, except Cu, no other heavy metal was detected in the water of Peerwadi well.

Cu enters the water system through mineral dissolution, industrial effluents, because of its use as algaecide, agricultural pesticide sprays and insecticide. Cu may be dissolved from water pipes and plumbing fixtures, especially by water whose pH is below 7. Other sources of Cu into water bodies are anthropogenic activities like metal plating, industrial and domestic waste, mining, and mineral leaching were main sources for the presences in environment (Reddy et al.; 2012). Occurrence of Cu in water sample could be attributed to the discharge of Cu containing industrial waste in the coastal ecosystem of Uran from the maritime activities of JNPT and also to the disposal of sewage and municipal waste. Results of the present study are in agreement with Alhibshi et al. (2014), Rajeswari and Sailaja (2014) and Souzaa et al. (2016).

Though, Cu is a trace essential element for human health, its large concentration can cause eminent health problem. High levels of copper in drinking water have been found to cause kidney and liver damage in some people. Children under one year of age are more sensitive to copper because it is not easily removed from their system (Tadiboyinaa and Ptsrkb; 2016).

Table 1: Analytical report of Peerwadi well water for heavy metals

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Month &amp; Year</th>
<th>Heavy metal ion concentration (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cu</td>
</tr>
<tr>
<td>1</td>
<td>April 2014</td>
<td>ND</td>
</tr>
<tr>
<td>2</td>
<td>May 2014</td>
<td>0.013</td>
</tr>
<tr>
<td>3</td>
<td>June 2014</td>
<td>ND</td>
</tr>
<tr>
<td>4</td>
<td>July 2014</td>
<td>0.028</td>
</tr>
<tr>
<td>5</td>
<td>Standard limits (WHO)</td>
<td>2.00</td>
</tr>
</tbody>
</table>

CONCLUSION

This study shows that heavy metal pollution of groundwater is an issue of environmental concern. In the present study, except Cu, no other heavy metal was detected in the water of
Peerwadi well. Ion concentration of Cu is also found to be within the acceptable and desirable limits set by the WHO. This indicates that Peerwadi well water is not polluted in any way and is fit for human consumption and other domestic purposes. Presence of trace concentration of Cu in water reveals that frequent monitoring of well water for contamination by heavy metals is necessary to avoid the human health risk. It is recommended that precautionary measures should be immediately taken to avoid the future consequences.

ACKNOWLEDGEMENT

INAMDAR AND PAWAR: ASSESSMENT OF HEAVY METAL CONTAMINATION IN GROUNDWATER FROM...
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Assessment of Water Quality Variables from Peerwadi Well of Uran Beach, Dist. – Raigad, Navi Mumbai

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**Physico-chemical characteristics of water are of vital concern to human as it is directly related to human health.**

Water quality is an important criterion used for evaluating the suitability of water for drinking, irrigation and recreation. During present investigation, water quality variables of ground water were assessed from Peerwadi open well of Uran Beach, Dist – Raigad, Navi Mumbai from October 2010 to August 2013. Various physico-chemical parameters assessed includes pH, Temperature, Total solids (TS), Total dissolved solids (TDS), Total suspended solids (TSS), Conductance, Dissolved oxygen (DO), Biochemical oxygen demand (BOD), Carbon dioxide (CO2), Chemical oxygen demand (COD), Salinity, Chloride, Alkalinity, Total hardness, Calcium hardness and Magnesium hardness. This study reveals that except the high values of chlorides and salinity, values of other physico-chemical variables are within the guideline values of WHO Standard for potable water. The quality of water from Peerwadi open well of Uran Beach was found to be safe and utilisable for drinking and other purposes.

**Introduction:**

Ground water is considered as one of the purest forms of water available in nature and meets the overall demand of rural as well as urban population. With the growth of industry the ground water is made susceptible for contamination due to addition of waste materials. Waste materials from the factories percolate with rain water and reach aquifer resulting in erosion of ground water quality. Groundwater is used for domestic, industrial, water supply and irrigation all over the world (Rao et al., 2013).

Water quality depends on the quality of recharged water, atmospheric precipitation, inland surface water, rock water interaction time, mineral weathering, ion exchange process and sub-surface geochemical processes. The intensive use of natural resources and increased human activities are posing great threat to groundwater quality. Water Quality Index is defined as a technique of rating that provides the composite influence of individual water...
quality parameters on the overall quality of water for human consumption. It becomes an important parameter for the assessment and management of ground water (Singh et al., 2013).

Fresh water is a finite resource, essential for agriculture, industry and even human existence, without fresh water of adequate quantity and quality, sustainable development will not be possible. The addition of various kinds of pollutants and nutrients through urban sewage, industrial effluents, agricultural runoff etc. into the water bodies brings about a series of changes in the physicochemical quality and its characteristics of water. Fresh water resource is becoming day by day at the foster rate of deterioration of the water quality is now a global problem (Sharma et al., 2013).

Water is one of the most important compounds that profoundly influence life. In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population and the accelerated pace of industrialization. According to WHO organization, about 80% of all the diseases in human beings are caused by water. Water quality index is one of the most effective tools to communicate information on the quality of water to the concerned citizens and policy makers. It, thus, becomes an important parameter for the assessment and management of groundwater (Dohare et al., 2014).

Over burden of the population pressure, unplanned urbanization, unrestricted exploration policies and dumping of the polluted water at inappropriate place enhance the infiltration of harmful compounds to the ground water. Contamination of water resources available for household and drinking purposes with heavy metals, metal ions and harmful microorganisms is one of the serious major health problems (Rajappa et al., 2011).

Mumbai, a major metropolis and generates 0.85 millions m3/d of liquid effluent and 14,600 t/d of solid waste, which without any treatment are discharged in the coastal region in and around Mumbai (Zingde, 1999). The coastal environment of Uran (Navi Mumbai) has been under considerable stress since the onset of industries like Oil and Natural Gas Commission (ONGC), Liquid Petroleum Gas Distillation Plant, Grindwell Norton Ltd., Gas Turbine Power Station, Bharat Petroleum Corporation Limited Gas Bottling Plant, Jawaharlal Nehru Port (JNP, an international port), Nhava-Seva International Container Terminal (NSICT), Container Freight Stations (CFS), etc. These activities affect the water quality of coastal region (Pawar, 2013). Although many studies have been undertaken to evaluate the ground water quality in coastal cities in India, no scientific studies have been carried out on ground water quality of Uran, Navi Mumbai; hence, the present study is undertaken.

**Study Area:**
Geographically, Uran (Lat. 18° 50′ 5″ to 18° 50′ 20″ N and Long. 72° 57′ 5″ to 72° 57′ 15″ E) with the population of 30,439 is located along the eastern shore of Mumbai harbor opposite to Coloba. Uran is bounded by Mumbai harbor to the northwest, Thane creek to the north, Dharamtar creek and Karanja creek to the south, and the Arabian Sea to the west. Uran is included in the planned metropolis of Navi Mumbai and its port, the Jawaharlal Nehru Port (JNPT) (see Fig. 1).

Peerwadi well is located about 210 mt away from the Peerwadi coast of Uran and was built
up in 1945. The well is with 20 ft in diameter and 40 ft in depth, of which 25 ft is built up with stones. It has safety wall of about 3.6 ft in height at the surface. It is the only source of freshwater for livelihood of the local community. Well water is lifted by traditional Indian method using rope and bucket or other suitable utensils by nearby population of about 600 people of the Nagaon village, Uran till today. Municipal waste water canal and canal of Oil and Natural Gas Commission (ONGC) are passing from nearby the well.

Many times during the year, local population claims that taste of water from the Peerwadi well of Uran differs from the normal and has repellent odour. Hence during present investigation, water quality variables of Peerwadi well were assessed to investigate impact of anthropogenic inputs on it.

The present study was carried out from October 2012 to August 2013. Well water samples were collected monthly in a clean, leakproof plastic container in triplicate and average value for each variable was reported. Standard methods described by APHA (2005) were followed for assessment of water quality variables.

The pH was measured with an accuracy of ±0.02 pH unit on a battery operated portable Philips pH meter. Temperature of water was measured by using a centigrade thermometer. Total solids (TS) and Total Dissolved solids (TDS) were determined by weighing the residue left after evaporation of 100 ml unfiltered and filtered water samples, respectively. Total suspended solids (TSS) were calculated by subtracting value of TDS from TS. Winkler’s Iodometric method was adopted for high precision dissolved oxygen (DO) estimation. Biochemical oxygen demand (BOD) and carbon dioxide (CO2) were determined by titrimetric method. Chemical oxygen demand (COD) was estimated by open reflux method. Salinity was estimated by argentometric method. Electrical conductivity was determined by conductivity meter (Elico), whereas total hardness was by EDTA titration. Alkalinity was estimated by indicator method. Calcium and Magnesium was determined by complexometric titration with standard solution of EDTA. All colorimetric measurements were done on ERMA INC (AE 11D) colorimeter. Values of water variables obtained during present investigation were compared with standard values of World Health Organization and Indian standard.

**Results & Discussion:**

**pH:** During present study, observed pH is in the range of 5.4 to 6.5. Seasonal range of pH is 5.4 to 5.5 during monsoon, 5.9 to 6.4 during winter.
and 5.9 to 6.5 during summer. Higher pH observed during summer season is attributed to the sewage discharge and also to the decomposition of organic matter by microbes. Similar results were reported by Patil et al. (2012) and Rao et al. (2013) (see Fig. 2). During remaining period of investigation, values of pH are within the prescribed limits.

Temperature:
In present study, water temperature varies from 28°C to 32°C with maximum during summer and minimum during monsoon. High temperature during summer could be attributed to high solar radiation. No major temperature variation is observed in water of Peerwadi well during present study (see Fig. 3) and similar results are reported by Sharma et al. (2013) from ground water of Abhanpur block of Raipur, Chhattisgarh.

Total solids (TS):
Total solids reported during present study are in the range of 39.24 to 44.00 mg/l. Seasonal variation of TS is in the range of 39.36 to 44.00 mg/l during monsoon, 39.24 to 39.92 mg/l during winter and 39.36 to 40.6 mg/l during summer (see Fig. 4). Reported values of TS are found to be within the standard limit of WHO.

Total dissolved solids (TDS):
High level of TDS (40.00 to 50.72 mg/l) is recorded during monsoon and is may be due to the increased turbulence during monsoon and particulate matter normally associated with the surface run off (see Fig. 5).

Total suspended solids (TSS):
Higher level of TSS in the range of 14.30 to 15.10 mg/l was recorded during Oct 2012 and Nov 2012 where as lower values were recorded during Dec 2012 i.e. 0.84 mg/l. Low level of TSS
observed during remaining period indicates discharge of industrial waste water into cannel (see Fig. 6).

**Fig. 6 - Monthly variation of total suspended solids from Peerwadi well of Uran**

**Conductance:**
Electrical conductance of water is the capacity of water to transmit an electric current and is a tool to assess the purity of water. Recorded conductance during present study is 0.042 - 0.05 \( \mu \text{mhos/cm} \) in monsoon, 0.03 \( \mu \text{mhos/cm} \) in winter and 0.03 \( \mu \text{mhos/cm} \) in summer (see Fig. 7).

**Fig. 7 - Monthly variation of conductance from Peerwadi well of Uran**

**Salinity:**
No significant variation is observed in salinity in well water of Peerwadi (see Fig. 8) and reported salinity is in the range of 0.1197 to 0.5459 ppt in monsoon, 0.247 to 0.444 ppt in winter and 0.1730 to 0.4524 ppt in summer. Higher salinity in summer is attributed to excessive evaporation and negligible input of fresh water.

**Fig. 8 - Monthly variation of salinity from Peerwadi well of Uran**

**Dissolved Oxygen (DO):** Except Nov 2012 and Jan 2013, DO values recorded during present investigation are present in the range of 2.31 to 4.14 mg/l. Higher DO recorded during Nov 2012 and Jan 2013 were attributable to wind velocity and monsoon influence and also to increase in photosynthetic activity with lower temperature (see Fig. 9). During present study, an inverse relationship between temperature and DO is observed. Similar results were also noted by Usharani et al. (2010) in Noyyual river and ground water quality of Perur, India.

**Fig. 9 - Monthly variation of dissolved oxygen from Peerwadi well of Uran**

**Biochemical Oxygen Demand (BOD):** BOD value is lowest in Month of May and is highest in month of January 2013. It is within the permissible limit.

Higher BOD values recorded during Nov 2012 were attributed to the contamination of organic material in the water (Patil et al., 2012) (see Fig. 10).
Carbon-di-oxide (CO$_2$): Except the month of Nov 2012, moderate values of CO$_2$ were recorded during present investigation. High values of free CO$_2$ recorded during Nov 2012 were attributed to the high rate of decomposition in the warmer months (see Fig. 11). Similar results were also reported by Dohare et al. (2014).

Total Hardness:
Hardness is the property of water to prevent lather formation with soap. It also elevates the boiling point of the water. Total hardness recorded during present investigation is in the range of 132.21 to 293.54 mg/l (see Fig. 13), which lies within desirable limit of hardness of 200 to 600 mg/l (Dohare et al, 2014). Results of total hardness are in agreement with Ramesh et al. (2012) recorded for ground water of Manacha.
nallur block, Trichy, Tamil Nadu, India.

Fig. 13 - Monthly variation of total hardness from Peerwadi well of Uran

**Calcium Hardness:**
Ca hardness recorded in present study is in the range of 24.08 to 60.92 mg/l and is within the acceptable limits for water for domestic use (Rajappa et al., 2011) (see Fig. 14).

**Conclusion:**
In conclusion it is to be stated that water quality variables of Peerwadi well of Uran are within the desirable limit and permissible limit as per IS: 10500-2012. The water is suitable for the human use and also for the domestic purpose. In future, due to heavy urbanization and industrialization around Uran, care should be taken to maintain the natural quality of this water to sustain the nearby population.

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**REFERENCE**

Fig. 15 - Monthly variation of magnesium hardness from Peerwadi well of Uran