Science Research Reporter, 4(1): 94-100, (April - 2014)

ISSN: 2249-2321 (Print); ISSN: 2249-7846 (Online)
Received: 01-12-2013, Revised: 26-01-2014, Accepted: 01-03-2014

Full length Article

Drinking water quality index of Avashi village of Lote Parshuram Industrial Area (LPIA) of (MS) India

Nilesh Rokade[1], Sagar Sankpal[2] Pratap Naikwade[3]

[1]University Department of Environmental science, Ratnagiri sub Center, University of Mumbai. Maharashtra, India.
[2]Department of Chemistry, ASP College, Devrukh, Maharashtra, India.
[3]Department of Botany, ASP College, Devrukh, Maharashtra, India.
rokade_nilesh@yahoo.com

ABSTRACT

The present investigation was carried out to assess drinking water quality of Avashi village of Lote Parshuram Industrial Area (LPIA) of Maharashtra. Water samples were collected from six selected sampling stations for the pre monsoon and post monsoon period during August 2012 to January, 2013. The Physico-chemical parameters like Temperature, Odour, Taste, pH, Conductivity, BOD, COD, DO, Total Hardness, Total Acidity, Total Alkalinity, TDS, Chloride, Turbidity etc. and some heavy metals like Copper, Mercury, Chromium, Zinc, Cadmium along with Biological parameter like Most Probable Number (MPN) was also analyzed respectively. The Standard procedures (APHA, 1995 and Trivedi and Goel, 1986) are used in this study. To assess the quality of water each parameter was compared with the desirable limit of that parameter in drinking water as prescribed as Bureau of Indian Standards (BIS). It was found that water quality in Awashi village of 6 different locations was very severely polluted specially with heavy metal contamination.

Key words: BOD, COD, heavy metals, physicochemical, water quality

INTRODUCTION

Environmental pollution is the global concern of the day. The growth of industrial area is rapid and very fast thus related anthropogenic activities has also been in increased like waste discharge from industries, transportation and domestic activities. In the Millennium Development Goals, the international community committed to halving the proportion of people without access to safe water and sanitation by 2015 (SIWI 2005). Every day, 2 million tons of sewage and industrial and agricultural waste are discharged into the world's water, the equivalent of the weight of the entire human population of 6.8 billion people. The amount of wastewater produced annually is about 1,500 km^3, six times more water than exists in all the rivers of the world (UN WWAP 2003).

Various devastating ecological effects and human disasters in the last 40 years have arisen majorly from industrial wastes causing environmental degradation (Bheshdadia and Chauhan, 2012). The discharges from these industries constitute biohazard to man and other living organisms in the environment because they contain toxic substances detrimental to health (Sargaokar and Deshpande, 2003). Since many effluents are not treated properly, these products are discharged on the ground or in the water bodies and most of these discharges to water bodies accumulate in the system through food chain (Sudhkar and Mamatha, 2004). Heavy Metals are commonly found in the environment all around the world, their presence being due to natural occurrence or as a result of anthropogenic activities.

Metals can enter and contaminate estuarine waters from feeder rivers and from direct discharges, and once there, they can be trapped and accumulated in sediments or be directly captured by living organisms (WHO, 2000).

Environmental degradation is a major threat confronting the world soil and water pollution leads to contamination of water resources (Naikwade *et al*., 2012). Ground water is one of the earth's important resources. It exists wherever water penetrates beneath surface. Ground water is an economic source and more than 85% of public water supplies are obtained from well. Ground water supplies for rural area have certain advantages over surface water. Depth of water table below ground level is governing factor in determining pollution since as water level approaches nearer ground surfaces, greater is the risk of contamination (Srinivasa Rao 2012). Major sources of ground water pollution are urban pollution, industrial pollution, agriculture pollution etc. Unsafe or inadequate water, sanitation, and hygiene cause approximately 3.1 percent of all deaths worldwide, and 3.7 percent of DALYs (disability adjusted life years) worldwide. (WHO, 2002). Rapid industrialization and urbanization resulted in successful pollution of water resources available on earth (Boyd and Tucker, 1998). Earlier research was carried out on physicochemical analysis of effluent discharge of fish processing industries in Ratnagiri, (Sankpal and Naikwade, 2012a). Heavy metal concentration in effluent discharge of pharmaceutical industries was also analysed (Sankpal and Naikwade, 2012 b).

In Lote Pershuram MIDC Area, industrialization and urbanization have more impact on groundwater environment. Both surface and subsurface water are getting polluted due to developmental activities. Various large scale industries release their effluent openly without treatment which interact with the groundwater and alter water quality parameters. The Avashi village of LPIA (Lote Parshuram Industrial Area) was selected to study the effect of these conditions on groundwater quality.

MATERIAL AND METHODS

Study area

In 1978, MIDC appropriated 51,273 hectares of land in Lote, Awashi, Songaon, Dhamanwadi and some other villages for setting up a chemical industrial zone. Lote Parshuram Industrial Area (MIDC), Chiplun Maharashtra set up an eco-sensitive Konkan belt. Some Industries are situated in the areas like Lote, Awashi, Ganeshnagar, etc are on the left hand side of the NH-17 (towards Goa) and some Industries are situated on the right hand side of the NH-17 (towards Mumbai) are Songaon, Dhamanvadi, Asgani, Satwin, etc. The Samples were taken only from the Awashi village which is further constituted of 8 minor villages namely; Tamhanvadi, Bhendevadi, Ganeshnagar, Buddhawadi, Devolwadi, Malwadi, Madhliwadi, Malkarwadi. Out of these Samples were taken only from 6 villages excluding Madliwadi and Malkarwadi for further review of physico-chemical analysis. The Lattitide and Longitude is given in Table 1. The Samples were taken At Monsoon (August 2012) and Post-monsoon (January 2013) respectively for the analysis of Physico-chemical and Bacteriological analysis.

Collection of samples and Analysis

Water samples for physical and chemical parameters determination were collected monthly from the sampling station with the help of clean plastic container well cleaned with non-ionic detergent, rinsed with tap water and finally washed with deionized water prior to usage.Monthly samplings weremade at Monsoon (August 2012) and Post-monsoon (January 2013) respectively.While collecting samples contamination of the sample was avoided with any foreign material. Collected samples were brought to laboratory and stored to the refrigerator at 4^oC temperature. Selected physicochemical parameters such as Temperature, pH, salinity, Dissolved Oxygen, Biochemical Oxygen Demand, Dissolved phosphate, Nitrate and Ammonia were analyzed according to APHA (1995) and Trivedi and Goel (1986). Atmospheric and surface water temperatures were measured using thermometer. Salinity wasestimated with a hand refractometer. pH value was measured using systronic pH meter. Dissolved oxygen was estimated by the modified Winkler's method (Strickland and Parsons, 1972). Analysis of some Heavy metals were also been carried out using Atomic Absorption Spectrophotometer (AAS).

Result and Discussion:

Physio-chemical parameter values obtained During Monsoon are given in table 2 and After Monsoon are given in Table 3.

Temperature: Generally, the temperature of the study area is quite cool during monsoon. The temperature plays a crucial role in physical-chemical and biological behavior of aquatic system. The Temp range of Min. was recorded as 24.7^{0}C during August & Max. of 30.3^0 C during January. Variability of Temperature was due to the seasonal changes Temperature in January, was high due to low water level, high temperature and clear Atmosphere.

pH: The minimum pH was found to be 3.82 in Devolwadi area After Monsoon & maximum of 8.02 in Malwadi area After monsoon. The water sample showed highly acidic pH in the areas which was suspected to have chemical pollutants in it, especially the water sample 4 showed high acidic range in both season.

Electrical Conductivity : EC measures the electric current, which is proportional to the mineral matter present in water. A sudden increase in conductivity of the water is the indicator of the addition of the pollutant to the water. The minimum value of EC was 0.07 & maximum value was found to be 0.24.The higher values may be due to the rock soils and the presence of high dissolved solids in the study area.

Turbidity (NTU): Turbidity is a measure of cloudiness in water. The higher the turbidity, the cloudier the water appears. The Turbidity was found 0.08 to 1.45 During Monsoon & 0.17 to 1.2 After Monsoon which was found very low as per BIS standard values. In most waters, turbidity is due to colloidal and extremely fine dispersions.

Total Hardness: BIS has specified the value of Total Hardness in the range of 200 mg/lit to 500 mg/lit. The Hardness in the water sample was found to be very low from 36 mg/lit-80 mg/lit in Monsoon & 32 mg/lit-104 mg/lit After Monsoon, which shows a wide variation in Hardness. This variation may be due to the soil leaching & addition of Calcium and Magnesium ions in minute quantities. This shows that the water is safe for drinking & has no known health effects.

Total Alkalinity: Total alkalinity of water in terms of $CaCO_3$ varied from 25mg/lit-51mg/lit in Monsoon and 31mg/lit-68mg/lit After Monsoon. Alkalinity is its acid neutralizing capacity. The acceptable limit of Total Alkalinity is 200mg/lit &600mg/lit in absence of alternate water source. This alkalinity fluctuation may be due to the Carbonated & Bicarbonates. It is itself not harmful to human beings.

Total Dissolved Solids: TDS was found to be in the range of 175 mg/lit-296mg/lit During Monsoon &137mg/lit-217mg/lit After monsoon. It may be due to water flows through the subsurface and increase the dissolved solids and major ions. This may be due to leaching taking place in groundwater.

Biological Oxygen Demand: The Biochemical Oxygen Demand (BOD) is a measure of the amount of food for bacteria that is found in water. It determines the strength in terms of oxygen required to stabilize domestic and industrial wastes. The BOD values were in the range of 3.2 - 7.2mg/lit At monsoon while 3.1 – 6.9 mg/lit After Monsoon. These all values were found under the permissible limit standards prescribed by BIS. Hence it can be determined that water is potable.

Chemical Oxygen Demand: Chemical oxygen demand determines the oxygen required for chemical oxidation of organic matter. COD values convey the amount of dissolved oxidisable organic matter including the non-biodegradable matters present in it. The minimum values of COD was found 14.9 mg/lit of During monsoon of sample 3 while maximum values was found to be 47.5 After monsoon of sample 4. All the values obtained were under permissible limit. The minimum values may be due to the low organic matter while high values obtained may be due to high concentration of pollutants and organic matter.

Dissolve Oxygen: The DO in the sample fluctuates from 3.8 – 5.8 mg/lit During Monsoon & 2.2 – 4.6 After Monsoon. Concentration of DO is one of the most important parameters to indicate water purity. The minimum value was found in January which might be due to the high rate of Oxygen consumption by oxidisable matter. And maximum values During Monsoon was due to the large capacity of water to hold Oxygen. The DO values obtained was particularly very low in samples (i.e) sample No.2,3,5 After monsoon were very low even less than 4mg/lit which determine its poor quality of water.

Sulphate: In present study, the sulphate concentration was found way below the permissible limit prescribed by BIS. The range set by BIS is 200 – 400 mg/lit. The values obtained are 10.3 – 37.9 mg/lit During Monsoon and 15.3 – 36.5 mg/lit.

This analysis reveals that none of the sample was sulphur polluted.

HEAVY METAL ANALYSIS:

Heavy metals values During Monsoon and After Monsoon are given in Table 4.

Copper: The copper concentration varies from 0.013 – 0.081 mg/lit During Monsoon while After Monsoon 0.016-0.072 mg/lit respectively. The higher concentration is found in S1, S2, S5, S4 during Monsoon and After Monsoon which is beyond the permissible limit 0.05 mg/lit prescribed by BIS.

Mercury: The higher concentration of Hg was found as per permissible limit prescribed by BIS. Maximum limit was found to be 0.024 mg/lit and minimum limit was found to be 0 mg/lit. This may be due to the industrial effluent discharged directly into the environment which has polluted the area into a great extent.

Chromium: The minimum chromium content was found to be in the range of 0.03 – 0.018mg/lit During Monsoon & 0.006 – 0.021 mg/lit After Monsoon. Accordingly it was found that all the samples from Awashi region were under permissible limit 0.05 mg/lit.

Zinc: Zinc ranges from 0.034 – 0.140 mg/lit At Monsoon while 0.056 – 0.131 mg/lit After Monsoon which is very low as per permissible limit prescribed by BIS. Zinc is below the permissible limit 5mg/lit. Wide spread dispersion of Zinc could be attributable to the use of liquid manure, composted material and agrochemicals. It showed a huge fluctuation under permissible limit.

Cadmium: The Monsoon values of Cadmium fluctuate from 0.003 – 0.019 mg/lit & 0.011 – 0.042 mg/lit in After Monsoon. All the samples were under permissible limit (i.e 0.01) by BIS. The Cd occurs due to the natural and Anthropogenic sources in the environment. Cd values of S3, S4, S5 of Monsoon & all the samples of After Monsoon found to be polluted at a small level. It can be an initial stage of a pollution load level in the area entering through soil by accumulation.

Biological Parameter Analysis

Most probable number (MPN) test was done to detect the coliform in water samples collected from well water. The results obtained as coliform bacteria are shown in Table 5. It shows variation at different sites.

Water Quality Index:

Water Quality Index (WQI) provides a single number (like a grade) that expresses overall water quality at a certain location and time based on several water quality parameters. The objective of an Index is to turn complex water quality data into information that is understandable and useable by the public. In present study the sampling location was compared according to the pollution level in that area (Table 6). However the water quality can be determined and best explained by the graph of fig correlating it. The WQI of each sample was correlated and accordingly sample was analyzed on basis of the water quality index values. All parameters were calculated and mean WQI variations were taken to further analysis of well water by reviewing through WQI Table.

The results are in accordance with Adekunle (2008) who showed that due to industrial effluent quality of water decreases. The increased values are due to pollution caused by industry. 70% of industrial wastes in developing countries are disposed of untreated into waters where they contaminate existing water supplies (UN-Water 2009). Physico-chemical analysis of borewell water samples in Tamilnadu also shows polluted water (Shyamlala *et al*, 2008). Chlorinated solvents were found in 30 percent of groundwater supplies in 15 Japanese cities, sometimes traveling as much as 10 km from the source of pollution. (UNEP, 1996). Nutrient enrichment, most often associated with nitrogen and phosphorus from agricultural runoff, can deplete oxygen levels and eliminate species with higher oxygen requirements, affecting the structure and diversity of ecosystems (Spalding and Exner, 1993). In India, over-extraction of groundwater resulted in saline groundwater nearly 10 km inland of the sea and similar problems can be found in populated coastal areas around the world. (UNEP, 1996)

The present study reveals that the assessment of water quality deterioration is due to various reasons. The ground water quality of the different parts of Awashi village of LPIA is evaluated as it is an important potable water source in some area of the city during summer & winter. Water pollution has become a prime concern for most nations, and there is a shortage of quality drinking water all round the globe. The same story is reflected by LPIA, Chiplun. It is now-a-days emerging as a boon to Industrial sector and severe situation of degradation of environment. It is high time that each one of us contributes towards making our environment clean and healthy.

Table No.1: Collection of Water Sample along with their Source & Geodatabase.

Sample No.	Sampling Location	Lattitude	Longitude	Type of Source
GWS 1	Bhendevadi	N 17^0 37′16.3″	E073^{0}29′ 17.3″	OW
GWS 2	Tamhanvadi	N $17^0$37′ 23.8″	E073^{0}29′ 17.6″	OW
GWS 3	Malwadi	N17^{0}37′ 49.3″	E073^{0}29′ 04.2″	OW
GWS 4	Devolwadi	N $17^0$37′ 55.4″	E 073^{0}29′ 05.1″	OW
GWS 5	Buddhawadi	N $17^0$38′ 05.0″	E073^{0}29′ 16.5″	OW
GWS 6	Ganeshnagar	N $17^0$37′ 33.4″	E073^{0}28′ 30.2″	OW

GWS= Ground Water Sample, OW= Open Well

Table No.2: Physio-chemical parameter values obtained During Monsoon (Aug 2012)

Sr.No	**Temp (^{0}C)**	**pH**	**E.C (mhos.cm^{-1})**	**Turbidity (NTU)**	**T.H**	**T.Al**	**TDS**	**BOD**	**COD**	**DO**	**SO_4**
GW1.	26.2^0	6.23	0.12	0.22	36	37	225	3.2	23.2	5	10.3
GW2.	26.5^0	6.59	0.18	0.23	54	42	175	6.1	22.1	4.1	25.1
GW3.	25.9^0	7.71	0.16	0.08	70	25	296	4.9	14.9	3.8	15.3
GW4.	26.1^0	4.40	0.24	1.45	80	39	202	7.2	28.3	5.8	37.9
GW5.	24.7^0	6.68	0.07	0.49	74	51	233	5.3	25.6	4.9	23
GW6.	26.2^0	6.80	0.15	0.35	44	29	187	6.5	23.5	5.6	21.2

(All parameters except Temp, pH, EC, Turbidity are in mg/lit)

Table No. 3: Physico-chemical parameters values obtained After Monsoon (Jan2013)

Sr.No	**Temp (^{0}C)**	**pH**	**EC (mhos.cm^{-1})**	**Turbidity (NTU)**	**TH**	**T.Al**	**TDS**	**BOD**	**COD**	**DO**	**SO_4**
GW1	29.5^0	6.40	0.11	0.30	36	35	180	3.1	19.1	4.2	15.3
GW2	28.7^0	7.48	0.10	0.59	62	39	137	6.7	18.9	2.3	21.7
GW3	30.2^0	8.02	0.13	0.17	94	31	217	5.3	20.3	2.2	16.2
GW4	29.8^0	3.82	0.21	1.20	98	35	183	6.5	47.5	4.1	36.5
GW5	29.7^0	6.24	0.14	0.97	104	68	192	6.9	19.0	3.6	19.1
GW6	30.3^0	7.35	0.07	0.82	32	35	173	5.1	26.2	4.6	

(All parameters except Temp, pH, EC, Turbidity are in mg/lit)

Table No. 4: Heavy metals values During Monsoon and After Monsoon.

Sr.No	**Copper**		**Zinc**		**Chromium**		**Cadmium**		**Mercury**		**Fluoride**	
	AM	AfM	AM	AfM	AM	AfM	AM	AfM	AM	AfM	AM	AfM
GW1	0.081	0.0333	0.140	0.056	0.003	0.009	0.005	0.029	0.005	0.031	0.004	0.024
GW2	0.025	0.066	0.094	0.069	0.013	0.021	0.003	0.042	0.000	0.024	0.009	0.030
GW3	0.013	0.039	0.082	0.078	0.018	0.031	0.010	0.011	0.012	0.014	0.012	0.029
GW4	0.044	0.052	0.132	0.131	0.007	0.006	0.017	0.014	0.006	0.008	0.010	0.018
GW5	0.062	0072	0.034	0.083	0.005	0.013	0.019	0.021	0.002	0.002	0.008	0.040
GW6	0.019	0.016	0.139	0.107	0.010	0.009	0.004	0.018	0.021	0.010	0.021	0.032

(AM-At Monsoon, AfM- After Monsoon)

Table No. 5 Analysis of MPN of coliform bacteria by MPN method

Sr.No	Most Probable Number (/100ml)	
	At Monsoon	After Monsoon
GW1	4.49 / 100 ml	14.32 / 100 ml
GW2	459 / 100 ml	562.43 / 100 ml
GW3	33.09 / 100 ml	49.51 / 100 ml
GW4	16.89 / 100 ml	29.43 / 100 ml
GW5	24.33 / 100 ml	25.08 / 100 ml
GW6	9.80 / 100 ml	15.69 / 100ml

Table No. 6: Water Quality Index values calculated

Sr.No	Copper		Zinc		Chromium		Cadmium		Mercury	
	AM	AfM	AM	AfM	AM	AfM	AM	AfM	AM	AfM
GW1	162	66	2.8	1.2	6	18	50	290	500	3100
GW2	50	132	1.8	1.3	26	42	30	420	000	2400
GW3	26	78	1.6	1.4	36	62	100	110	1200	1400
GW4	88	104	2.6	2.7	14	12	170	140	60	800
GW5	124	144	0.6	0.6	10	26	190	210	200	200
GW6	38	32	2.8	2.4	20	18	40	180	2100	1000

(AM=At Monsoon; AfM=After Monsoon)

We can all provide a helping hand by minimizing the waste material in our own households, especially with the proper treatment of water. Only with a collective effort this grave problem can be tackled, before it is too late.

We may not be able to eliminate groundwater pollution from scratch, but we can definitely do our bit to protect this source of water. Moreover, governments are seen taken serious steps to fight the problem of pollution, so let's stand by it, educate ourselves and fight this evil (groundwater pollution) in unity. In order to avoid future problem it is necessary to protect ground water sources from further pollution. Periodical and continuous monitoring of ground water quality is necessary so that an appropriate step may be taken for water resources management.

LITERATURE CITED

Adekunle AS, 2008. Impact of Industrial Effluent on Quality of Well water within Asa Dam, Industrial estate, Ilorin Nigeria. *Nature and Science*" 6(3).

American Public Health Association (APHA), 1998. Standard methods for the examination of water and wastewater. 18thEdition.American Public health Association, Washington, DC 45-60.

Bheshdadia BM and Chauhan MB, 2012. Physico-chemical Analysis of Underground Drinking Water in Molbi-MaliaTerritor. **7**(1):169-173.

Boyd CE and Tucker CS, 1998. Pond Aquaculture & Water Quality Management, Klunner Academic Publications.

Naikwade PV, Sankpal ST and Jadhav BP, 2012. Management of waste by composting, vermicomposting and its use for improvement of growth, yield and quality of fodder maize, *ARPN Journal of Science and Technology* 2(5): 184-194.

Sankpal ST and Naikwade PV, 2012a. Physicochemical analysis of effluent discharge of fish processing industries in Ratnagiri, *Bioscience discovery*, 3(1):107-111.

Sankpal ST and Naikwade PV, 2012b. Heavy metal concentration in effluent discharge of pharmaceutical industries, *Science Research Reporter*, 2(1): 88–90.

Sargaokar A and Deshpande V, 2003. Development of an overall Index of Pollution for Surface Water based on a General Classification Scheme in Indian context. *Environmental Monitoring Assessment*, 89: 43-67).

Shyamlala R, Shanthi M and Lalitha P, 2008. Physico-chemical analysis of Borewell Water samples of Telungupalayam area in Coimbatore District, TN India.5 (4): 924-929.

Spalding, RF and Exner ME, 1993. Occurrence of nitrate in groundwater: A review. *Journal of Environmental Quality*, 22: 392–402

Srinivasa Rao V, 2012. Physicochemical analysis of water samples of Nujendla area in Guntur District, Andhra Pradesh, India.4(2):691-699.

Stockholm International Water Institute (SIWI), 2005. Making water a part of economic development: The Economic Benefits of Improved Water Management and Services. Retrieved December 16, 2009 from http://www.siwi.org/documents/Resources/Reports/CSD_Making_water_part_of_economic_development_2005.pdf.Spalding, R.F., and M.E. Exner. (1993). Occurrence of nitrate in groundwater: A review. Journal of Environmental Quality 22:392–402.

Strickland JDH and Parsons TR, 1972. Fisheries Research Board of Canada, Supply and Services Canada, Ottawa, Canada.

Sudhkar MR and Mamatha R, 2004. "Water Quality in Sustainable Water Management, *Current Science* 87(8).

Trivedi RK and Goel PK, 1984. Chemical and biological methods for water pollution studies Karad Environmental Publication. 1-251.

UN WWAP, 2003. United Nations World Water Assessment Programme. The World Water Development Report 1: Water for People, Water for Life. UNESCO: Paris, France.

United Nations Environment Programme (UNEP), 1996. Groundwater: a threatened resource. UNEP Environment Library No. 15, UNEP, Nairobi, Kenya.

UN-Water 2009. World Water Day brochure, http://www.unwater.org/worldwaterday /downloads/wwd09brochureenLOW.pdf.

World Health Organization (WHO). 2002. World Health Report: Reducing Risks, Promoting Healthy Life. France. Retrieved 14 July 2009, from http://www.who.int/whr/2002/en/whr02_en.pdf.

World Health Organization. (WHO), 2000. Global Water Supply and Sanitation Assessment 2000 Report. WHO and UNICEF Joint Monitoring Programme for Water Supply and Sanitation.

How to Cite this Article:

Nilesh Rokade, Sagar Sankpal Pratap Naikwade, 2014. Drinking water quality index of Avashi village of Lote Parshuram Industrial Area (LPIA) of (MS) India. *Sci. Res. Rept.,* **4**(1):94-100.