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Research Paper

Qualitative analysis of ground water from GIDC (Gujarat Industrial Development Corporation) area, Vadodara, Gujarat

Dr. Seema Verma

Department of Zoology, MSJ, Government College, Bharatpur, Rajasthan

Abstract: The world is currently experiencing a water crisis due to the growing industrialization and developmental efforts to keep up with the population boom. Due to enterprises producing vast amounts of very harmful effluents, India's ground water is fast diminishing. Monitoring the physical and chemical characteristics of water is crucial since there are many physico-chemical factors that must be evaluated. GIDC Nandesari is chosen for the study's focus as a heavily polluted industrial location. Water samples from a bore well and a dug well were taken, and their physico-chemical characteristics were examined. The environment Protection Act of 1986 should be immediately and strictly enforced, the present suggests after studying the circumstances. It's because there are few known treatments for treating badly polluted ground water.

Keywords: Water, Industrialization, Physicochemical, Nandesari.

INTRODUCTION

The advancement brought about by industrial and technical growth has undoubtedly changed the way people live, but it has also had a negative influence on the environment and human health because of the trash it produces. The businesses dispose of these chemicals in a variety of methods, which ultimately target the groundwater, soil, and water bodies. One of the greatest chemical industrial areas in Asia is Ankleshwar. The ground water is polluted in this area as a result of toxins being released directly into the environment (Table 3). Table -2 lists the chemicals and their derivatives that were discovered in the effluent discharges from the nearby industrial areas of Vadodara (Labunska *et al*., 1999; Vachhrajani and Verma, 2010).

The Ankleshwar industrial area was researched for heavy metal contamination zones in shallow aquifers and fluctuations in the qualitative status of the groundwater, which showed significant pollution levels and the occurrence of many metallic compounds simultaneously increasing the dangerous potentials (Kumar and Pawar, 2008; Kumar et al., 2008). Similar to this, there are reports of significant pollution in the industrial region near Vadodara, where the ground water is contaminated and contains high quantities of dangerous metals (Table - 4) (Verma, 2010; Vachhrajani and Verma, 2010).

Today, untreated filthy water is discharged into the delicate fresh water ecosystem, primarily as a result of human activities, development, and frequent and widespread industry. The massive amount of waste produced by an ever-growing population and industry has impacted the capacity of water bodies to clean themselves (Gosh, 2008; Khurshid *et al.*,1998). There are 30 industrial zones in the city of Vadodara, the most important of which is Nandesari. There are almost 50 small, medium, and large companies, and both groundwater and surface water are contaminated by pharmaceutical, chemical, and refining units. The intended use of water, the influence on public health, or the ecological impact are used to measure the degradation of water quality (Dwivedi, 2000; Vachhrajani and Verma, 2010; Verma, 2010).

MATERIAL AND METHODS –

Three zones managed by the Gujarat Industrial Development Corporation (GIDC) in the Vadodara industrial complex are home to hundreds of industrial units. The industrial chemical facilities are situated at Nandesari GIDC. The chemical industrial units are dispersed throughout the villages of Angarh, Nandesari, Ranoli, Bajwa, Dhanora, Karachia, and Koyali in Nandesari GIDC. For the purpose of locating shallow dug wells and bore wells, the entire industrial area was examined. The usage of bore wells or hand pumps is severely limited because this area is serviced by Vadodara's drinking water system. Although severely constrained, bore wells are nevertheless used to irrigate the agricultural areas in the suburbs. Therefore, only a small number of these sampling locations could be used in the current experiments. 500 ml limnological sampling bottles were used to collect the samples taken by the motorized pump, which were then brought to the lab for additional investigation of common limnological parameters in accordance with established procedures (APHA, 2000; Kodakar, 1992; Vachhrajani and Verma, 2010).

The so obtained surface and ground water was also used to analyse contaminants using AAS in accordance with established protocols. The analysis included total organics, phenol compounds, oil and grease, as well as metals like cadmium, chromium, copper, cobalt, iron, lead, nickel, and zinc. The samples were filtered using a vacuum pump through a membrane filter

(0.45 m), concentrated by evaporating in a hot air oven at 100°C, treated with concentrated HNO3, and then subjected to an AAS analysis. Table -1 lists the minimal detection thresholds for heavy metals.

RESULT AND DISCUSSION –

Vadodara's industrial area encompasses multiple villages, and its effects can be felt throughout a much wider region. The industrial pollutants are anticipated to have an impact on the ground water throughout this region. In the study, many ground water sites were studied to better understand the impact of contamination. Since the focus of growth in this area has been on industries rather than civic facilities, flooding during the monsoon has always been an issue there. In the end, this would result in the widespread distribution of dangerous substances in both surface water and ground water.

As a result, the industrial area surrounding Vadodara has been polluting its subsurface area for more than three decades. Pollution of a range of resources has led to the biomagnification of toxicants in diverse trophic statuses of different ecosystems. Surface and ground water supplies have been distinctly documented to be contaminated in numerous studies conducted in industrial locations throughout the world (Alaoui, 2008) and various states in India (Gupta and Saxena, 1996; Prasad and Jaiprakash, 1999; Rai, 2009). Heavy metals were also discovered in ground water in some regions (Rajmohan, 2005).

A 56 km long channel that transports wastewater from nearby industry to the Mahi estuary travels through the districts of Vadodara and Bharuch. Sadly, over time, farmers in the neighbouring communities have used this channel as a free source of irrigation water. Groundwater samples from wells 50 to 200 metres away from the effluent channel had significant concentrations of total solids, total dissolved solids, chemical oxygen demand, metals, chlorides, sulphates, and nitrates, according to analysis. Additionally, compared to produce cultivated in other places, produce grown in the channel areas has a significantly greater metal concentration, including fruits, vegetables, and cereal grains (Sharma, 1995). Additionally, the Gulf of Khambhat's estuary vegetation and wildlife have rapidly declined in quality (Nanda and Vachhrajani, 2002). Complex interactions exist between surface water and groundwater. As a result, groundwater pollution is more difficult to categorise than surface water pollution.

Table – 1: Minimum detection limits for heavy metals as per AAS analysis

Metal	Reading wave length (nm)	Minimum detection limit (ug/ml)
Cadmium	228.8	0.02
Chromium	357.9	0.1
Cobalt	240.7	0.1
Copper	324.7	0.04
Nickel	232	0.1
lead	217	0.25

Table 2: Chemicals and derivatives found in the effluent discharges from the industries around Vadodara as given by Labunska *et al.*, 1999.

Industrial waste water	Industrial Solid waste
1,1-Biphenyl and derivatives	1,1-Biphenyl and derivatives
1,3 Butadiene and derivatives	1-Tetradecene
6- -Tridecene	Aliphatic hydrocarbons
9 H-Carbazole	Alkylbenzenes
Acridine derivative	Azulene
Aliphatic hydrocarbons	Benzenamine and derivatives
Alkylbenzenes	Benzene and derivatives
Alkylphenol derivatives	Ocytyl phenol
Benzenamine and derivatives	Benzene methanol
Benzene and derivatives	Biphenyl derivatives
Benzenemethanamine	Chlorinated methoxy benzene
Benzenemethanol	Diazene
Benzenethiol	Dibenzothiophene and derivatives
Benzofuran	Docosane
Benzonitrile	Eicosane
Chlorinated benzenamine	Heneicosane
Cyclododecane	Heptadecane and derivatives
Cyclohexadecane	Hexacosane
Decane	Hexadecane and derivatives
DEHP	Naphthalene derivative
Diazene and derivatives	Nonadecane and derivatives

Disulfide	Octadecane and derivatives
Docosane	Octadecanoic acid,
Eicosane	Organosulphur compounds
Eicosane	PCB-135, 136
Ethanone	Pentacosane
Heneicosane	Pentadecane and derivatives
Junipene	Phenanthrene derivative
Naphthalene derivative	Tetracosane
Nonadecane	Tricosane and derivatives
Octadecane	Tridecane
Organonitrogen compounds	
Organosulphur compounds	
PCB-3,9,10,13, 19,24	
Pentadecane	
Phenazine	
Pthalates	
Pyridine	
Thiophene	
Tricosane	
Tridecane	
Valencene	

Table 3: Ground water status in the industrial area around Vadodara

	Units	Ranoli Gram Panchayat ground water	Dhanora Gram Panchayat ground water	Angarh Gram Panchayat ground water	Nandesari Gram Panchayat ground water	Koyali Gram Panchayat ground water
Color		Colorless	Colorless	Colorless	Colorless	Colorless
Turbidity	NTU	1	1	2	6	2
TDS	mg/l	1099	1180	1215	1482	1093
pH	mg/l	7.6	7.7	8	7.3	7.6
Total hardness	mg/l	412	396	346	510	296
Calcium	mg/l	32	25	42	42	20
Magnesium	mg/l	48	34	58	69	12
Chlorides	mg/l	310	345	428	764	326
Alkalinity	mg/l	327	324	410	310	414
Sulphate	mg/l	33	32	32	98	28
Nitrate	mg/l	1.8	0.9	2.3	2.6	1.3
DO	mg/l	4.8	4.5	4.1	41	4.3
BOD	mg/l	18	14	8	22	12
Iron	mg/l	0.11	0.10	0.15	0.51	0.41

Table 4: Chemical analysis of industrial effluent collected from the effluent channel release site

	1996	1997	1998	1999	2000	2003	2005	2006
pH	7.2	6.8	7.4	7.2	6.7	7.0	6.9	7.8
Temperature	30.5	30	29.5	30	30	29.5	31	28.8
COD	350	227	208	215	320	376	395	428
BOD	186	103	356	128	204	228	243	250
TDS	1025	850	735	740	874	760	1102	1085
Oil And Grease	18	12	2	10	14	35	27	48.0
Phenols	1.2	0.59	ND	0.85	0.82	0.67	1.06	3.14
Ammonical Nitrogen	5.55	6.40	5.50	3.5	4.2	6.8	6.3	5.6
Total Kjeldahl N2	7.3	9.5	5.8	5.5	8.3	4.6	6.3	7.4
Copper	1.65	0.40	0.11	0.30	0.62	0.37	0.42	0.75
Mercury	0.83	0.72	ND	0.4	0.06	0.21	0.03	BDL
Lead	1.50	2.1	0.06	0.30	0.61	0.86	1.22	0.18
Cobalt	2.85	2.93	1.16	0.62	0.23	0.51	0.09	0.08
Cadmium	0.65	0.75	0.50	0.33	0.31	0.17	0.21	0.15
Arsenic	0.03	0.02	ND	ND	ND	ND	ND	ND

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Nickel	1.50	1.8	0.75	0.65	1.22	1.05	0.74	0.34
Chromium	2.45	1.29	2.62	1.86	0.63	1.16	0.65	0..28
Iron	3.80	1.7	1.35	0.66	2.59	2.32	1.08	0.52
Zinc	2.20	1.15	0.68	0.55	1.85	1.46	0.93	1.31

CONCLUSION –

In the last 50 years, Vadodara's industrial sector has expanded significantly. Industrial buildings have largely replaced agricultural fields as the predominant form of land use. Prior to 20 years ago, greater regions near the industries were utilised as landfills for solid garbage. Some of the sites were recently closed off, while new industrial buildings sprouted up at other locations. In this area, discontinuing solid waste disposal or closing solid waste disposal plants has not actually reduced pollution.

The distinction between a point source and a non-point source may not matter because groundwater aquifers are vulnerable to contamination from sources that may not directly affect surface water bodies. There are records of multiple complaints made concerning the quality of the water in the nearby districts by locals in the 1970s and 1980s. Deeper than 60 metres, the groundwater has been seriously contaminated. According to accounts, untreated effluent from the area's pesticide, agrochemical, and dye manufacturers has been dumped in the rivulets. Due to an increase in the discharge of industrial and agricultural waste, many ponds in Vadodara are known to be polluted. The main factor in improving the quality of the aquatic body in the industrial vicinity may be subsurface and groundwater management (Vachhrajani and Verma, 2010; Verma, 2010).

The GIDC industrial area's ground water has already suffered severe pollution, as is obvious. It is regrettable that groundwater, a natural gift, ends up being a man-made problem. In this area, finding high-quality ground water is now practically difficult. Therefore, strict implementation of the environment Protection Act of 1986 is urgently needed.

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