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Reassessment of Geological Inputs and Anthropogenic Pressure on Aquifers at Agra - Mathura Region

Susan Verghese. P

Asso. Professor, Dept of Chemistry, St. John's College, Agra.

*Corresponding Author: drsusanverghesep@gmail.com

Abstract

Industrialization has brought in water pollution which is one of the major hazards facing environment today with rapid growth of population coupled with increasing urbanization and agriculture. The demand for water in Uttar Pradesh s continually on the increase. Still more than one billion people all over the world do not have ready access to an adequate and safe water supply and more than 800 million of those unsaved live in rural area. In India, ground water is being used as raw water for 85% public water supply and water supply varies widely in terms of region and country. At the beginning of 1980s, water supply coverage has 75% urban areas and 46% rural areas. Therefore, quality of water is the most important parameter which is required to be monitored in any area for sustainable development. The notion to assess groundwater and sort out the contaminated region economically is very significant. An approach where six basic physical and chemical parameters like TDS, conductivity, pH, turbidity, fluoride ,. heavy metals (Pb,Cu,Cr and Zn) concentration were utilized to assess the quality of ground water. The concentration of flouride is extremely high at Mathura (Vrindawan- 200,ppm, Chotikhana,- 50ppm , Goverdhan, - 20 ppm, Baldev -20 ppm, Refinery town ship -50ppm and Mathura Industrial area, 50, ppm) and concentration of heavy metals like lead, chromium and copper are also objectionably higher than the permissible limit for drinking water given by W H O.

Keywords: water pollution, physical and chemical parameters, heavy metals .

Introduction

Water pollution is a major global problem which requires ongoing evaluation and revision of water resource policy at all levels, international down to individual aquifers and wells. It has been suggested that it is the leading worldwide cause of deaths and diseases and that it accounts for the deaths of more than 14,000 people daily (1) .An estimated 700 million have no access to a proper toilet and 1000 Indian children die of diarrheal sickness everyday and nearly 500 million people lack access to safe drinking water. Ground water is susceptible to contamination from sources that may directly affect surface water bodies and the distinction of point vs. non- point source may be irrelevant. A spill or ongoing release of chemical or contaminants into soil may not create point source or non- point source pollution but can contaminate the aquifer below, defined as toxin .Analysis of ground water contamination may focus on the characteristics and site geology and the nature of the contaminants (3) hence this paper is an attempt to this throw light into the various contaminants found in ground water of Agra and Mathura region.

Materials and Methods

The Agra city is famous as Taj city in the world and a well known business center. It is situated at 27.10'N and 78.5'E in north central part of India. It is bounded by the Thar Desert of Rajasthan on its South, East, West and North West peripheries, hence it is a semiarid zone of 120 Km 2 area. It is fourth most popular city of Uttar Pradesh having 2.5 million populations.

In Agra, there are a number of small scale industries such as carpet manufacturing, shoes manufacturing, petha industry,electro plating industries pharmaceuticals,

cosmetic, factories manufacturing glassware, knives, scissors and other cutlery. Agra's Iron foundries, leather industry and the Mathura oil refinery were identified as prime source of pollution mainly in three components of air water and soil. The commercial and tourist activity of Agra and Mathura has increased manifold to meet demands of the locals as well as capital city of India which is just 200km away. There activities are of considerable importance for socio – economic growth and continuous modification in the physical chemical and biological composition of 46% rural areas. Therefore, quality of our living environment as a result millions of people living in and around urban centers are exposed to an unnatural and unhealthy environment.

Climate

The climate is tropical dry and continental type .Meteorologically the year is divided into three distinct seasons: Summer (March-June), Rainy (July-September) and winter (October-February).Studies indicate that winds in Agra and Mathura generally blow from directions between South-West and North-West during mornings and between west and north during afternoons (IMD- 1989). In the monsoon seasons, winds from directions between north-east and south-east are also common. Dust storms and thunder storms are frequently observed during the period from March to June. The winds speeds vary from 2.6 to 6.9km h-1 with maximum during summer and monsoons and minimum in winters (IMD- 1989).

Industrial Emission Layouts

Agra has been the traditional seat of iron casting products from Mughal period. With the passage of time there were approximately 250 foundry units before 1993. Major polluting industry in Agra city are gray iron foundaries, pit furnaces, chemical industries ,lime processing unit, refractory brick kilns, rubber processing units etc In Mathura, refinery is the main polluter of the environment apart from textile and dye industries.

Table:1 Industrial Development in Agra, Number and kinds of industrial in Agra.

S. No.	Kinds of SSI Units	Number of SSI Units
1.	Non metallic mineral products	347
2.	Metal Products	169
3.	Machinery I Part except electrical	273
4.	Electrical Machinery apparatus	273
5.	Repairing and servicing industry	729
6.	Chemical and chemical products	119
7.	Rubber & Plastic	198
8.	Leather Products	268
9.	Paper products & Printing	68
10.	Wood Products	349
11.	Hosiery & Garments	668
12.	Food Products	239
13.	Beverage and tobacco products	10
14.	Miscellaneous Manufacturing	1000
Source GM Office, District Industries Center, Nunihai, Agra (2010)		

Land use pattern

Most of the land has been cleared of forest and at present 10% of the land area is in pasture. About 30% of the area is in cropland although acreage varies rudely from block to block depending mainly on the topography. Farms are mostly small to medium size. Wheat is the main cash crop. Bajra barely linlel and gram are also grown. Live stock uses most of the course grain pasture and hey product .There are many cow and buffalo farms in the region. The production of milk is very significant. The forest vegetation is mixed hard woods.

Geology and topography.

The topography ranges from slightly dissected hills that contain the oldest rocks exposed in some placers; dominantly thick bedded limestone of Middle Ordovician age that were raised to their present position by uplift. It is characterized by gently rolling terrain and a thick fertile residual soil. Some of the lime stone strata are phosphates and weathering of these rocks has enhanced the fertility of the soil. The rock formation is mainly lime stone but is inter bedded with thin layers of calcareous shale.

Water resources.

Water is present as both surface and ground water. Surface water occurs in river, ponds and reservoirs. Ground water occurs in the pore spaces within rocks and alluvium in fractures and in solution openings or conduits in area under line by carbonate rocks (lime stone). The median depth to ground water in Agra city is about 30m and Mathura city about 32m. Surface water system through sinkholes and cave opening surface and ground water supplies are susceptible to pollution from natural agricultural and industrial source. Naturally occurring substances such as Iron, manganese barium fluoride, hydrogen sulphide and salt may be present at objectionable levels. Bacteria from sewage septic lanks and animal wastes are a common problem. High levels of nitrate- nitrogen pesticides and organic chemicals threaten water suppliers in some areas.

Soils pattern

Soils are fine to moderately fine to moderately fine textured and have a me sic temperature regime, audic moisture regime and mixed mineralogy. The soils are net moderately mineralogy. The soils are net moderately deep and well dawned. They were formed in sandy residuum from thinly bedded timeslot and siltstone. Sound soles, occur on rolling ridge tops and side slopes with many dissections by small streams near the Yamuna river. They are deep to shallow well drawn and formed in clayey residuum from limestone or time stone inter bedded with shale.

Sampling, processing and analysis

The water samples were collected from six sampling sites in Mathura (stations M1 – Vrindawan, M2- Chotikhana, M3- Goverdhan, M4- Balde, M5- Refinery town ship of six and M6- Mathura Industrial area) and water samples were collected from. Agra station A1- Kamla Nagar A2- Madhu Nagar, A3- Avas Vikas, A4- St. John's College campus, A5- Loha Mandi, A6- Kheria Mor, Physical Parameters were analyzed at site by using water analyzer kit and chemical parameters were analyzed in the laboratory .Analytical methods were adopted as per the standard method for the examination of water and waste water (APHA, 1989)

Results and Discussion

The specific contaminants leading to pollution in water include a wide spectrum of chemical and physical sensory changes. Ground water pollution is much more difficult to abate their surface pollution because ground water can move great distance through unseen area. Ground water that moves through evicts and caverns is ner feted and can be transported as casely as surface water. water pollution may be analyzed through several broad categories of methods: physical, chemical and biological.

Total dissolved solids and electrical conductance at all sites(M1-M6 and A1-A6) exceeds premisible limit given by WHO. According to WHO 1984 and Indian Standard drinking water (9)specification 1991 the maximum permissible limit of fluoride in drinking water is 1.5ppm. Above this in drinking water causes dental fluorosis and skeletal fluorosis. Concentration of F^- in M_1-M_6 are extremely higher than the permissible limits. India is among the 23 nations around the globe where health problems occur due to the consumption fluoride contaminated water.

Pollution due to the presence of heavy metals in ground water is a very serious environmental problem because of their toxic effects, non-biodegradability ,accumulation in living tissues and effect on the food chain as they can easily enter human and animal bodies. Lead from the atmosphere or soil can contaminate the ground water and surface water. Lead poisoning in human beings can cause damage to the nervous system reproductive system liver, kidney and brain. These heavy metals are released from various industries like electroplating, textile ,dying, metal finishing ,refinery ,galvanizing, glass, ceramics and agricultural activities etc into water bodies (2-5,10) According to US Environmental protection agency the permissible limit of pb (11) in drinking water is 0.015 mg/l and the concentration of lead exceeds in in all sites ,much higher than the permissible limits.

Chromium is unique among regulated toxic elements in the environment due to its varied toxicity different oxidation numbers and is treated differently. Chromium exists in +3 and +6 oxidation states as other oxidation states are not slable in aqueous solution. Chromium III is a dietary requirement for a number of organisms. Hexavalent chromium is very toxic to flora and fauna. Health effects related to (VI) exposure include diarrhea stomach and intestinal bleeding cramps liver and kidney damage. Hexavalent chromium is mutagenic (6-9) the world health organisation has established 0.05 mg/l as a maximum allowable concentration of CR(VI) in drinking water. The concentration of chromium in all samples exceed the permissible limit. (Table 2)

Table 2 Physico- chemical parameters of ground water at Mathura (M1-M6) and Agra (A1-A6) region

Sl.No	Site	Conductivity	TDS	COD	PH	Cu ppm	Cr	pb	Temp.	Zn
1	M1	5.88ms	922ppm		7.68	0.216	3.312	0.391	30.0	0.996
2	M2	7.10ms	1026ppm		8.23	0.1230	2.022	0.320	30.2	0.581
3	M3	7.73ms	793ppm		7.73	0.134	4.794	0.584	30.2	0.931
4	M4	6.98ms	1243ppm		7.78	0.142	4.365	0.953	30.1	0.324
5	M5	6.92ms	1243ppm		8.01	0.152	3.321	0.558	30.1	0.556
6	M6	5.43ms	1456ppm		7.90	0.253	2.081	0.382	30.0	0.325
7	A1	5.91ms	1456ppm		7,12	0.234	1.012	0.391	31.1	0.342
8	A2	5.43ms	1243ppm		7.32	0.124	0.982	0.201	31.2	0.238
9	A3	5.42ms	1254ppm		7.92	0.125	0.678	0.231	31.1	0.523
10	A4	5.41ms	1342ppm		7.32	0.211	0.342	0.234	31,1	0.421
11	A5	6.34ms	1543ppm		7.54	0.121	0.432	0.256	31.2	0.321
12	A6	7.45ms	1324ppm		7.54	0.127	0.124	0.156		0.487
Permissible limit(WHO)		0.30-0.40ms	200-500ppm		6.5-7.9	0.05	0.05	0.01	25-32	

Conclusion

It, is, therefore, concluded that, tourist cities like Agra and Mathura ground water is highly polluted. Adequate measures need to be adopted by citizens to use it as a potable water. Alarmingly high concentration of fluoride, lead, copper and chromium and high value of total dissolved solid indicates that ground water at these sites are not at all good and more studies in and around these cities need to be done to know more about the cause of these type of pollutants found in ground water.

Suggestions

1. An adequate supply of safe drinking water for Mathura and Agra citizens

2. Contaminating sources, their flow direction and disposal sites should be decided keeping in view of the density of population.

3. Further studies need to be conducted for monitoring other heavy metals.

4. To develop suitable techniques either to prevent or to reduce the contamenants

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