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PHYSICO-CHEMICAL ANALYSIS OF WATER IN AND AROUND SATNA DISTRICT

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ABSTRACT Water represents the basic elements supporting life and the natural environment, a primary component for industry, a consumer item for humans and animals, and a vector for domestic and industrial pollution. Much of ill health that affects humanity, especially in the developing countries can be traced to lack of safe and wholesome water supply. There can be not state of positive health and well being without water. The study was aimed at examining the various samples of drinking water and the quality of the groundwater as it relates to public health.

Water samples collected during the July-October of 2017 from the study area/region and the samples were analyzed for various physical and chemical properties. During the study it was found that Total Dissolved Solids varies from 645 mg/L to 888 mg/L and compared with permissible limits. The concentration of calcium and magnesium in all water samples is very high. Therefore, the best accepted option is to avoid the possibility of polluting the groundwater resources.

KEYWORDS : Contamination, Physical and Chemical Properties.

Introduction:

Water is one of the most significant and precious gift of nature. 3/4 parts of our earth are covered by water, but only approximately 1.0 % of the total water is fresh and useable for drinking, bathing, irrigation and other domestic purposes. Water is an essential natural resource and an absolute necessity for sustaining life. Water is not only the most valuable constituent of all animals, plants and other organisms but it is also pivotal for the survivability of the mankind in the biosphere. It is the lifeblood of the environment. Human beings solely depend upon the availability of fresh water for living and livelihood and in its natural state it is a 'savior of life'. One can hardly live without water even for a few days. Today, by ignoring these facts, man is indiscriminately polluting water and unknowingly providing nature a complex situation.

Ground water quality depends on the quality of recharged water atmospheric precipitation inland surface water and sub-surface geochemical processes. Temporal change in the origin and constitution of the recharged water, hydrologic and human factors may cause periodic change in ground water quality. Water pollution not only affects water quality but also threats human health, economic development and social prosperity. Ground water is a source of drinking water and even today more than half of the word population depends on ground water for survival. The assessment of water quality is very important for knowing the suitability for various purposes. Assessment of ground water for drinking and irrigation has become a necessary and important task for present and future ground water quality monitoring and evaluation for domestic and agricultural activities around the world. Water is prime need for human survival ad industrial development. For many rural and small communities ground water is the only source of drinking water [1-2].

Studied the ground water quality in down town Srinagar, Kashmir and reported that the temperature of tube well waters ranged from 170C to 21.40C [3]. A lot of work on drinking water quality and ground water quality of different parts of India has been carried out by various workers viz. [4 -7].

Groundwater is that portion of subsurface water which occupies the part of the ground that is fully saturated and flows into a storage area under pressure greater than atmospheric pressure. Groundwater occurs in geological formations known as aquifer. [8] Landfills are considered as one of the major threats to the groundwater [9-10]. The scale of this threat depends on the concentration and toxicity of contaminants in leachate, type and permeability of geologic strata, depth of water table and the direction of groundwater flow [11]. Water through rainfall is mixed with the water already present in the solid waste piles which causes the leachate to leave the dumping ground as infiltration in lateral or vertical directions to find its way into the ground water thereby causing the contamination [12-13]. Municipal landfill leachate is highly concentrated complex effluent which contains dissolved organic matters; inorganic compounds such as ammonium, calcium, magnesium, sodium, potassium, iron, sulphates, chlorides and heavy metals such as cadmium, chromium, copper, lead, zinc, nickel; and xenobiotic organic substances [14-15]. It is therefore necessary to check the quality of ground water at regular time intervals to study the danger of its possible contamination which may cause water-borne diseases to human population. The determination of physical & chemical parameters of water samples which also dictate various other life processes should be taken as an environmentally viable study [16-17]. The present study involves the analysis of water quality in terms of various parameters of water in and around the different sites of Satna district, M.P.

Material and Methods

Description of the Study Area:

The ten major towns of Satna district were selected for the study of subsurface water quality in the vicinity of municipal solid waste dumping sites of Satna district. These dumping sites are from Hawai patti Satna, Amarpatan, Rampur, Maihar Hospital, Unchehara, Nagod, Birsinghpur, Kothi, Majhagwan and Chitrakoot.

Sampling and Analysis:

Survey was conducted during the months of July-October of year 2017 of the ten different sampling sites around Satna District. Sampling was done in accordance with grab sampling methods in 1litre plastic containers and prior to collection all the bottles were washed with non-ionic detergent and rinsed with de-ionized water prior to usage. Before the final water sampling was done, the bottles were rinsed three times with well water at the point of collection. During sampling from hand pumps and bore wells, the water pumped to waste for about five minutes and sample was collected directly. Each bottle was labeled according to sampling location while all the samples were preserved at 4ºC and transported to the laboratory.

Physico-Chemical Analysis:

All the samples were analyzed for the following parameters: Temperature, pH, Electrical Conductivity, Turbidity, Total Dissolved Solid, Total Alkalinity, Total Hardness, Chloride, Calcium hardness, Magnesium hardness, Dissolved Oxygen, Biological Oxygen Demand, Chemical Oxygen Demand, Fluoride, Nitrate, Nitrite, Sulphate. The physicochemical analysis of water samples were carried out in accordance to standard analytical methods (APHA). pH determination was carried out by digital pH meter, turbidity by using Nephelometric turbidity meter. The heavy metals were analyzed by using Atomic Absorption Spectrophotometer.

Result and Discussion

In present study the water samples were collected in the ten different sites of Satna district. The physico-chemical characteristics of subsurface water sample of Satna district of ten different sites are presented in Table-1.

Temperature: The temperature of bore-well water samples varies

from 24.40C to 29.40 C.

pH: The pH of all the water samples was about neutral, the range being 6.45 to 7.90.

Turbidity: Turbidity of all the water samples ranges from 1.5 to 2.9 NTU, the values are under the limits of BIS.

Electrical Conductivity (EC): The EC of all the water samples varies from 672µS/cm to 846µS/cm. It is a valuable indicator of the amount of material dissolved in the water. The high value of EC can be related to the effect of the leachate seepage towards the bore-wells.

Total Dissolved Solids (TDS): Total Dissolved Solids indicates the general nature of water quality or salinity. The range of TDS for water samples varies from 645 mg/l - 888 mg/l. The TDS concentration was found to be above the permissible limit may be due to the leaching of various pollutants into the ground water. The ground water pollution from refuge in the vicinity of the dumping sites is detectable through increased TDS concentration of water [18]. High concentration of TDS decreases the palatability and may cause gastro-intestinal irritation in human and may also have laxative effect particularly upon transits [19].

Total Alkalinity (TA): The concentration of Total Alkalinity as $CaCO_3$ in all the water samples ranges from 139 mg/l to 172 mg/l which are under the limits of BIS.

Total Suspended Solids (TSS): The range of TSS for the water samples varies from 36 mg/l to 74 mg/l. It may be due to the presence of several suspended particles. The total suspended solids are composed of carbonates, bicarbonates, chlorides, phosphates and nitrates of Ca, Mg, Na, K, Mn, organic matter, salt and other particles. The effect of presence of total suspended solids is the turbidity due to silt and organic matter. When the concentration of suspended solids is high it may be aesthetically unsatisfactory for bathing [20].

Total Hardness (TH): The total hardness of water samples varies from 312 mg/l to 398 mg/l, the desirable limit for hardness of water is 300 mg/l. The water in all sampling point is very hard.

Calcium Hardness: Calcium hardness in ground water samples ranged from 214 mg/l to 267 mg/l. The desirable limit for calcium is 75 mg/l, the concentration of calcium in all water samples is very high. Calcium often comes from carbonate based minerals, such as calcite and dolomite. The excess of calcium causes concretions in the body such as kidney and bladder stones and irritation in urinary passages.

Magnesium Hardness: Magnesium hardness in the bore-well water samples varies from 88 mg/l to 142 mg/l, the desirable for magnesium is 30 mg/l., the concentration of magnesium in all water samples is very high. Magnesium salts are cathartic and diuretic and high concentration may cause laxative effect, while deficiency may cause structural and functional changes. It is essential as an activator of many enzyme systems [19].

Dissolved Oxygen (DO): Dissolved Oxygen is one of the most important measures of water quality. It is found in the water samples ranges from 4.6 mg/l to 6.6 mg/l.

COD: The COD level in the water samples ranges from 5.9 mg/l to 9.4 mg/l, the COD is a measure of oxygen equivalent to the organic and non-organic matter content of water susceptible to the oxidation by a strong chemical oxidant and thus is an index of organic pollution [21].

BOD: The BOD level in the water samples range from 2.9 mg/l to 3.6 mg/l, the BOD is a measure of the amount of oxygen that microbes need to stabilize biologically oxidizable matter.

Chloride: The concentration of Chloride in the water samples ranged between 34 mg/l to 86 mg/l. which are under the limits of BIS. An excess of Chloride in water is usually taken as an index of pollution and considered as a tracer for ground water contamination [22].The Chloride content of ground water is likely to originate from pollution sources such as domestic effluents, fertilizers, septic tank and from the natural sources such as rainfall and the dissolution of fluid inclusion. Increase in chloride level is injurious to the people suffering from diseases of heart or kidney [19].

Fluoride: The concentration of Fluoride in the water samples ranged from 0.12 mg/l to 0.92 mg/l. Fluoride at low concentration in drinking water has been considered beneficial but high concentration may cause dental fluorosis (tooth mottling) and more seriously skeletal fluorosis [23].

Nitrate: The concentration of nitrate in water samples ranges from 0.01 mg/l to 5.80 mg/l, the values are under the limits of BIS.

Nitrite: The concentration of nitrite in water samples ranges from 0.22 mg/l to 5.52 mg/l.

Sulphate: The concentration of sulphate in water samples ranged from 0.70 mg/l to 4.61 mg/l, values are under the limits of BIS.

Heavy Metals: The water samples were analyzed for heavy metals such as Iron, Lead, Zinc, Nickel and Copper, which are characterized as undesirable metals in drinking water. The concentration of these metals was found to be below the BIS limit in ground water samples. This indicates that these metals are possibly absorbed by the soil strata or by the organic matter in soil.

Table-1. Physico-Chemical Parameters of the water samples.

SN	Parameters	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
1	Temperature (^{0}C)	29.1	28.3	28.3	28.6	29.4	27.9	25.6	25.6	27.7	24.4
2	pH	6.80	7.80	7.45	7.90	7.86	6.70	7.83	6.68	7.55	6.78
3	Turbidity (NTU)	2.9	2.8	2.6	1.5	1.6	2.0	1.8	2.0	1.6	2.0
4	Electrical Conductivity (µS/cm))	823	803	706	715	846	803	672	795	813	819
5	TDS (mg/l)	888	751	769	780	837	880	645	756	774	807
6	TSS (mg/l)	74	58	46	46	54	36	42	45	59	68
7	Total Solids (mg/l)	962	809	815	826	891	916	687	801	833	875
8	Total Alkalinity (mg/l)	172	135	164	159	153	140	148	145	156	167
9	Total Hardness (mg/l)	398	332	329	386	359	365	359	345	320	312
10	Calcium Hardness (mg/l)	256	228	227	258	247	248	267	243	232	214
11	Magnesium Hardness (mg/l)	142	104	102	128	112	117	92	102	88	98
12	Dissolved Oxygen (mg/l)	4.6	6.6	5.7	5.3	4.2	5.0	4.7	5.2	4.6	5.2
13	COD (mg/l)	8.9	8.1	6.4	9.4	8.1	6.4	8.5	5.9	7.7	6.4
14	BOD (mg/l)	3.6	3.1	2.9	3.2	3.4	2.9	3.3	3.3	3.1	3.5
15	Chlorides (mg/l)	56	71	48	77	86	34	77	54	80	68
16	Fluorides (mg/l)	0.72	0.12	0.42	0.42	0.52	0.92	0.72	0.52	0.62	0.32
17	Nitrate (mg/l)	3.52	3.47	5.82	4.14	1.80	4.67	0.12	0.62	0.03	0.37
18	Nitrite (mg/l)	1.27	5.12	0.32	0.22	5.27	5.24	3.69	0.32	5.52	2.22
19	Sulphate (mg/l)	3.35	1.10	4.61	3.47	2.42	0.70	3.19	2.81	3.82	1.23
20	Iron as Fe (mg/l)	0.56	0.04	0.39	0.22	0.43	0.31	0.40	0.32	0.36	0.21
21	Lead as Pb (mg/l)	0.71	0.62	0.61	0.51	0.68	0.66	0.57	0.81	0.56	0.69
22	Zink as Zn (mg/l)	0.02	ND	ND	ND	0.01	ND	ND	0.02	ND	0.01

S1-Hawai patti Satna, S2-Amarpatan, S3-Rampur S4-Maihar Hospital, S5-Unchehra, S6-Nagod, S7-Birsinghpur, S8-Kothi S9-Majhgawan, S10-Chitrakoot and ND-Not Detectable.

Conclusion:

From the present study of physico-chemical analysis of subsurface water in the vicinity of sites, it is found that some of the parameters like Total Dissolved Solid (TDS), Total Hardness (TH), Calcium and

Magnesium concentration are above the limits of Indian Standard for drinking water (BIS- 10500:1991) and WHO. The higher concentration of TDS shows the penetration of landfill leachate has occurred to the subsurface water and polluted the water. While total hardness (TH) and Calcium and Magnesium hardness is due to the soil of that area because the place is renowned for Dolomite mines and Limestone.

Although the water quality is just good but it needs to be maintained from being polluted due to municipal solid waste dumping sites for the future. The emphasis should be given to improve the waste management practices and construct properly engineered landfill sites to curtail the ground water pollution. It is need of human to expand awareness among the people to maintain the cleanness of water at their highest quality and purity levels to achieve a healthy life.

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