IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Assessment of Ground Water Quality in After Monsoon period in Region of Comrawli Village (Jagdishpur) District Sultanpur

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Abstract

In this investigation we have studied the impact of industries on ground water and compared the data wuth the prescribed BIS:IS: 10500,2003 standards. We found that so far the parameters are well within the standard desirable limit except alkalinity , hardness and sulphate concentration are not under desirable limit but it is under permissible limits. Chloride and fluoride ion concentration is slightly higher near cement industries . But all data is under permissible limits . So we can conclude that the ecological imbalances of the area of Comrawli village appear to be normal,because the parameters are also present on slight high concentration than desirable limits.

Keywords: Physico chemical characteristics, ground water , pH, anions , metal , bacteriological study

INTRODUCTION

One of the most natural resource which is widely distributed on earth is Ground water . It is a potential source of water supply throughout the world. Water is also an integral part of this ecosystem and in nature clean water results only when biotic components are capable of performing their functions effectively. One of the major concern for humans is the standard of because it is directly related to health of human beings. In India which is a densely populated country the maximum source of drinking water supply is dependent on ground water. The water obtaind from the ground is considered to be free from pollutants than surface water. The contamination of ground water is due to the life style adapted by humans[1-4]. The diversified use of ground water is all around in day to day life including each and every sector such as domestic, farming, industry and many more[5]. It is therefore mandatory to maintain its originality and purity of water because if adulterated than it will become difficult to reinstate to its native form[6].

The increasing need for groundwater, along with the growing impact of groundwater at a site is degraded so monitoring of groundwater quality is the need of the day. In earlier paper[7] we have reported the data of monsoon period The present paper tries to investigate the water quality status of village Comrawli (Jagdishpur) District Sultanpur of after monsoon period. This area was chosen for present study due to the presence of number of industries like Indogulf ,B.H.E.L., Malvica and Marva cement industries. The sampling was done in after monsoon at all the site locations. The different parameters are pH, alkalinity, hardness, chloride, sulphate, nitrate, phosphate, fluoride, sodium, potassium, calcium, magnesium, boron, iron, manganese, copper, chromium, lead, cadmium and zi**nc.**

Material and Methods:

Sample collection

The samples were collected from one of the following three types of wells depending upon the availability

i) Open dug wells

ii) Tube wells

iii) Hand Pumps

A weighted sample bottle or sampler was used for collecting the samples which were collected directly in to the pre-sterilized glass bottles. The samples were transported to the laboratory, which were analyzed within a week time. The mercury thermometer was used to temperature on site.

S. No.	Name of Sampling site	Site Code	DW/ OW	TW	HP	BW	Others
1.	Indogulf Fertilizer	S1	x	X	√	X	x
2.	B.H.E.L	S2	x	√	√	X	
3.	Malvica Cement	S3	x	X	√	X	x
4.	Marva cement	S4	x	X	√	X	x
5.	Arif Cement	S5	x	X	√	X	x
6.	Rhenather Textile	S6	x	√	√	X	x
7.	SAIL	S7	x	X	√	X	x
8.	Apex Shoes Factory	S8	x	√	√	X	x

Sampling Period

The sampling was done in After Monsoon (October) at all the site locations.

Parameters Analyzed

The physical and chemical analysis was performed following standard methods[8]. The brief details of analytical methods and equipment used in the study are as follows:

S. No.	Parameter	Method	Instruments/Equipment

A.	**Physico-chemical Parameters**		
	Ph	Electrometric	pH Meter
	Alkalinity	Titration by H_2SO_4	-
	Hardness	Titration by EDTA	-
	Chloride	Titration by $AgNO_3$	-
	Sulphate	Turbidimetric	Turbidity Meter
	Nitrate	Ultraviolet screening	UV-VIS Spectrophotometer
	Phosphate	Molybdophosphoric acid	UV-VIS Spectrophotometer
	Fluoride	SPADNS	UV-VIS Spectrophotometer
	Sodium	Flame emission	Flame Photometer
	Potassium	Flame emission	Flame Photometer
	Calcium	Titration by EDTA	-
	Magnesium	Titration by EDTA	-
	Boron	Carmine	UV-VIS Spectrophotometer

									0.20
									ND
									ND
									ND

									ND
									ND
									4.1

Results and Discussion :

The calibration of quality of water is a compound subject which involves substantial parameters related to physical state, chemical nature , hydrological behavior and biological feature of water and their correlation with each other. The entire process of investigation of the samples related to its collection from various sources, treatment with chemicals and its analysis , its storage, the calculation and interpretation of the data was done very carefully and methodically with care. None of these steps are carried out carelessly otherwise the final result will be no more than a figure without relation to the actual situation in the environment, and therefore it will prove to be useless. The entire protocol was followed during collection of the ground water obtained from various domains and are depicted below in the Tables,

- Analysis of water sample (year 2017-18) from the study point areas revealed data have been presented in tables 1 and 2.

- **Analysis of Physico-Chemical, Heavy Metals and Bacteriological Parameters (Groundwater) of Study Location Sites**

  - **[After Monsoon 2017]**

Table 1

	Site Locations	Indogulf Fertilizer	B.H.E.L	Malvica Cement	Marva cement	Arif Cement	Rhenather Textile	SAIL
Physico-Chemical Parameters								
	pH Value	**7.1**	7.2	7.5	7.3	7.6	7.8	7.7
	Alkalinity (as HCO_3)	250	235	350	**395**	360	**240**	270
	Hardness (as $CaCO_3$)	283	341	320	490	448	382	400
	Chloride (as Cl)	170	155	175	195	165	250	140
	Sulphate (as SO_4)	264	160	245	97	110	85	175
	Nitrate (as NO_3)	47	41	50	49	35	30	41
	Phosphate (as PO_4)	1.6	1.9	1.7	1.6	1.9	0.8	1.2
	Fluoride (as F)	0.8	0.5	0.6	0.9	1.4	0.9	0.7
	Sodium (as Na)	55	95	67	54	85	98	90
	Potassium (as K)	9.8	8.9	8.1	6.3	6.9	2.9	6.1
	Calcium (as Ca)	71	48	45.3	71.3	75.2	78.3	69.5
	Magnesium (as Mg)	22.2	28.3	32.5	33.1	35.6	22.4	23.1
	Boron (as B)	ND	ND	ND	0.001	ND	ND	ND

Table 2

Heavy Metals									
	Iron (as Fe)	0.10	0.21	0.10	0.27	0.23	0.01	0.01	0.24
	Manganese (as Mn)	0.07	0.06	ND	0.04	0.05	ND	0.10	ND
	Copper (as Cu)	0.02	0.04	0.01	0.01	ND	ND	0.01	ND
	Chromium (as Cr)	0.01	0.03	0.03	ND	0.01	0.03	0.04	ND
	Lead (as Pb)	ND	0.04	ND	ND	ND	0.05	0.04	ND
	Cadmium (as Cd)	ND	ND	ND	ND	ND	ND	ND	ND
	Zinc (as Zn)	1.9	1.6	3.4	3.2	3.9	2.8	2.9	4.0
Bacteriological									
	Total coliform (MPN/100ml)	Nil	Nil	2	Nil	1	Nil	Nil	Nil

	Faecal coliform (MPN/100ml)	Nil	1	2	Nil	Nil	1	Nil	Nil

Results and Discussions

pH

- The pH of various water samples of different site locations were measured by 744 pH Meter Metro-ohm. Analysis of samples collected in the year 2017 predicted that the pH values from 7.1 to 8.0 in the post monsoon season which were in accordance to limits of BIS.

- **Alkalinity**

The alkalinity of water is a measure of the amount of acid it can undergo neutralization . The water can be prevented from sudden shifts in pH. This ability to neutralize acid, or H+ ions, is particularly important in regions affected by acid rain. Water may also be unsuitable for use in irrigation if the alkalinity level in the water is higher than the natural level of alkalinity in the soil. The alkalinity of the site locations varies from 250 to 395 mg/l in the analysis of year 2017, Results indicate that alkalinity is not under desirable limit of 200 ppm but under permissible limit of 600ppm.

Hardness

The classification of hardness can be categorised as carbonate and non-carbonate hardness. Carbonate hardness refers to calcium and magnesium bicarbonate. When calcium bicarbonate is heated, solid calcium carbonate forms. This is the primary cause of scale formation in water heaters and boilers. Non-carbonate hardness is caused primarily by calcium and magnesium nitrates, chlorides, and sulfates. Analysis of year 2017 shows that hardness of site locations varies from 283-490 mg/l .The hardness data are under permissible limits of 600 ppm while not under desirable limits of 300 ppm . It was reported that there are lesser cardiovascular diseases in the areas of hard water[9].

Chloride

Chloride is a very pertinent chemical indicator of river / groundwater fecal contamination The chloride ion is formed when the element chlorine picks up one electron to form an anion (negatively-charged ion) . The salts of hydrochloric acid contain chloride ions and can also be called chlorides. It is very essential for the metabolism of human body thereby maintaining body's acid-base balance. The chloride content of the samples collected in the year 2017 varies from 140-300 mg/l. The desirable limit of chloride ion in drinking water is 250ppm and permissible limit is 1000ppm. This indicates that slightly high concentration of chloride ion near cement factories.

Sulphate

Sulphate is a substance that occurs naturally in drinking water. Health concerns regarding sulfate in drinking raised because of reports that diarrhea may be associated with the ingestion of water containing high levels of sulfate. Sulphate content of the samples collected in the year 2017 varies from 85 to 264 mg/l . The results show that at Indogulf Fertilizer , Malvica and Marva cement factories the values are higher than desirable limits of 200 ppm but under permissible limits of 400ppm.

Nitrate

It is found that water naturally contains less than 1 milligram of nitrate-nitrogen per liter which is not a major source of exposure. Plant debris decay, waste from animals , fertilizers , septic tanks, municipal sewage treatment plants are common sources of nitrate contamination. The nature of soil,depth and construction of the well and bed rock determines the capacity of extent of nitrate in well water The nitrate data obtained from the site locations were in the range of 30 to 54 mg/l in the year 2017. The desirable limit in drinking water is 45ppm .

Phosphate

The chemical compounds containing phosphorus are termed as phosphates . The phosphate content were reported to be in the range of 0.8 to 1.9 mg/l in the year 2017 .Phosphorus is a non-metallic element essential for life and is found in rock as inorganic phosphates. Animals obtain their essential phosphorus from phosphates in water and plant material.

Fluoride

Sodium fluoride and fluorosilicates are fluoride compounds which dissolve into ground water as it moves through gaps and pore spaces between rocks. Most water supplies contain some naturally occurring fluoride. Fluoride also enters drinking water in discharge from fertilizer or aluminum factories. Also, many communities add fluoride to their drinking water to promote dental health.. Because of the large number of variables, the fluoride concentrations in groundwater can range from well under 1 ppm to more than 35 ppm. The fluoride content of the study locations were reported to be in the range 0.5 to 1.4 mg/l in the year 2017. In some locations it is higher than desirable limits of 1.0 ppm and under permissible limits of 1.5 ppm.

Sodium

Sodium occurs naturally found in groundwater. The most common sources of elevated sodium levels in ground water are dissolution of silicate , naturally occurring brackish water of some aquifers, cation excahange , Infiltration of surface water contaminated by road salt, Irrigation and precipitation leaching through soils high in sodium, The sodium content were in the range of 55 to 98 mg/l in the year 2017 which is under limits of 200 ppm.

Potassium

About 2.59% of the Earth's crust comprises of potassium . Tt is highly reactive and does not occur in nature as a free metal. The sources of potassium can be due to silicate minerals inm igneous and metamorphic rocks.. Potassium is a natural and essential element in plants and animals. The prime exposure of potassium in humans is through food. Although potassium concentrations in drinking water are generally low and do not pose health concerns. The potassium content of the study site locations were in the range of 2.9 to 9.8 mg/l in 2017 .

Calcium

Calcium is of natural occurrencein water. The source of calcium is primarily from rocks such as limestone, marble, calcite, dolomite, gypsum, fluorite and apatite. It is very essential for formation of bones and tooth in living organisms . It also helps in blocking the absorption of heavy metals in the body therby preventing certain types of cancer . Calcium is a determinant of water hardness, because it can be found in water as Ca^{2+} ions. Although its high concentrations adversely affect the absorption of other essential minerals in the body. The calcium content of the study site locations were in the range of 45.3 to 78.3 mg/l in the year 2017. Some samples show higher values than desirable limits. The desirable limits of calcium are 75 ppm and permissible limits are 200 ppm.

Magnesium

Magnesium is also dissolved in water from rocks It creates a impact on the taste of drinking water. Sensitive people may find the taste unpleasant at 100 mg/L. The average person finds the taste unpleasant at about 500 mg/L. These levels are well above the magnesium concentrations found in most water. The major cause of hardness and scale forming properties is due to magnesium It may also cause a laxative effectin drinking water, particularly with magnesium sulphate concentrations above 700 mg/L. However, the human body tends to adapt to this laxative effect with time.The magnesium content evaluated from site locations were in the range of 22.2 to 35.6 mg/l in the year 2017 .

Boron

Boron can be present in drinking water through the natural leaching of rocks and soils containing borates and borosilicates, or by contamination of water sources. It occurs as undissociated boric acid enters the environment from seawater in the form of boric acid vapor and from volcanic and other geothermal activity such as geothermal steam. It is also released from human activities by the use of borate-containing fertilizers and herbicides, the burning of plant-based products such as wood, coal, or oil, and the release of waste from borate mining and processing. The boron content of the study site locations were in the range of 0.0 to 0.001 mg/l in the year 2017. It is under desirable limits of 1.0 ppm and permissible limits of 5.0 ppm.

Heavy metals

Metallic elements that are dense and heavy and occur in trace levels are heavy metals They are very toxic and tend to accumulate. Heavy metals are natural components of the Earth's crust. They cannot be degraded or destroyed. Iron, Manganese, Copper, Chromium, Lead, Cadmium and Zinc were analyzed in the collected samples by heavy metal parameters

Iron

Iron occurs naturally in aquifier in the soluble (ferrous) state but, when exposed to oxygen, is converted into the insoluble (ferric) state with its characteristic reddish brown or rusty color. Is concentration in ground water can be increased by dissolution of ferrous borehole and hand pumps . Presence of iron in drinking water gives a rusty color and may affect taste which is highly objectionable. The iron content of the study site locations were in the range of 0.01 to 0.27 mg/l in the year 2017 The concentration of iron is under desirable limits of 0.3 ppm and permissible limits of 1.0 ppm.

Manganese

Manganese is a mineral that naturally occurs in rocks and soil and is a normal constituent of the human diet. It exists in well water as a naturally occurring groundwater mineral, but may also be present due to underground pollution sources. Manganese may become noticeable in tap water at concentrations greater than 0.05 milligrams per liter of water (mg/l) by imparting a color, odor, or taste to the water. However, health effects from manganese are not a concern until concentrations are approximately 10 times higher. High content of magnese in water can stain the laundary causing scaling in plumbing .Exposure to high concentrations of manganese over the course of years caused disorders in the nervous system, producing a syndrome that resembles Parkinsonism. This type of effect may be more likely to occur in the elderly. The manganese content of the study site locations were in the range of 0.04 to.0.10 mg/l in the year 2017 which is under desirable limits of 0.1 ppm and permissible limits of 0.3 ppm .

Copper

Copper occurs naturally in rock, soil, water, sediment, and air. Its unique chemical and physical properties have made it one of the most important metals . Copper can get into drinking water even by corrosion of copper pipes if water is acidic in nature . Levels of copper found naturally in ground water and surface water are generally very low; about 4 micrograms of copper in one liter of water (4 µg/litre) or less. However, drinking water may contain higher levels of a dissolved form of copper. The copper content of the study site locations were in the range of 0.0 to 0.02mg/l in the year 2017. The results are under desirable limits of 0.05 ppm and permissible limits of 1.5 ppm.

Chromium

Hexavalent chromium in ground water contaminant is potentially harmful to human health state . Chromium is widely distributed in the earth's crust. It can exist in oxidation states of +2 to +6. Soils and rocks may contain small amounts of chromium, almost always in the trivalent state. In water, chromium (III) is a positive ion that forms hydroxides and complexes, and is adsorbed at relatively high pH values. In general, the chromium concentration in groundwater is low (<1 µg/litre). The chromium content of the study site locations were in the range of 0.01 to 0.04 mg/l in the year 2017 and in the year 2011 the values were reported to be 0.01 to 0.05mg/l which is under desirable limits of 0.05 ppm.

Lead

Lead is a toxic metal that is harmful to human health, there is no safe level for lead exposure. It has been estimated that up to 20 % of the total lead exposure in children can be attributed to a waterborne route, i.e., consuming contaminated water. In addition, infants, fetuses, and young children are particularly vulnerable to lead poisoning. This is because they usually consume more water. The main sources of lead are from automobiles is washed out of the atmosphere by the precipitation and finally enters the infiltrated water or runoff. The lead content of the study site locations were in the range of 0.04 to 0.05 mg/l in the year 2017 under desirable limits of 0.05 ppm. It is not present in most locations.

Cadmium

In natural waters, cadmium is found mainly in bottom sediments and suspended particles and their concentrations in unpolluted natural waters are usually below 1 µg/litre. Many cases of itai-itai disease and low-molecular-weight proteinuria have been reported among people living in contaminated areas and exposed to cadmium via food and drinking-water. The cadmium content of the study site locations were reported NIL in the year 2017 .The desirable limits are 0.01 ppm.

Zinc

Zinc occurs in small amounts in almost all igneous rocks. Zinc imparts an undesirable astringent taste to water. Water containing zinc at concentrations in the range 3–5 mg/litre also tends to appear opalescent and develops a greasy film when boiled. Zinc is an essential element in all living organisms. Nearly 200 zinc-containing enzymes have been identified, Absorption of ingested zinc is highly variable (10–90%) and is affected by a number of factors. High zinc concentrations are found in prostate, bone, muscle, and liver. Excretion takes place mainly (75%) via the gastrointestinal tract, and only to a smaller extent via urine and sweat. The zinc content of the study site locations were in the range of 1.5 to 4.1 mg/l in the year 2017 and in the year 2011 the values were reported to be 1.6 to 4.0 mg/l which is under desirable limits of 5.0 ppm and permissible limits of 15 ppm..

Bacteriological

Total Coliform Count

Coliform bacteria occur in the environment and are generally not harmful. However, drinking water contaminated with these bacterias causes germs that can cause disease. The total coliform count of the study site locations were in the range of 2 to 3 MPN/100ml in the year 2017. It is only present in the site near Malvica cement and Arif cement industries.

Faecal Coliform Count

The presence of Faecal Coliform bacteria indicates that the water may be contaminated with human or animal wastes. Microbes in these wastes can cause short-term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms.

The faecal coliform count of the study site locations were in the range of 0 to 1 MPN/100ml in the year 2017. It is only present in the site near BHEL, Malvica Cement and Rhenather textile industries.

CONCLUSIONS

Groundwater quality monitoring is an essential aspect in assessment of ground water repository. The standard testings gives an idea of permissible and desirable limits of various parameters in drinking water . The quality of ground water is being degraded by agricultural, urban and industrial wastes, which leach or are injected into underlying aquifers. With respect to physico-chemical properties of the samples collected, it is either conforming to desirable or permissible limits and its probable effects on human health . The quality of ground water from a few shallow source sites has been impaired in some of the areas.

Recommendations

Monitoring ground water level is a big challenge in the technoworld In order to minimize over-abstraction and deterioration of ground water quality all the ground water extraction structures should be properly registered and timely regulated. The water obtained from all the ground water structures should be tested before use to ensure compatibility for human consumption. The ground water abstraction sources and their surroundings should be properly maintained to ensure hygienic conditions and no sewage or polluted water should be allowed to percolate directly to ground water aquifer.

The de-fluoridation treatment (domestic level) should be undertaken if the water is having high fluoride. Treatment option for nitrate should be undertaken in ground water drawn from sources exceeding the permissible limit.

A regular Groundwater quality study and monitoring should be done in the areas where water was found contaminated in metropolitan cities.. No stagnation of wastewater should be allowed to avoid percolation of contaminants in groundwater.

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