Analysis of Drinking Water Quality in Industrial Area Phagwara, Punjab (India)

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Abstract:-

It is evident that many parts of the Industrial areas in India are colonized and in very close vicinity of the industries and are using groundwater for drinking and domestic purposes. The drinking water should be pure, free from contamination and harmful chemicals. Quality of water can be defined in terms of physical and chemical parameters. The various physicochemical parameters are affected by the industrial effluents. The study aimed to assess the impact of industrial activities on drinking water in Phagwara region of Kapurthala district. It throws a light on physico chemical analysis of tubewell water in and around the industries. Various physico-chemical parameters like color, odor, taste, pH, TDS (Total dissolved solids), TH (Total Hardness) Turbidity, EC (Electrical Conductivity), Total alkalinity were analyzed. The observed values were compared with BIS (2012) and WHO Standards. Results showed that water quality parameters were within the acceptable limit (normal range), but pH, alkalinity and hardness were above the acceptable limit. Water is fit for drinking. It is suggested that water quality should be monitored regularly to avoid any contamination.

Keywords: - Physicochemical characteristics, water quality, industrial area.

1. Introduction

Water is one of the most important and precious natural resources. It is of vital importance in human life. Water is most abundant compound (70%) on earth's surface. It is significant due to unique physical and chemical properties ^[1-4].

It is incredibly and indispensable for human life. Safe drinking is essential for life and a satisfactory supply must be made to consumers ^[5]. The WHO ^[6] revealed that seventy five percent of all diseases in developing countries arise from polluted drinking water. Groundwater is the definitive and most fit freshwater resources with trace concentration of the salts for consumption by humans ^[7]. Mahmoud et.al stated that most common problems in household water supplies may be attributed to hardness, iron, sulphide, sodium, chloride, alkalinity, acidity and disease producing pathogens such as bacteria and fungi. International and local agencies have established parameters to determine biological and physicochemical quality of drinking water ^[8]. Acceptable quality shows the safety of drinking water in terms of physical and chemical parameters ^[8,9].

2. Literature Review

Water is the elixir of life. It is the major constituent of all living bodies water makes up two third of the human weight ^[10]. About 780 million people do not have access to clean and safe water and about 2.5 billion people do not have proper sanitation. Around 4 million people die each year due to water related diseases and disasters ^[11]. According to the World Health Organization (WHO), drinking contaminated water is one of the major causes of diarrheal diseases, which make up the second leading cause of child mortality resulting in the deaths of about 760,000 children aged below 5 years annually. For this reason, the WHO has identified the lack of access to clean drinking water as the most critical factor that negatively influence the general health and well being of population in developing countries ^[12]. Overall provision of safe drinking water can help to reduce or eliminate preventable deaths emanating from water borne diseases ^[13]. Access to safe drinking water & sanitation is a global concern. Water quality and suitability for use are determined by its taste, color, odor, turbidity and concentration of organic and inorganic matters ^[14]. Contaminants in water can affect its quality and consequently the human health ^[15]. Keeping in view the literature review, attempts have been made to study parameters of drinking water. Various technical research papers on physico –chemical characteristics of drinking water were carried out in this study are given below:

Md. Aminur Rahman et al. ^[16] carried out physico -chemical and bacteriological analysis of drinking tube-well water from some primary schools-Magura, Bangladesh to evaluate suitability for students. The drinking water samples from twenty primary schools were tested. The results showed that about 35% tubewells were found to be polluted with FC and others 70% with TC. Drinking water samples were not safe for human consumption and could cause diarrheal diseases.

Sudhir Yadav and Arvind Kumar ^[17] did the research on physico-chemical analysis of water of Triveni Sugar Mill (Ramkola). The analysis was done for getting the knowledge of physical and chemical properties of water that is coming out from the sugar-mill which is located in Ramkola, Kushinagar, UP. All the parameters were within the permissible range.

G.S. Gaikwad, Atul.V. Wankhade and Atul V. Maldhure ^[18] studied on the hydrochemical characteristics of ground water (well & tubewell) in the slum area of Bhoogaon, Wardha district of Maharashtra state, water samples were collected and analyzed. The results showed that most of the ground water samples were of good quality and were within the permissible limit prescribed by BIS (1991) for pH, Turbidity, TS, Total Hardness etc.

H.H. Oyem, I.M.Oyem and D. Ezeweali ^[19] studied the Temperature, pH, Conductivity Total dissolved solids in ground water of Agbor/Owa town and immediate suburbs were studied. The parameters were analyzed for pH, EC, TDS and COD resp. It was found out that groundwater is of good quality with values below the guidelines of WHO, USEPA and Nigerian Water Safety Standard.

3. Material and Methods:-

3.1 Geographical Location:- Phagwara is the prominent Industrial centre in the Kapurthala district of Punjab. It is located on the National highway 44 and located 124 Kilometres away from Chandigarh and 20 Kilometres away from Jalandhar. It is an area of 20 km² (approx) in Kapurthala district.

Co-ordinates: 31.22° N and 75.77° E. It is on the land between Beas and Sutlej rivers and is typical Doaba City. It has an average elevation of 767 feet (234m).

3.2 Area of Study:- Phagwara owes its significance due to diverse group of industries like Wahid Sandhar Sugar Mill, Sukhjot Starch and Chemicals Ltd., Dairy industries etc are found here. These industries release industrial effluents, which contain toxic chemicals, hazardous compounds, suspended solids and non-biodegradable materials and pollute the groundwater in and around the Industrial area. The discharged chemicals interact with the ground water and alter the pH and water quality parameters. Hence, Industrial area was selected to study the effect of effluents on water quality.

3.3 Collection and analysis of samples

The main elements of water quality monitoring are collection and analysis of water samples, the study and evaluation of the analytical results and reporting of the findings. The purpose of monitoring was to gather sufficient data (by sampling and analysis) and to assess the quality of drinking water in the Industrial Town. Tube well water samples were collected from different places around the Sugar Mill, Starch Mill and Dairy Industry. The following guidelines for water quality monitoring were followed while collecting the water samples.

- ❖ The bottles containing the water samples were rinsed three times before they were filled.
- ❖ A small air space was left in the bottles to allow mixing of the samples.
- ❖ The sample bottles were labelled properly, by attaching a label on each bottle.
- ❖ Analysis of sample was done within 24 hours of collection.

The following is the list of areas from where the sample were collected:-

Sample No.	Source	Area /Location
T-1	Tubewell	Sugar Mill
T-2	Tubewell	Temple near Sugar mill
T-3	Tubewell	Railway Road
T-4	Tubewell	Starch Mill
T-5	Tubewell	Street Near Starch Mill
T-6	Tubewell	Gaushalla Market
T-7	Tubewell	Bus Stand
T-8	Tubewell	Dairy Industry

The samples of various locations were analyzed with respect to physicochemical parameters such as pH, TDS (Total dissolved solids) TH (Total Hardness), Turbidity, EC (Electrical Conductivity) & Total Alkalinity. Standard method for the examination of water and wastewater by APHA (2012) and Standard Method of Sampling and Test (Physical and Chemical) for water and wastewater by BIS (1984) were used for analysis of various physicochemical parameters.

4. Results and Discussion

In order to assess the physicochemical study of tubewell water from different areas in the Industrial town, the obtained results were compared with BIS (2012) and WHO guidelines. The analyzed values of each parameter is discussed below and shown in Table 4(a).

Color: - The water samples from all tubewell were found to be colorless and clear. Color was observed by visual method by taking the samples in clean test tube.

Taste: - Water was tasteless in all the samples.

Odor: - Odor is determined soon after collecting the samples in pre-washed bottles. The bottles were shaken vigorously for 2-3 seconds. By smell, water was found to be odorless in all the samples.

pH :- Measurement of pH relates to the acidity or alkalinity of water^[21]. pH was measured by portable pH meter and was calculated before use. The pH of all the samples was recorded turn by turn. It ranged from 7.5 to 8.2. The pH was found to be slightly alkaline.

Electrical Conductivity (EC):- Conductivity is the measure of the ability of water to carry electric current. It was measured by conductivity meter. Conductivity value ranged from 406 to 516 μcm at different sampling sites.

Total Dissolved Solid (TDS)

The terms TDS describes all dissolved solids (usually mineral salts) in water. The acceptable limit of TDS is 500 mg/l (BIS, 2012) ^[18]. TDS of water samples in the present study varied from 217 mg/l to 324 mg/l, which is also measured by conductivity meter.

Turbidity: The suspension of particles in water interfering with passage of light is called turbidity. It is caused by wide variety of suspended particles. It is measured by turbidity meter. The values of the samples were between <1 to 1.3.

Total Hardness: Hardness mainly depends upon the amount of calcium or magnesium salts or both. It is the property of water which prevents the formation of lather with soap and increases the boiling point of water. BIS desirable limit for total hardness is 200mg/l ^[18]. It was tested by EDTA titration method.

The highest and lowest values of total hardness were observed at samples T-4 as 501 and T-3 as 420 respectively, which are all measured by titration. The tubewell samples T-1 and T-4 taken from sugar mill and starch mill showed higher hardness values.

Total Alkalinity: Alkalinity is the sum of total components in the water that tend to elevate the pH to the alkaline side of neutrality. It is measured by titration with standardized acid to a pH value of 4.5 and is expressed commonly as milligrams per liter as calcium carbonate (mg/l as CaCO₃). Commonly occurring material in water that increase alkalinity are carbonates, phosphates and hydroxides^[22]. According to BIS Standard acceptable limit and permissible limit of total alkalinity are 200-600 mg/l. Total alkalinity of water samples ranged from 315 to 333 mg/l. It was slightly alkaline in nature but within the permissible limit.

S.No.	Parameters	Bureau of Indian Standard (IS-10500:1994)		SITE 1	SITE 2	SITE 3	SITE 4	SITE 5	SITE 6	SITE 7	SITE 8
		Acceptable limit	Permissible Limit	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8
1	Color	Agreeable	Agreeable	Agr	Agr	Agr	Agr	Agr	Agr	Agr	Agr
2	Taste	Agreeable	Agreeable	Agr	Agr	Agr	Agr	Agr	Agr	Agr	Agr
3	Odor	Agreeable	Agreeable	Agr	Agr	Agr	Agr	Agr	Agr	Agr	Agr
4	pH	6.5	8.5	8.2	8.1	8.0	7.5	7.9	8.0	7.9	8.1
5	Turbidity	1	5	<1	1.2	1.3	1.2	<1	1	1.3	1
6	Electrical Conductivity	700	3000	515	437	448	406	492	445	419	5.16
7	Total dissolved Solids	500	2000	255	217	222	302	298	324	258	258
8	Total hardness mg/l, max	200	600	500	440	420	501	480	460	440	480
9	Alkalinity (mg/l)	200	600	333	330	325	315	315	317	333	332

Table 4 (a): Results of Physicochemical analysis of Tubewell water sample

5. Conclusion:

With respect to above the tests the water quality parameters such as color, taste, odor, turbidity, electrical conductivity, total dissolved solids (TDS) are within the acceptable limit. But the parameters pH, alkalinity and total hardness is slightly higher above the acceptable limit as compared with BIS and WHO standards. It is concluded that water in the Industrial area is fit for drinking and domestic use, from selected areas of study.

As water is affected by the industrial effluents which alter the parameters of water and cause risk of various health hazards to population. Therefore, it is necessary to analyze the water quality. It is suggested that water should be treated and monitored regularly to avoid any contamination.

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