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STUDY OF CHEMICAL PROPERTIES OF SURFACE WATER AND ANALYZING THE CHARACTERISTICS OF POTABLE SURFACE WATER USING PIPER DIAGRAMS

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ABSTRACT

The availability and chemical quality of surface water are closely related to precipitation. As a general rule, the least mineralized water, both in streams and underground, occurs in areas of greater amount of rainfall. As inland, precipitation decreases, water supplies diminish, and the quality deteriorates. The composition of water bearing rocks may override the role of precipitation. In India, out of total water balance, 70% are used for agriculture, 25% by industries and remaining 5% are used for drinking purposes. The demand for country's water supply at present is 30 cubic km. This would increase to 52 cubic km in 2025. The demand is not only due to population but also due to improvement in living standards. The use of water resources due to the development of industries, power, engineering, transport, urbanization, intensification of agriculture exert greater qualitative and quantitative impacts on the hydro geological regimes of inland waters.

Keeping in view all the above factors are systematic study was conducted to evaluate the stability of surface water of different areas. In the studies localities surface water was free from colour and odour. The taste was slightly to moderately brackish in most of the private installations whereas the water was non saline in case of deep installation.

Keywords: *Surface water, pH, piper diagram, contamination, etc.*

I. INTRODUCTION

Safe drinking water is essential to humans and other life forms. Access to safe drinking water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to safe water and over 2.5 billion lack accesses to adequate sanitation. There is a clear correlation between access to safe water and GDP per capita. However, some observers have estimated that by 2025 more than half of the world population will be facing water-based vulnerability. A report published in November 2009 suggests that by 2030, in some developing regions of the world, water demand will exceed supply by 50%. Water plays an important role in the world economy, as it functions as a solvent for a wide variety of chemical substances and facilitates industrial cooling and transportation. Approximately 70% of the fresh water used by humans goes to agriculture.

Surface Water

Surface water is water collecting on the ground or in a stream, river, lake, wetland, or ocean; it is related to water collecting as groundwater or atmospheric water. It plays the largest role of shaping the geography of land.

Surface water is naturally replenished by precipitation and naturally lost through discharge to evaporation and sub-surface seepage into the ground. Although there are other sources of groundwater, such as connate water and magmatic water, precipitation is the major one and groundwater originated in this way is called meteoric water.

Contamination of Surface Water

Surface water pollution occurs when hazardous substances come into contact and either dissolve or physically mix with the water. Because of the close relationship between sediments and surface water, contaminated sediments are often considered part of surface water contamination. Sediments include the sand and soils on the bottom of an ocean, lake, or stream. Surface water can become contaminated in many ways. Surface water can be contaminated when hazardous substances are discharged directly from an outfall pipe or channel or when they receive contaminated storm water runoff. Direct discharges can come from industrial sources or from certain older sewer systems that overflow during wet weather. Storm water runoff becomes contaminated when rain water comes into contact with contaminated soil and either dissolves the contamination or

carries contaminated soil particles. Surface water can also be contaminated when contaminated groundwater reaches the surface through a spring, or when contaminants in the air are deposited on the surface water. Contaminated soil particles carried by storm water runoff or contaminants from the air can sink to the bottom of a surface water body, mix with the sediment, and remain.

How can we clean it up?

The most effective approach for cleaning up contaminated surface water is to prevent further discharges from contaminated sources and enable natural biological, chemical, and physical processes to break down the existing contamination. In some surface water bodies where natural processes are not enough to break down the contaminants, other clean-up approaches such as mixing and aeration may be required to further promote natural clean-up. A significant source of surface water contamination may be contaminated sediments. Contaminated sediments generally contain persistent contaminants and are difficult to clean up. Three main approaches to cleaning up contaminated sediments are: 1) remove them by dredging; 2) place a cover over them to prevent contact with the surface water; or 3) allow natural processes to cover them or break them down over time. For contamination that does not mix with surface water and floats on the surface, such as that encountered during an oil spill, contamination can be removed by skimming it from the surface using a "boom."

II. METHODOLOGY

This study was divided into two parts:-

- Sample of surface water from rivers and waterworks of different areas of Bathinda, Panchkula and Mullana in such a manner that surface water of whole areas get represented.
- Chemical analysis of procured samples analysed water quality parameters include ph, Alkalinity(Co3, Hco3), Sulphate content, Chloride content, Co2 acidity, T.D.S, values of Sodium (Na), Potassium (K), Calcium (Ca), Magnisium (Mg).

Sample collection

Sr no.	Sample no.	Place of Sample
1	S-1	Markanda River (Ambala)
2	S-2	Soap Factory (Bathinda)
3	S-3	Thermal Power Plant (Bathinda)
4	S-4	Gaggar River (Panchkula)
5	S-5	Tangri River (Ambala)

Samples were collected in cleaned, sterilized, polyethylene bottles of 1 litre capacity. It was ensured every time that bottle satisfies the following requirements:

- Free from contamination
- Resistant to any internal pressure
- Don't affect water characteristics.

While sampling, all the precautions were taken APHA(1989) and NEERI manual of water analysis. The sample were kept in ice box and brought to lab within 5 hrs of sampling and were refrigerated to avoid any change in chemical properties due to various contamination's.

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III. RESULTS AND DISCUSSION

Following results were obtained after conducting various experiments on the samples available for testing. Standard test procedures were followed and results were noted accordingly. These results were then combined, studied and compared as per guidelines for potable drinking water.

a) pH (Hydrogen ion Activity)

Sr no.	Sample No.	pH	Temperature(°C)
1	S-1	8.7	32.0
2	S-2	8.3	33.6
3	S-3	8.6	33.9
4	S-4	8.2	29.0
5	S-5	9.3	31.0

b) Chloride content (Cl^-)

Sr no.	Sample no.	Chloride Content (mg\l)
1	S-1	36
2	S-2	32
3	S-3	4
4	S-4	4
5	S-5	28

c) Sulphate content (SO_4^{2-})

Sr no.	Sample no.	Sulphate Content (mg/l)
1	S-1	0.329
2	S-2	0.082
3	S-3	0.247
4	S-4	0.412
5	S-5	0.494

d) Acidity

Sr no.	Sample no.	CO_2 Acidity
1	S-1	1.44
2	S-2	0.96
3	S-3	0.72
4	S-4	0.80
5	S-5	0.56

e) Total Alkalinity

Phenolphthalein alkalinity (P)

Sr no.	Sample no.	mg/l
1	S-1	0.08
2	S-2	0.08
3	S-3	0.08

4	S-4	0.08
5	S-5	0.08

Methyl orange alkalinity (M)

Sr no.	Sample no.	mg/l
1	S-1	0.32
2	S-2	0..48
3	S-3	0.40
4	S-4	0.24
5	S-5	0.24

Carbonates and Bicarbonates

S. No.	Sample no.	Hydroxide Alkalinity as CaCo3	Carbonate Alkalinity 2P (mg/l)	Bicarbonate Alkalinity T-2P (mg/l)
1	S-1	0	0.16	0.16
2	S-2	0	0.16	0.24
3	S-3	0	0.16	0.24
4	S-4	0	0.16	0.08
5	S-5	0	0.16	0.16

f) Total Dissolved Solids (T.D.S.)

Sr no.	Sample no.	Total Solids (mg/l)	Suspended Solids (mg/l)	T.D.S (mg/l)
1	S-1	6.8	6.8	0.0
2	S-2	0.4	0.2	0.2
3	S-3	0.2	0.2	0.0
4	S-4	5.6	3.0	2.6
5	S-5	18.0	8.8	9.2

Piper Diagram

A **piper diagram** is a graphical representation of the chemistry of a water sample or samples.

The cations and anions are shown by separate ternary plots. The apexes of the cation plot are calcium, magnesium and sodium plus potassium cations. The apexes of the anion plot are sulphate, chloride and carbonate plus hydrogen carbonate anions. The two ternary plots are then projected onto a diamond. The diamond is a matrix transformation of a graph of the anions (sulphate + chloride/ total anions) and cations (sodium + potassium/total cations).

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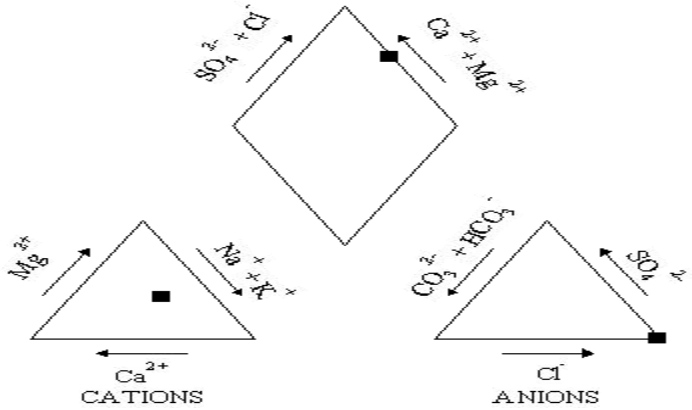

Fig.1 Markanda River (S-1)

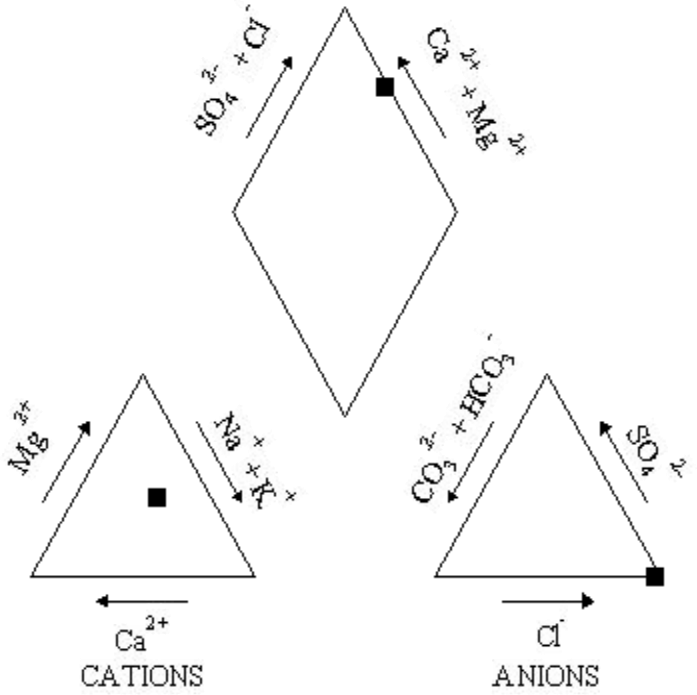

Fig.2 Soap Factory, Bathinda (S-2)

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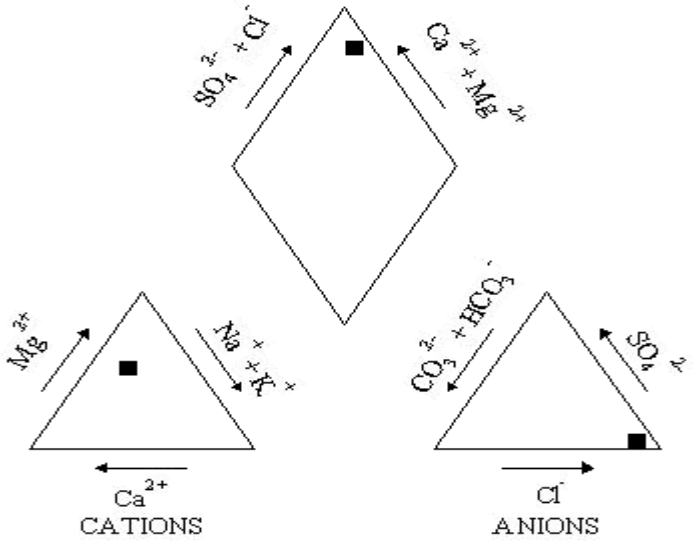

Fig.3 Thermal Power Plant, Bathinda (S-3)

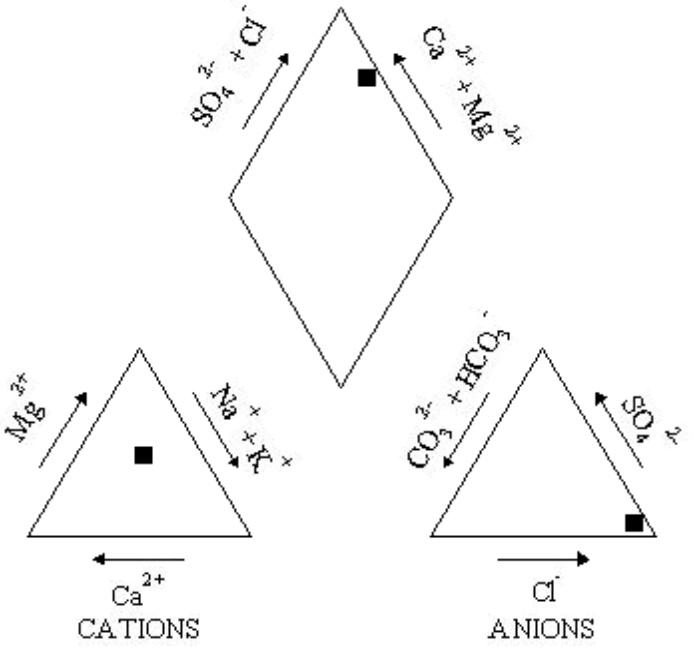

Fig.4 Gaggar River, Panchkula (S-4)

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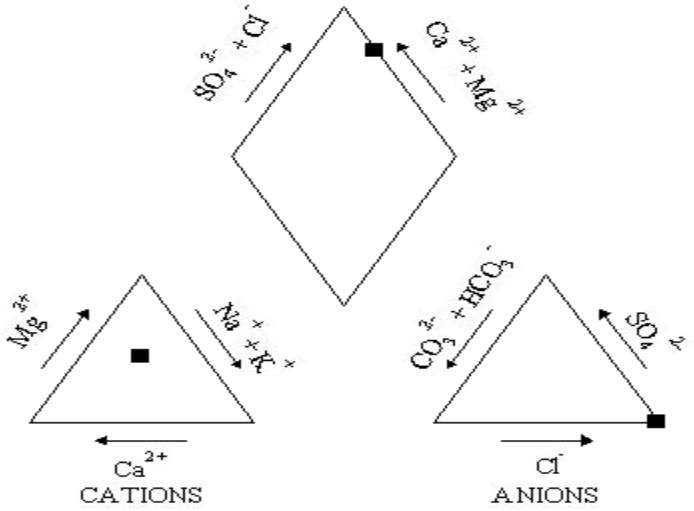

Fig.5 Tangri River, Ambala (S-5)

IV. CONCLUSION

On the basis of the analytical findings following conclusions can be drawn for the study area:

a) In the present study, the pH value of most of the water samples are within the permissible limit. The pH value ranges from neutral to alkaline range. The pH value varies between 8.2 to a highest of 9.3 at a given temperature.
b) The value of chloride content in the given surface water samples is far less than the permissible limit, as the concentration of chloride content in the surface water depends on the geological formation of that given study area.
c) In the present study of surface water samples, the value of sulphate content and Total dissolved solids (TDS) is also found within the permissible limit.
d) Since, the surface water is free from the presence of atmospheric CO2, thus the value of CO2 acidity and mineral acidity is very less which indicate that the given surface water samples are fit for human consumptions, agricultural and industrial uses.
e) The given samples of surface water having carbonate and bicarbonate alkalinity due to the presence of carbonates and bicarbonates, which may impart hardness in the given surface water samples.

Interpretation of hydrochemical analysis reveals that the surface water samples collected from different nearby areas is fit for human consumption, agricultural use and industrial use. The given surface water sample are fresh to slightly saline and slightly alkaline in nature. Piper diagram characterizes the water types. The surface water samples collected from Markanda River (Ambala) was found to be of Ca-Mg-SO4-Cl type but sulphate content is comparatively far less in respect with other parameters, whereas in the surface water sample collected from Soap Factory (Bathinda) having Ca-Mg-SO4-Cl in equal proportions. But the water samples collected from Tangri River (Ambala) consist only Ca-Mg type. Principal quality was mainly controlled by geology, agricultural uses and domestic discharges. Almost all the parameters like pH, Na+, K+, Ca2+, Mg2+, SO42-, CO3-, HCO3- and Cl- are within the permissible limits prescribed by prescribed by ISI, ICMR, WHO.

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