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WATER CONTAMINATION STUDIES: IMPACT OF INDUSTRIAL AND URBAN ACTIVITIES ON HEALTH ECOSYSTEM IN SELECTED STUDY AREAS

Environmental Science

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ABSTRACT

Rapid urbanization, industrial growth, population expansion, and intensified agriculture have heightened freshwater demand, and requiring rigorous quality assessments. This study evaluates the physicochemical and biological properties of water samples from Rameshwaram, Valparai, Kanniyakumari, Gobichettipalayam, Erode, Kerala, and Thoothukudi, collected and preserved per standard protocols. The analyzed physical parameters temperature, colour, odor, total dissolved solids chemical indicators pH, electrical conductivity, hardness, chloride, fluoride, magnesium, iron, residual chlorine, and profiles using validated laboratory methods. Results show marked spatial variability in water quality, driven by geological factors and anthropogenic influences, including contamination sources, salinity risks, and health hazards. These finding underscore the needs for ongoing monitoring, evidence- based management, and robust regulations to promote sustainable water use, environmental protection, and public health.

KEYWORDS

Water quality assessment, physicochemical parameters, groundwater, surface water, environmental monitoring, public health, sustainable water management.

INTRODUCTION

Water Analysis

The total amount of water on surface of earth is 3.5×10^{20} gallons on which 97% is found in sea while fresh water is only 37 million km^3 of this 0.8% occurs in polar ice water which percolates in ground is called ground water and it emerges on surface of earth as river or lake water.

Due to hydrological cycle on water, earth is in constant circulation by evaporation and precipitation. The ground water there is aquifiers is mainly used for drinking. The main supply of water from earth is called hydrological cycle. Hydrosphere and lithosphere (Earth) interaction is of great significance.

The human consumption relates to fresh water and ground water. There is however no uniform distribution of water. Water has excellent characteristics such as good solvent properties, high dielectric constant and surface tension, transparent appearance, maximum density at 4^0C, high heat of evaporation with higher heat of fusion of ice and higher heat capacity. In such water the marine organism thrives very well. Unfortunately, this fresh water does not remain pure but gets polluted by several agencies.

Water Quality

Water quality can be definited as the chemical, physical and bilogical characteristics of water, ususally in respect to its suitability for a designated use. Water can be used for recreation , drinking , designated uses has different defined chmical,physical and bilogical standards necessary to fulfil the respective purpose. For example, there are stringent standards for water to be used for drinking or swimming compared to that used in agriculture or industry.

Figure 1: Water Samples Collected

Drinking Water Quality

1. Ground water – water that fills the spaces between rocks and soil making an aquifer. Ground water depth and quality varies from place to place.about half of the worlds drinking water comes from the ground.

2. Surface water – water that is taken directly from a stream, river , lake, pond, spring or smilar source.surface water quality is generally ussafe to drink without treatment.

3. Rainwater – water that is collected and stored using a roof top, ground surface or rock catchment. The quality of rain water collected from a roof surface is usually better than a ground surface or rock catchment. Wateris in continous movement on,above and below the surface of the earth.

As water is recycled through the earth, it picks up many things alone its path.water quality will vary from place to place, with the seasons, and with various kinds of rock and soil which it moves through. For the most part, it is natural processes the affect water quality.

For instance , water moving through underground rocks and soils may pick up natural contaminants, even with no human activity or polllution in the area.

In addition to influence, water is also polluted by human activities, such as open defecation, dumping ,garbage, poor agricultural practices, and chemical spills at industrial sites. Even though it is safe for us to drink. It is important for us to judge the safety of water by taking the following three qualities into consideration.

1. Microbiological – bacteria, viruses ,protozoa, and worms.
2. Chemical – minerals ,metals and chemicals
3. Physical – temperature, colour smell, taste, and turbidity safe drinking water should have the following microbilogical, chemical and physical qualities. free of pathogens, low in concentrations of toxic chemicals ,clear, tasteless and colourless. When considering is drinking water quality ,in most cases microbilogical contamination is the main concern since responsible for the majority of illnesses and deaths related to drinking unsafe water.

MATERIALS AND METHODS

Water quality differs from places to places due to factors such as rainfall,soil type,polllution levels ,industrial activity ,and availability of natural water bodies. To understand these variations ,carefully planned steps were taken to collect the samples and study their characteristics. The materials used were simple and suitable for fieldwork, while the methods ensured accurate and uncontaminated sample collection.

CASE STUDY

Water samples were collected from different districts – Rameshwaram ,Valparai, Kanniyakumari , Gobichettipalayam, Erode ,Kerala and Thoothukudi.

COLOUR

The colour of water is mainly due to the presence of dissolved organic

matter,humic substances,metallic,ions industrial wastes,and other suspended materials. Colour in water is determined by comparing the sample visually or instrumentally with standard colour solutions, usually prepared from platinum – cobalt satndards. Colour of the samples is noted ath the of sample collection.

ODOUR

The principle of odour analysis involves diluting the watetr sample with odour free water until the odour becomes just detectable. The odour measurement is based on sensory preception and dilution principles which provide a practical method for assessing water quality. Odour of the samples is noted ath the of sample collection.

pH

The pH of water is determined using a pH meter based on the electrochemical measurement of hydrogen ion activity. The glass electrode develops a potential when immersed in water which is compared with a reference elecctrode. The resulting voltage difference is directly related to the hydrogen ion concentration and is displayed as pH.

ELECTRICAL CONDUCTIVITY

Electrical conductivity is a measured of the ability of water to conduct an electric current. This ability depents on the presence and concentration of dissolved ions such as calcium,magnesium ,sodium,potassium ,chloride ,sulfate and bicarbonate.

TOTAL HARDNESS

Total hardness of water in mainly due to the presence of calcium and magnesium ions. It is determined by complexometric titration using EDTA as a chelating agent.

CHLORIDE

Chloride in water is commonly determined by the argentometric titration method,also known as mohrs method. This method is based on the quantitative reaction between chloride ions and silver nitrate in a netural of slightly alkaline medium using potassium chromate as an inticator.

CALCIUM

Calcium present in water is commonly determined by complexometric titration using EDTA as a chelating agent. EDTA forms a stable ,coloureless,water soluble 1:1 complex with calcium ions.

MAGNESIUM

Magnesium in water is commonly determined by complexometric titration using EDTA or by spectrophotometric methods. The principle mainly depends on the formation of a stable complex between ions and suitable reagents.

IRON

Iron present in water may exist in both ferrous and ferric forms. In this method,all irons is first reduced to ferrous form using a suitable reducing agent such as hydroxylamine hydrochloride.

FLUORIDE

The detrmination of fluoride in water is commonly carried out by the spectrophotometric method. This method is based on the reaction between fluoride ions and a zirconium dye complex.

RESULTS AND DISCUSSION ON WATER ANALYSIS

The quality of water was assessed based on imporatnt parameters like permanent hardness, chloride, fluoride,residual chlorine,calcium , magnesium and iron content. These parameters are crucial in determining the suitability of water for drinking and domestic purposes,as they directly influence water palatability,health safety, and household usability.

Table -1 Physical Parameters Of Water Analysis

Location	Colour	Odour	pH	Electrical conductivity	Total hardness
Sample 1 (valparai)	Colourless	Odourless	7.1	84.2µs	80 mg/l
Sample 2 (erode)	Colourless	Odourless	8.0	2.72 µs	400 mg/l
Sample 3 (rameshwaram)	Colourless	Odourless	7.6	0.405 µs	500 mg/l
Sample 4 (gobichettipalayam)	Colourless	Odourless	7.8	0.845 µs	460 mg/l
Sample 5 (kerala)	Colourless	Odourless	7.5	126.1 µs	76 mg/l
Sample 6 (kanyakumari)	Colourless	Odourless	6.9	100.9 µs	600 mg/l
Sample 7 (thoothukudi)	Colourless	Odourless	7.3	158.3 µs	60 mg/l

Table - 2 Chemical Parameters Of Water Analysis

Location	Fluriode	Chloride	Calcium	Iron	Magnesium	Residual chlorine
Sample 1 (valparai)	0.0mg /l	40 mg /l	50.8 mg /l	0.02 mg /l	11.3 mg /l	0.0 mg /l
Sample 2 (erode)	1.5mg/l	840 mg /l	68.1 mg /l	0.05 mg /l	9.3 mg /l	0.0 mg /l
Sample 3 (rameshwaram)	0.0mg /l	300 mg /l	68.5 mg /l	0.09 mg /l	15.2 mg /l	0.0 mg /l
Sample 4 (gobichettipalayam)	0.0mg /l	450 mg /l	67.7 mg /l	0.07 mg /l	19.6 mg /l	0.0 mg /l
Sample 5 (kerala)	0.0mg /l	200 mg /l	40.2 mg /l	0.04 mg /l	10.2 mg /l	0.0 mg /l
Sample 6 (kanyakumari)	0.0mg /l	130 mg /l	65.5 mg /l	0.02 mg /l	15.3 mg /l	0.0 mg /l
Sample 7 (thoothukudi)	0.0mg /l	170 mg /l	60.2 mg /l	0.03 mg /l	16.2 mg /l	0.0 mg /l

Chloride concentration was within permissible limits in most locations, except for erode and gobichettipalayam wher high chloride levels may causes salty taste and corrosion problems.The flouride content was found to be absent in almost samples, which is a matter of concern, asa prolonged consumption of fluoride deficient water may increase the risk of dental caries,especially in children.

The significant observation was the complete absence of residual chloride in all water samples, indicating inadequate disinfection. The raises serious concern regarding possible microbial conatamination and associated health risks. Therefore, most of the water sources ,all suitable for only certain domestic purposes.

CONCLUSION

The water quality analysis revealed that the total hardness of the samples ranged from soft to extremely hard. Water from valparai ,thoothukudi showed low hardness and was generally suitable for domestic use.

In contrast water samples from erode , rameshwaram gobichettipalayam and kanniyakumari exhibited very hard to extremely hard characteristics , which can lead to scaling in pipelines redused efficiency of appliances, and increased maintenance costs.such water is not ideal for direct consumption without proper treatment.

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