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DEPARTMENT OF CIVIL ENGINEERING

Waste Water Engineering Lab

Innovative Experiment

REPORT ON DRINKING WATER ANALYSIS

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DEPARTMENT OF CIVIL ENGINEERING

CERTIFICATE

Certified that the project work titled **'Report on Drinking water analysis'** is carried out by **Aryaman, Ashish, Abhijeet** who are bonafide students of RV College of Engineering, Bengaluru, in partial fulfilment for the award of degree of **Bachelor of Engineering in Civil** of the Visvesvaraya Technological University, Belagavi during the year 2023-2024. It is certified that all corrections/suggestions indicated for the Internal Assessment have been incorporated in the project report deposited in the departmental library. The project report has been approved as it satisfies the academic requirements in respect of project work prescribed by the institution for the said degree.

Signature of Staff in-charge

INTRODUCTION

The primary purpose of the Guidelines for drinking-water quality is the protection of public health. The Guidelines provide the recommendations of the World Health Organization (WHO) for managing the risk from hazards that may com- promise the safety of drinking-water. The recommendations should be considered in the context of managing the risk from other sources of exposure to these hazards, such as waste, air, food and consumer products.

Drinking-water supply agencies are usually required to verify that the quality of water supplied to the consumers meets specific numerical standards. Yet, by the time, water quality analysis is completed and results indicate that the water is not safe to drink; thousands of people may have consumed that water putting them on risk. Moreover, even with frequent monitoring, the vast majority of water distributed to consumers will never be tested. Therefore, reliance on only end-of-pipe monitoring is inadequate to address the problem in totality.

Potable Water - Potable water, also known as drinking water, comes from surface and ground sources and is treated to levels that that meet state and federal standards for consumption. Water from natural sources is treated for microorganisms, bacteria, toxic chemicals, viruses and fecal matter. Drinking raw, untreated water can cause gastrointestinal problems such as diarrhea, vomiting or fever.

Palatable water - It is esthetically pleasing; it considers the presence of chemicals that do not cause a threat to human health.

Contaminated (polluted) water - It is that water containing unwanted physical, chemical, biological, or radiological substances, and it is unfit for drinking or domestic use.

Infected water - It is contaminated with pathogenic organism.

DRINKING WATER - Drinking water is water intended for human consumption for drinking and cooking purposes from any source. It includes water (treated or untreated) supplied by any means for human consumption.

GENERAL CONSIDERATIONS AND PRINCIPLE

Water is essential to sustain life, a satisfactory, adequate, safe and accessible supply must be available to all. Improving access to safe drinking-water can result in tangible benefits to health. Every effort should be made to achieve drinking-water that is as safe as practicable. Safe drinking-water, as defined by the Guidelines, does not represent any significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages. Those at greatest risk of waterborne disease are infants and young children, people who are debilitated and the elderly, especially when living under unsanitary conditions. Those who are generally at risk of waterborne illness may need to take additional steps to protect themselves against exposure to water-borne pathogens, such as boiling their drinking-water. Safe drinking-water is required for all usual domestic purposes, including drinking, food preparation and personal hygiene. The Guidelines are applicable to packaged water and ice intended for human consumption.

However, water of higher quality may be required for some special purposes, such as renal dialysis and cleaning of contact lenses, or for certain purposes in food production and pharmaceutical use. The Guidelines may not be suitable for the protection of aquatic life or for some industries.

Such approaches are termed as Water Safety Plan (WSP). The purpose of a Water Safety Plan (WSP) is to consistently ensure the safety and acceptability of a drinking-water supply.

This is done by eliminating/ minimizing potential risk of contamination in raw water sources, water treatment plants, catchment, distribution network, storage, collection and handling. WSP is an essential tool in providing safe water to the people for all types of water supply systems i.e., large piped drinking water supplies, small community supplies, stand-alone household systems such as wells and also in rain harvesting systems. Water safety plan aims to minimize risks of contamination via sanitary surveillance and can be conjoined with water quality monitoring for ensuring safe water to the communities. This means that the water quality data is useful along with Water Safety Plans (WSP) for preventive and curative management measures.

REQUIREMENTS

Drinking water shall comply with the requirements given in Tables 1. The analysis of pesticide residues shall be conducted by a recognized laboratory using internationally established test method meeting the residue limits. Drinking water shall also comply with bacteriological requirements virological requirements and biological requirements.

Table 1 Organoleptic and Physical Parameters
(*Foreword* and *Clause* 4)

Sl No.	Characteristic	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source	Method of Test, Ref to Part of IS 3025	Remarks
(1)	(2)	(3)	(4)	(5)	(6)
i)	Colour, Hazen units, *Max*	5	15	Part 4	Extended to 15 only, if toxic substances are not suspected in absence of alternate sources
ii)	Odour	Agreeable	Agreeable	Part 5	a) Test cold and when heated b) Test at several dilutions
iii)	*p*H value	6.5-8.5	No relaxation	Part 11	—
iv)	Taste	Agreeable	Agreeable	Parts 7 and 8	Test to be conducted only after safety has been established
v)	Turbidity, NTU, *Max*	1	5	Part 10	—
vi)	Total dissolved solids, mg/l, *Max*	500	2 000	Part 16	—

NOTE — It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under 'acceptable' render the water not suitable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under 'permissible limit in the absence of alternate source' in col 4, above which the sources will have to be rejected.

BACTERIOLOGICAL REQUIREMENTS

Water in Distribution System Ideally, all samples taken from the distribution system including consumers' premises, should be free from coliform organisms and the following bacteriological quality of drinking water collected in the distribution system, as given in Table 6 is, therefore specified when tested in accordance with IS 1622.

VIROLOGICAL REQUIREMENTS

Ideally, all samples taken from the distribution system including consumers' premises, should be free from virus. None of the generally accepted sewage treatment methods yield virus-free effluent. Although a number of investigators have found activated sludge treatment to be superior to trickling filters from this point of view, it seems possible that chemical precipitation methods will prove to be the most effective. Virus can be isolated from raw water and from springs, enterovirus, reovirus, and adenovirus have been found in water, the first named being the most resistant to chlorination. If enterovirus is absent from chlorinated water, it can be assumed that the water is safe to drink. Some uncertainty still remains about the virus of infectious hepatitis, since it has not so far been isolated but in view of the morphology and resistance of enterovirus it is likely that, if they have been inactivated hepatitis virus will have been inactivated also.

Tests done on water for quality test While the details of sampling, testing and analysis are beyond the scope of this handbook, what follows is a general description of the significance of water quality tests usually made. Testing procedures and parameters may be grouped into physical, chemical, bacteriological and microscopic categories.

- Physical tests indicate properties detectable by the senses.
- Chemical tests determine the amounts of mineral and organic substances that affect water quality.
- Bacteriological tests show the presence of bacteria, characteristic of faecal pollution.

PHYSICAL TESTS

Color, turbidity, total solids, dissolved solids, suspended solids, odour and taste are recorded. Color in water may be caused by the presence of minerals such as iron and manganese or by substances of vegetable origin such as algae and weeds. Color tests indicate the efficacy of the water treatment system. Turbidity in water is because of suspended solids and colloidal matter. It may be due to eroded soil caused by dredging or due to the growth of microorganisms. High turbidity makes filtration expensive. If sewage solids are present, pathogens may be encased in the particles and escape the action of chlorine during disinfection. Odour and taste are associated with the presence of living microscopic organisms; or decaying organic matter including weeds, algae; or industrial wastes containing ammonia, phenols, halogens, hydrocarbons. This taste is imparted to fish, rendering them unpalatable. While chlorination dilutes odour and taste caused by some contaminants, it generates a foul odour itself when added to waters polluted with detergents, algae and some other wastes.

CHEMICAL TESTS

pH, hardness, presence of a selected group of chemical parameters, biocides, highly toxic chemicals, and B.O.D are estimated. pH is a measure of hydrogen ion concentration. It is an indicator of relative acidity or alkalinity of water. Values of

9.5 and above indicate high alkalinity while values of 3 and below indicates acidity. Low pH values help in effective chlorination but cause problems with corrosion. Values below 4 generally do not support living organisms in the marine environment. Drinking water should have a pH between 6.5 and 8.5. Harbor basin water can vary between 6 and 9. B.O.D.: It denotes the amount of oxygen needed by microorganisms for stabilization of decomposable organic matter under aerobic conditions. High B.O.D. means that there is less oxygen to support life andindicates organic pollution.

BACTERIOLOGICAL TESTS

For technical and economic reasons, analytical procedures for the detection of harmful organisms are impractical for routine water quality surveillance. It must be appreciated that all that bacteriological analysis can prove is that, at the time of examination, contamination or bacteria indicative of faecal pollution, could or could not be demonstrated in a given sample of water using specified culture methods. In addition, the results of routine bacteriological examination must always be interpreted in the light of a thorough knowledge of the water supplies, including their source, treatment, and distribution. Whenever changes in conditions lead to deterioration in the quality of the water supplied, or even if they should suggest an increased possibility of contamination, the frequency of bacteriological examination should be increased, so that a series of samples from well-chosen locations may identify the hazard and allow remedial action to be taken.

DRINKING WATER QUALITY MONITORING

Bureau of Indian Standards (BIS), has specified drinking water quality standards in India to provide safe drinking water to the people. It is necessary that drinking water sources should be tested regularly to know whether water is meeting the prescribed standards for drinking or not and, if not, then, the extent of contamination/ unacceptability and the follow-up required. A need has arisen to have a separate uniform protocol for Drinking Water Quality Monitoring in view of increasing risk of geogenic and anthropogenic contamination. BIS has set specifications in it IS– 10500 standards for drinking water. The revised edition of IS 10500: 2012 standard shall be followed in Uniform Drinking Water Quality Monitoring protocol. Some parameters apart from those mentioned in IS 10500: 2012 may also be measured if the States deem it necessary. This standard has two limits i.e., desirable limits and maximum permissible or cause for rejection limits. If any parameter exceeds the cause for rejection limit, that water is considered unfit for human consumption.

ANALYSIS REPORT OF DRINKING WATER QUALITY

1. **Location of sample collected** BDA INDRAPRASHTHA.

2. **Sample collected by** Ashish,Aryaman,Abhijeet

3. **Sample quantity** 3 liters

4. **Date of sample collected** 30-08-2024

5. **Date of analysis of sample** 30-08-2024

6. **Sample description:** It is the Cauvery River water that is collected and treated for drinking purposes by the municipal corporation. It is then conveyed to the households by pipeline methods. Therefore, our sample water was collected from the same tap of the Cauvery River Water.

Table 1. Drinking water quality standards

Parameters	ISI (1983)		WHO (1984)		ICMR		BIS	
	HDL	MPL	HDL	MPL	HDL	MPL	HDL	MPL
pH	6.5 – 8.5	-	7.0 – 8.5	6.5 – 9.5	7.0 – 8.5	6.5 – 9.2	7.0 – 8.3	8.5 – 9.0
TDS, mg/L	500	2000	-	-	500	1500	500	2000
Ca, mg/L	-	75	-	75	-	-	-	75
Chloride, mg/L	-	250	-	250	-	250	-	250
TH, mg/L	300	600	200	600	300	600	200	600
Alkalinity, mg/L	200	600	-	120	-	-	200	600
COD, mg/L	150	255	-	255	-	-	150	255

HDL - Highest Desirable Level; MPL - Maximum Permissible Level; BIS - Bureau of Indian Standard; ICMR - Indian Council of Medical Research; WHO - World Health Organisation; ISI-Indian Standard Institute; TDS-Total Dissolved Solids; TH-Total Hardness; COD-Chemical Oxygen Demand

Analysis of water sample

Analysis was carried out for various water quality parameters such as pH, total dissolved solids, total hardness, total alkalinity, calcium, chloride, fluoride and MPN as per standard procedures.

Determination of water quality parameters

The water quality parameters analyzed were; pH- measured using a standard pH meter, total dissolved solids (TDS) by TDS meter, calcium content by EDTA titrimetric method, chloride content by argentometric method, total hardness (TH) by EDTA titrimetric method, methyl orange alkalinity, fluoride by spectrometer.

pH

pH is considered an important ecological factor and provides an important piece factor and piece of information in many types of geochemical equilibrium or solubility calculation. pH is an important parameter in the water body since most aquatic organisms are adapted to an average pH and do not withstand abrupt changes.

The pH value found was 7.0.

The limit of pH value for drinking water is specified as 6.5 to 8.5. The pH shows as slightly alkaline trend. Generally, the pH of water is influenced by the geology of the catchment area and buffering capacity of water.

Temperature

The temperature was found to be 28°C during the study. The higher value of water temperature observed in the present study could be attributed to the early summer months that prevailed during the period of investigation.

Total alkalinity

The standard desirable limit of alkalinity in potable water is 120 mg/L. The maximum permissible level is 600 mg/L. The value of alkalinity in water provides an idea of natural salts present in water. The cause of alkalinity is the minerals which dissolve in water from the soil. The various ionic species that contribute to alkalinity include bicarbonate, hydroxide, phosphate, borate and organic acids. These factors are characteristics of the source of water and natural processes taking place at any given time.

Total hardness (TH)

ISI has specified the total hardness to be within 300 mg/L of CaCO3. Regarding total hardness, the value was found to be 118mg/I. The observed total hardness values were within the limits.

Calcium

Calcium concentrations were found to vary from 7 to 71 mg/L. The upper limit of calcium concentration for drinking water is specified as 75 mg/L (ISI, 1983). The calcium hardness observed was above the desirable limits and was found to be 28.24mg/l

DO

1. Carefully fill a 300-mL glass Biological Oxygen Demand (BOD) stoppered bottle brim-full with sample water.
2. Immediately add 2mL of manganese sulfate to the collection bottle by inserting the calibrated pipette just below the surface of the liquid. (If the reagent is added above the sample surface, you will introduce oxygen into the sample.) Squeeze the pipette slowly so no bubbles are introduced via the pipette.
3. Add 2 mL of alkali-iodide-azide reagent in the same manner.
4. The bottle is sealed with stopper with care to be sure no air is introduced. Mix the sample by inverting several times. Check for air bubbles; discard the sample and start over if any are seen. If oxygen is present, a brownish-orange cloud of precipitate or floc will appear. When this floc has settle to the bottom, mix the sample by turning it upside down several times and let it settle again.
5. Add 2 mL of concentrated sulfuric acid via a pipette held just above the surface of the sample. Carefully stopper and invert several times to dissolve the floc. At this point, the sample is "fixed" and can be stored for up to 8 hours if kept in a cool, dark place. As an added precaution, squirt distilled water along the stopper, and cap the bottle with aluminum foil and a rubber band during the storage period.
6. In a glass flask, titrate 201 mL of the sample with sodium thiosulfate to a pale straw color. Titrate by slowly dropping titrant solution from a calibrated pipette into the flask and continually stirring or swirling the sample water.
7. Add 2 mL of starch solution so a blue color forms.

8. Continue slowly titrating until the sample turns clear. As this experiment reaches the endpoint, it will take only one drop of the titrant to eliminate the blue color. Be especially careful that each drop is fully mixed into the sample before adding the next. It is sometimes helpful to hold the flask up to a white sheet of paper to check for absence of the blue color.
9. The concentration of dissolved oxygen in the sample is equivalent to the number of milliliters of titrant used. Each mL of sodium thiosulfate added in steps 6 and 8 equals 1 mg/L dissolved oxygen.
10. Obtained value is 8.16 mg/L which is within the permissible limit.

Iron content

Iron concentrations were found to vary from 0.3 mg/L. The upper limit of calcium concentration for drinking water is specified as NO RELAXATION (ISI, 1983). The calcium hardness observed was above the desirable limits and was found to be 0.2 mg/l.

Fluoride content

FLUORIDE concentrations were found to vary from 1 to 1.5 mg/L. The upper limit of calcium concentration for drinking water is specified as 1.5 mg/L (ISI, 1983). The calcium hardness observed was above the desirable limits and was found to be 1.25 mg/l.

MPN test

The Most Probable Number (MPN) test is a widely used method in microbiology to estimate the concentration of microorganisms, specifically indicator organisms, in a given sample. It is commonly employed in water quality analysis to determine the presence of contaminants such as fecal coliforms, with Escherichia coli (E. coli) being a common indicator used to assess pollution levels.

RESULTS

SL NO	PARAMETERS	UNIT	RESULT	ACCEPTABLE LIMITS	PERMISSIBLE LIMITS
1	pH Value Ph paper method Universal Indicator Method ph meter method		 7.5 7.5 7.8	6.5-8.5	No relaxation

2	Alkalinity Partial Total	mg/l	0 0	0 20-200	600
3	Calcium content	mg/l	48.24	50-75	200
4	Magnesium content	mg/l	28.45	30	100
5	**Hardness** Calcium hardness Magnesium hardness Total hardness	mg/l	78.21 90.56 118	200	600
6	**Chloride content**	mg/l	16.3	30	100
7	**DO**	mg/l	8.16	Above 6.5-8	Above 6.5-8
8	**Fluoride**	mg/L	1.35	1	1.5
9	**Iron**	mg/l	0.26	0.3	No relaxation

Conclusion

The analysis of the water quality parameters of water of Cauvery River water shows that the pH, Total dissolved solids, total hardness, average alkalinity and calcium values are within in the permissible limits. The COD content and the chloride content were within the permissible limit. In conclusion from the results of the present study, it may be said that the supply water of Cauvery River water is fit for drinking purpose and need treatments to minimize the contamination.

THANK YOU