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Devendra Jalihal

Prof. Devendra Jalihal
Chairman
Centre for Continuing Education, IITM

Jul-Oct 2021
(12 week course)

Prof. Andrew Thangaraj

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Indian Institute of Technology Madras



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J.S.V. AQUA FARM

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Date :

DATE: 16/12/2021

INDUSTRIAL INTERNSHIP COMPLETION CERTIFICATE

This is to certify that **Mis. V.MANASA, Register no: 39030011** student pursuing bachelor of chemistry final year in the Department of chemistry, Sathyabama institute of science and technology, Chennai-600119, has completed 15 days in the date of **01/12/2021** to **15/12/2021** internship at Quality control of chemistry in packaged Drinking water unit at **J.S.V. AQUA FARM**, Kalpaka nagar, No: 114, Nallur village,, ponneri - Tk, Thiruvallur - Dt, Chennai-600067. She has learnt testing method of ISI 14543:2016 norms like Colour, Taste, Odour, Alkalinity, Turbidity, TDS, Ph.

I wish her all success in the studies and bright full future.

J.S.V. AQUA FARM,

AUTHORIZED SIGNATURE
For JSV AQUA FARM

P. J. S. Kar

Signature

INTERNSHIP REPORT IN
METHOD OF ANALYSIS OF WATER
AT
J.S.V AQUA FARM, CHENNAI.

INTERNEE NAME: V.MANASA

BSC.CHEMISTRY

SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY,
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Introduction

Water Quality can be defined as the chemical, physical and biological characteristics of water, usually in respect to its suitability for a designated use. As we all know, water has many uses, such as for recreation, drinking, fisheries, agriculture and industry. Each of these designated uses has different defined chemical, physical and biological standards necessary to support that use. For example, we expect higher standards for water we drink and swim in compared to that used in agriculture and industry. Water quality standards are put in place to ensure the efficient use of water for a designated purpose. Water quality analysis is to measure the required parameters of water, following standard methods, to check whether they are in accordance with the standard.

Why water analysis required?

Water quality analysis is required mainly for monitoring purpose. Some importance of such assessment includes:

1. To check whether the water quality is in compliance with the standards, and hence, suitable or not for the designated use.

2. To monitor the efficiency of a system, working for water quality maintenance
3. To check whether up gradation / change of an existing system is required and to decide what changes should take place.
4. To monitor whether water quality is in compliance with rules and regulations.

Water quality analysis is of extremely necessary in the sectors of:

1. Public Health (especially for drinking water)
2. Industrial Use

1. COLOUR

Introduction:

Colour in water may be due to inorganic ions, such as iron & manganese, humus & peat Materials, plankton, weeds and industrial wastes. The term 'colour' is used to mean true colour that is the colour of water from which turbidity has been removed. The term apparent colour includes not only the colour due to substances in solution, but, also that due to suspended matter. Apparent colour is determined on the original sample without filtration or centrifugation.

Method: PLATINUM COBALT (VISUAL COMPARISON)

1. Principle -Colour is measured by visual comparison of the sample with platinum-cobalt standards. One unit of color/Hazen is, that produced by 1 mg platinum per litre in the form of chloroplatinate ion.

2. Interferences

- i. Slight amount of turbidity interfere with the determination. Therefore sample showing visible turbidity should be clarified by centrifugation.
- ii. The method is pH dependant. Colour of water normally increases with increase in pH value unless the coloured ion precipitates.

- iii. Use of filter paper may result in removal of some of the color, leading to Erroneous results. Therefore filter paper should not be used for determination of true color

3. Sample Handling and preservation – Representative samples shall be taken in clean glassware. Color should be determined as early as possible after the collection of samples as biological activity or physical changes occurring during storage may affect the colour. Refrigeration of water samples at 4°C is recommended.

4. Apparatus

- i. Nessler cylinders 50 mL capacity.
- ii. Centrifuge or filter assemblies with glass fiber filters or membrane filters with functional pore sizes of approximately 0.45µm.

5. Reagents

Standard chloroplatinate solution – Dissolve 1.246 gm potassium chloroplatinate (K_2PtCl_6) (equivalent to 500 mg metallic platinum) and 1.0 gm crystalline cobaltous chloride ($CoCl_3 \cdot 6H_2O$) (equivalent to 250 mg metallic cobalt) in distilled water containing 100 mL concentrated hydrochloric acid. Dilute to 1000ML with distilled water. This standard solution is equivalent to 500 colour units.

Preparation of standards- Prepare standards having color units of 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60 and 70 by diluting 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 6.0 and 7.0 mL standard chloroplatinate solution with distilled water to 50 mL. Use distilled water as 0 unit standard/Control. Protect these standards against evaporation and contamination by use of clean inert stoppers. The standards should also be protected against absorption of ammonia which causes increase in colour.

6. Procedure:

Apparent color – Observe the color of the sample by filling a matched Nessler cylinder to the 50 mL mark with water and compare with standards. Compare by looking vertically downward through the cylinder towards a white surface placed at such an angle that light is reflected upwards through the column of liquid. If turbidity has not been removed, report the colour as 'apparent colour'. If the colour exceeds 70 units, dilute the sample with distilled water until the colour is in the range of the standards.

True color- Remove turbidity by centrifuging the sample until the supernatant liquid is clear. Compare the centrifuged sample with distilled water to ensure that turbidity has been removed. If the sample is clear, then compare with the standards.

7. Result

Normal range- 2TCU

Result- <1TCU

8. Reference

IS: 3025 (part 4) - 1983 (Reaffirmed 2002) - Methods of Sampling and Test (Physical and chemical) for water and Waste Water: Colour

2. ODOUR

Introduction:

Odour is recognized as a quality factor affecting acceptability of drinking water and food prepared from it, tainting of fish and other aquatic organisms & aesthetes of recreational waters. Most organic and some inorganic chemicals contribute taste or odour. These chemicals may originate from municipal and industrial waste discharges, natural sources, such as decomposition of vegetable matter or from associated microbial activity. Odour of water, though very important, cannot be determined in absolute units. Olfactory sense, which is the most sensitive means of detecting small concentrations of odoriferous substances, lacks precision and mathematical expression nevertheless a qualitative test is prescribed. In case of doubt as to the intensity or character of odour, a majority opinion of several observers should be recorded

Method: OLFACTORY

1. Preparation of apparatus – Thoroughly clean the requisite number of wide mouth glass stoppered bottles of about one litre capacity. Rinse them with hydrochloric acid and render them completely odour-free by repeated washing with odour-less distilled water, which can be prepared by passing distilled water through a column of granulated activated carbon

2. Procedure

- i. As soon as possible after collection of sample, fill a cleaned bottle half full of sample, insert the stopper, shake vigorously for 2 to 3 seconds and then quickly observe the odour. The sample taken for observation of odour shall be at a room temperature.
- ii. When it is desired to record the odour at an elevated temperature, make the observation after warming the sample to about 60°C in a clean stoppered bottle.

3. Report

3.1. Report the true odour of the sample at the mouth of the bottle as rotten egg, burnt, sugar, soapy, fishy, septic, aromatic, chlorinous, alcoholic odour or any other specific odour. In case it is not possible to specify the exact odour, report as agreeable or disagreeable.

4. Result

Normal range- Agreeable

Result-Agreeable

5. Reference

4.1. IS: 3025 (part 5): 1983 (Reaffirmed 2002) - Methods of Sampling and Test (Physical and chemical) for water and Waste Water: Odour

3. pH

Introduction:

pH value is the logarithm of reciprocal of hydrogen ion activity in moles per litre. In water solution, variations in pH value from 7 are mainly due to hydrolysis of salts of strong bases and weak acids or vice versa. Dissolved gases such as carbon dioxide, hydrogen sulphide and ammonia also affect pH value of water. The overall pH value range of natural water is generally between 6 and 8. In case of alkaline thermal spring waters pH value may be more than 9 while for acidic thermal spring waters, the pH may be 4 or even less than 4. Industrial wastes may be strongly acidic or basic and their effect on pH value of receiving water depends on the buffering capacity of water. The pH value of

water obtained in the laboratory may not be the same as that the time of collection of water samples, due to loss or absorption of gases, reactions with sediments, hydrolysis and oxidation or reduction taking place within the same sample bottle.

Method: Electrometric Method

1. Principle – The pH value is determined by measurement of the electromotive force of a cell consisting of an indicator electrode immersed into the test solution and a reference electrode. Contact between the test solution and the reference electrode is usually achieved by means of a liquid junction which forms part of the reference electrode. The electromotive force is measured with a pH meter i.e. a high impedance voltmeter calibrated in terms of pH.

Several types of electrodes have been suggested for electrometric determination of pH value. Although the hydrogen gas electrode is recognized as primary standard, the glass electrode in combination with calomel electrode is generally used with reference potential provided by saturated calomel electrode. The glass electrode system is based on the fact that a change of 1 pH unit produces an electrical change of 59.1 mV at 25°C. The active element of glass electrode is membrane of a special glass. The membrane forms a partition between two liquids of differing hydrogen ion concentration and a potential is produced between the two sides of the membrane which is proportional to the difference in pH between the liquids.

2. Interference

At pH value above 10, high sodium concentrations interfere with the measurement. Correction for the sodium error may be made by consulting the chart supplied by the manufactures of electrodes being used. Sodium errors at pH value levels greater than 10 can be reduced or eliminated by using a low sodium error electrode.

Oil and grease may interfere by coating the pH electrode and causing a sluggish response. These coatings can usually be removed by gentle wiping or detergent washing, followed by distilled water rinsing. An additional treatment with hydrochloric acid (1%) may be necessary to remove any remaining film.

Temperature affects the pH values in two ways. The first is covered by the change in electrode output at various temperatures. This interference can be

controlled with instruments having temperature compensation or by calibrating the electrode instrument system at the temperature of the samples. The second source is the change of pH inherent in the sample at various temperatures. This error is sample dependent and cannot be controlled. Therefore the temperature at the time of analysis should be reported.

3. Apparatus

- I. pH Meter with glass and reference electrode (saturated calomel) preferably with temperature compensation.
- II. Magnetic stirrer with polytetrafluoroethylene coated stirring bar.
- III. Thermometer with least count of 0.5°C.
- IV. Reagents - Standard pH buffer solutions be prepared using commercially available tablets or powder with NIST traceability or known amount of chemicals.

4. Reagents

Standard pH buffer solutions be prepared using commercially available tablets or powder with NIST traceability or known amount of chemicals.

5. Sample handling /preservation

- I. Samples should be analysed as soon as possible preferably in the field at the time of sampling.
- II. High purity waters and waters not at equilibrium with the atmosphere (ground waters or lake waters collected at depth) are subject to changes when exposed to the atmosphere. Therefore the sample containers should be filled completely and kept sealed prior to analysis.

6. Procedure

Set the temperature in actual temperature which is finding by thermometer. Take 7.00 buffer solution and immerse the electrode then adjust the reading to 7.00 using CAL (7.00) Knob. Take 4.00 buffer solution and immerse the electrode then adjust the reading to 4.00 using SLOP (4.00) Knob. Repeat the steps which are given in above until the meter shows concordant values. Take sample water in beaker and immerse the electrode and stir gently note the reading after 30 seconds.

7. Result

Normal range- 6.5 to 8.5

Result- 6.59

8. Reference

IS 3025 (part 11) - 1983 (Reaffirmed 2002) - Methods of Sampling and Test
(Physical and chemical) for water and Waste Water: pH Value

4. TASTE

Method: TASTE RATING

1. Principle- Each panellist (tester) is presented with a list of nine statements about the water, ranging from very favourable to very unfavourable. The tester selects a statement that best expresses his opinion. The scored rating is the scale number of the statement selected. The panel rating is the arithmetic mean of the scale numbers of all testers.

2. Apparatus

- I. Tasting – Present each sample to the observer in a clean 50 mL beaker filled to the 30mL level.
- II. Temperature control – Temperature of the samples shall be such that the observers find it pleasant for drinking. Maintain this by using a controlled temperature water bath. A temperature of 15°C is recommended but in any case do not allow it to exceed 27°C.

3. Reagents

Taste and odour-free water and 2000 mg/L solution of sodium chloride prepared with taste and odour -free water as reference sample.

4. Procedure

For test efficiency a single rating session may contain up to 10 samples including the reference samples. Observers should work separately after receiving thorough instructions and trial or orientation sessions followed by questions and discussion on procedures. Select panel members on the basis of performance in trial sessions.

Rate the samples as follows:

- I. Initially taste about half of the sample by taking the water into the mouth, holding it for several seconds and leaving off it without swallowing.
- II. Form an initial judgment on the rating scale
- III. Make a second tasting the same manner as the first.
- IV. Make a final rating for the sample and record the results on the appropriate data form
- V. Rinse the mouth with taste and odour free water.
- VI. Give a gap of one minute before repeating steps 4.2.1 to 4.2.5 on the next sample
- VII. Independently randomize sample order for each judge. Allow 30 min gap between repeated rating sessions. The observers should not know the composition or source of specific samples. Use the scale given in 4.4 for rating and record ratings as integers ranging from one to nine with one given the highest quality rating.

5. Rating scale: Action tendency scale

- a. I would be very happy to accept this water as my every day drinking water.
- b. I would be happy to accept this water as my every day drinking water.
- c. I am sure that I could accept this water as my everyday drinking water.
- d. I could accept this water as my everyday drinking water

6. Result

Normal range- Agreeable (scale Range A, B, C)

Result- Agreeable A

7. Reference

IS 3025 part-8:1984 (Reaffirmed 2002) - Methods of Sampling and Test (Physical and chemical) for water and Waste Water: Taste Rating

5. TURBIDITY

Introduction:

The turbidity of sample is the reduction of transparency due to the presence of particulate matter such as clay or slit, finely divided organic matter, plankton or other microscopic organisms. These cause light to be scattered and absorbed rather than transmitted in straight lines through the sample. The values are expressed in nephelometric turbidity units (NTU). The method is applicable to drinking, surface and saline waters in the range of turbidity 0-40 NTU. Higher values may be obtained by dilution of the sample.

Method: Nephelometric method

1. Principle

It is based on comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions.

2. Interferences

Coloured solutes because lowering of turbidity values.

3. Apparatus

- I. Sample tubes - The sample tubes should be of clear and colourless glass.
- II. Turbidity meter - The turbidity meter shall consist of a nephelometer with a light source for illuminating the sample and one or more photoelectric detectors with a readout device to indicate the intensity of light scattered at right angles to the path of the incident light. The turbidity meter should be so designed that little stray light reaches the detector in the absence of turbidity and should be free from significant drift after a short warm up period.

4. Reagents

- I. Hexamethylene tertramine solution - Dissolve 10.0gm hexamethylene tetramine in demineralized water and dilute to 100mL.
- II. Hydrazine sulphate solution - Dissolve 1.0 gm hydrazine sulphate $[(\text{NH}_2)_2\text{H}_2\text{SO}_4]$ in demineralized water and dilute to 100mL
- III. Turbidity standard suspension-I (Formazin) - In a 100mL volumetric flask mix 5.0mL hydrazine sulphate solution with 5.0mL hexamethylene

tetramine solution. After 24 hr standing at $25\pm 3^{\circ}\text{C}$, dilute to 100mL with demineralized water and mix well. Prepare fresh suspension monthly.

- IV. Turbidity standard suspension-II -Dilute 10mL turbidity standard suspension 1 to 100mL with demineralized water. The turbidity of this suspension is defined as 40

5. Sample Handling and Preservation

Preservation of sample is not practical. Analysis should begin as soon as possible. Refrigeration or chilling to 4°C is recommended to minimize microbiological activity.

6. Procedure

- i. Take distilled water in sample tube – I and adjust the reading to 00.0 using ZERO knob.
- ii. Take 40 NTU solution tube –II and adjust the reading to 40.00 using CAL knob.
- iii. Repeat the steps which are given in above until the meter shows concordant value
- iv. Take sample water in sample tube-I and note the reading which is shown in the meter.

7. Result

Normal range- 2NTU

Result- 0.5 NTU

8. Reference

IS: 3025 Part-10 1984 (Reaffirmed 2002) - Methods of Sampling and Test
(Physical and chemical) for water and Waste Water: Turbidity

6. TOTAL DISSOLVED SOLIDS (TDS)

Method: GRAVIMETRIC METHOD

1. Principle

The sample is filtered and the filtrate evaporated in a tarred dish on steam bath. The residue after evaporation is dried to constant mass at 103-105°C or 179-181°C

2. Interferences

- i. Highly mineralized waters containing significant concentration of calcium, magnesium, chloride and sulphate may be hygroscopic. These may require prolonged drying, desiccation and rapid weighing. However, prolonged drying may also cause loss of constituents, particularly nitrates and chlorides.
- ii. A large amount of residue in the evaporating basin may crust over and entrap water preventing its evaporation during drying. For this reason, the volume of the sample should be adjusted so that the residue left after drying should be about 100-200mg.

3. Apparatus

- i. Drying oven with thermostatic control
- ii. Desiccators provided with a colour indicating desiccant.
- iii. Analytical Balance 200gm capacity and capable of weighing to nearest 0.1 mg.
- iv. Evaporating dish (100 ml)

4. Sample handling and preservation

Preservation of the samples is not practical. Analysis should begin as soon as possible. Refrigeration or chilling to 4°C to minimize microbiological decomposition of solids is recommended.

5. Procedure

- i. Take 100 ml evaporating dish, wash with distilled water and kept in oven for one hour at 105°C. then cool in desiccators for 15min, take the empty weight of the dish (W1)
- ii. Kept the same evaporating dish on a water bath with 100 ml sample and do continue evaporating until all the sample evaporate.
- iii. After complete evaporation of water residue will form, transfer the dish to an oven and kept for one hour at 105°C. then cool in desiccators for 15 min, take the final weight of the dish (W2).

6. Result

Normal range- 500mg/L

Result- 30mg/L

7. Reference

IS: 3025 part 16 – 1984 (Reaffirmed 2002) - Methods of Sampling and Test (Physical and chemical) for water and Waste Water: Filterable Residue (Total Dissolved Solids)

7. ALKALINITY

Introduction: Alkalinity of sample can be estimated by titrating with standard sulphuric acid (0.02N) at room temperature using phenolphthalein and methyl orange indicator. Titration to decolourisation of phenolphthalein indicator will indicate complete neutralization of

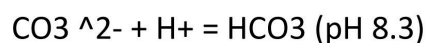
OH⁻ and ½ of CO₃⁻ while sharp change from yellow to orange of methyl orange indicator total alkalinity (complete neutralization of OH⁻, CO₃⁻, and HCO₃⁻)

Method: POTENTIOMETRIC TITRATION

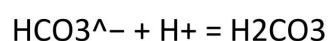
1. Principle

Alkalinity of water is the capacity of the water to accept protons. It may be defined as the quantitative capacity of an aqueous medium to react with hydrogen ions to pH 8.3 (phenolphthalein alkalinity) and then to pH 3.7 (total alkalinity or methyl orange alkalinity).

The equation in its simplest form is as follows:



From pH 8.3 to 3.7 the following reaction may occur:



2. Interferences

Free available residual chlorine markedly affects the indicator color response. The addition of minimal volume of sodium thiosulphate eliminates this

interference. Substances such as salt of weak organic or inorganic acids present in large amount may interfere.

3. Sample Preparation- The sample aliquot used for analysis should be either free from turbidity or should be allowed to settle prior to analysis.

4. Apparatus

- i. pH meter
- ii. Burette- 50 mL capacity
- iii. Magnetic stirrer assembly

5. Reagents

- i. Sulphuric Acid - Dilute 5.6 mL of concentrated sulphuric acid (relative density 1.84) to 1 liter with distilled water.
- ii. Standard solution of sulphuric acid - 0.02N
- iii. Phenolphthalein indicator - Dissolve 0.5 gm of phenolphthalein in 100mL, 1:1 (v/v) alcohol water mixture.
- iv. Mixed indicator solution: Dissolve 0.02gm methyl red and 0.01gm bromocresol green in 100mL, 95 percent, ethyl or isopropyl alcohol.

6. Procedure

- i. Pipette 20 mL or a suitable aliquot of sample into 100 mL beaker.
- ii. If the pH of the sample is over 8.3 then add 2 to 3 phenolphthalein indicator and titrate with standard sulphuric acid solution till the pink color observed by indicator just disappears (equivalence of pH 8.3).
- iii. Record the volume of standard sulphuric acid solution used. Add 2 to 3 drops of mixed indicator to the solution in which the phenolphthalein alkalinity has been determined.
- iv. . Titrate with the standard acid to light pink color (equivalence of pH 3.7). Record the volume of standard acid used after phenolphthalein alkalinity.

7. Result

Normal range- 200mg/L

Result-7mg/L

8. Reference

IS: 3025 (Part 23) – 1986 (Reaffirmed 2003) - Methods of Sampling and Test (Physical and chemical) for water and Waste Water: Alkalinity

CONCLUSION

This internship has been an excellent and rewarding experience. I can conclude that there have been a lot I've learnt about Method of Analysis of water in J.S.V AQUA FARM. Overall, my internship has been a success. I was able to gain practical skills, work in a fantastic environment, and was so helpful in grooming the mindset of working in a real firm.