KG REDDY
College of Engineering
& Technology
AN AUTONOMOUS INSTITUTION

CELEBRATING 15 YEARS OF BRILLIANCE

Environmental Engineering Lab

LABORATORY MANUAL

Prepared By: Mr. Mahantesh Paruti, Assistant Professor

Department of Civil Engineering

Institute Vision

To become an institution which is internationally recognized for its holistic approach to engineering, innovative teaching and learning culture, research and entrepreneurial ecosystem, and sustainable social impact in the community.

Institute Mission

- To offer undergraduate and post-graduate programs which are supported through industry relevant curriculum and innovative teaching and learning processes that would help students succeed in their professional careers.
- To provide faculty and students with an ecosystem that fosters innovation, research, entrepreneurship, and international exposure through strategic partnerships with government organizations and collaboration with industries.
- To provide holistic learning environment to students which will contribute to their personal and professional growth and enable them to become leaders in their respective fields.
- To contribute to the development of the region by using our technological expertise to work with nearby communities and support them in their social and economic development

Department Vision

To be recognized for excellence in teaching, innovation, and research aimed towards betterment of society through sustainable infrastructural development.

Department Mission

- To integrate innovative teaching and learning practices that will enable students to build technical competence for working in civil engineering industries.
- To encourage innovation, research, and entrepreneurship among faculty and students that will lead to sustainable development.
- To become self-sustainable through strategic collaborations with industries and nearby communities focused on consultancy services.

Program Educational Objectives

PEO1: Graduates will be able to work in multidisciplinary teams focused on development of infrastructure, design, sustainability, construction management and all the other related fields of Civil Engineering.

PEO2: Graduates will be professionally competent through their ability to use modern civil engineering tools and manage projects in leadership positions.

PEO3: Graduates will transform into change makers who will work towards societal development and advocate for equity, social justice, and sustainable development

Program Outcomes

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the imitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7.Environment and sustainability: Understand the impact of the professional Engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11.Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12.Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

PSO1: Graduates will be able to plan, analyze, design safe and sustainable green infrastructure.

PSO2: Graduates will be able to utilize the latest software tools for modeling and simulation in the field of civil engineering.

PSO3: Graduates will be able to work in multidisciplinary teams to design, develop and promote smart construction related.

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Environmental Engineering Lab

Course Objectives: The objectives of this course for the students are to:

1. Perform the experiments to determine water and waste water quality
2. Understand the water & waste water sampling, their quality standards
3. Estimate quality of water, waste water, Industrial water
4. Determine the Degree and Type of Treatment
5. Understand the Environmental Significance

Course Outcomes: After completion of this course, the students will be able to

CO1: Determine water and waste water quality for different.

CO2: Experiment on water quality parameter's in water.

CO3: Examine and Estimate water, wastewater, air and soil Quality.

CO4: Compare the water, air quality standards with prescribed standards set by the local governments.

CO5: Develop a report on the quality aspect of the environment Practical Work.

Department of Civil Engineering

Environmental Engineering Lab

Course Code: KG23ACE311 **B. Tech. III Year I - Semester**

LIST OF EXPERIMENTS:

CYCLE – I

1. Determination of P^H
2. Determination of Electrical Conductivity
3. Determination of Total Solids (Organic and inorganic)
4. Determination of Acidity
5. Determination of Alkalinity
6. Determination of Hardness (Total, Calcium and Magnesium Hardness)
7. Determination of Chlorides

CYCLE – II

1. Determination of optimum coagulant Dosage
2. Determination of Dissolved Oxygen (Winkler Method)
3. Determination of COD
4. Determination of BOD/DO
5. Determination of Residual Chlorine
6. Total count No.
7. Noise level measurement

MANDATORY INSTRUCTIONS

1. Students should report to the labs concerned as per the timetable.
2. Record should be updated from time to time and the previous experiment must be signed by the faculty in charge concerned before attending the lab.
3. Students who turn up late to the labs will in no case be permitted to perform the experiment scheduled for the day.
4. After completion of the experiment, certification of the staff in-charge concerned in the observation book is necessary.
5. Students should bring a notebook of about 100 pages and should enter the readings/observations/results into the notebook while performing the experiment.
6. The record of observations along with the detailed experimental procedure of the experiment performed in the immediate previous session should be submitted and certified by the staff member in-charge.
7. The group-wise division made in the beginning should be adhered to, and no mix up of student among different groups will be permitted later.
8. The components required pertaining to the experiment should be collected from Lab- in-charge after duly filling in the requisition form.
9. When the experiment is completed, students should disconnect the setup made by them, and should return all the components/instruments taken for the purpose.
10. Any damage of the equipment or burnout of components will be viewed seriously either by putting penalty or by dismissing the total group of students from the lab for the semester/year.
11. Students should be present in the labs for the total scheduled duration.
12. Students are expected to prepare thoroughly to perform the experiment before coming to Laboratory.

13. Procedure sheets/data sheets provided to the students groups should be maintained neatly and are to be returned after the experiment.

14. DRESS CODE:
    i. Boys -Formal dress with tuck in shoes, hand gloves and mask
    ii. Girls - Formal dress
    iii. **Apron for both boys and girls.**

EXPERIMENT NO -1

DETERMINATION OF P^H

Aim: To determine pH of the given water sample using the pH meter.

Apparatus:pH meter

pH Meter with pH electrode and Temperature Probe

Reagents: Standard buffer solution

Theory: The pH value is a measure of the acidity or alkalinity of a solution. It is expressed as thenegative logarithm of hydrogen ion concentration of the solution.

pH = - log $[H^+]$

where $[H^+]$ = Hydrogen ion concentration of the solution in moles per liter.

The pH scale is used to express the degree of acidity or alkalinity. The pH scale extends from0 to 14 with 7 as the pH of pure water at 25^0C taken as the neutral point. pH greater than 7 and up to 14 indicates the degree of alkalinity, and pH less than 7 and up to 0 indicates the degree of acidity.

Principle:

When the pair of electrodes, namely the pH sensitive glass electrode and reference electrode are dipped in a solution, they develop an electrical potential, which is also dependent on the temperature of the solution. This electrical potential is calibrated and read as pH on the indicator.

Procedure:

1. Each instrument is supplied complete with four 1.5V batteries. Install the batteries. Attach pH electrode and temperature probe to the connectors on the top of the instrument. Turn ON by pressing the ON/OFF key.

2. Remove the protective bottle from the pH electrode tip. Immerse pH electrode and temperature probe in the solution to be tested, stir gently and wait for stable reading. Note that the pH electrode tip should be submersed at least 4 cm into the solution. The temperature probe should be located as near as possible to the pH electrode.

3. Press the SET/HOLD key to display the desired range: PH or ° C (temperature) .pH readings are automatically compensated for temperature variations. If the temperature probe is not connected, the compensation is done at a fixed value of 25 °C.

4. The reading shown in the appropriate scale of the meter is the pH values of the given solution.

5. To freeze the display, from measurement mode, press and hold the SET/HOLD key until the “H” tag lights up.

6. Press SET/HOLD again to return to normal mode. After use, turn the meter OFF by pressing ON/OFF and disconnect the probes.

7. Clean the pH electrode with water and insert the tip protection bottle. Never let the electrode tip dry

8. "Set 7" control should be operated only in the stand by position.

9. While cleaning the electrodes, do not touch the tip of the electrodes

Importance: To calibrate the instrument, prepare the buffer solution by dissolving the buffer substance supplied in fresh distilled water. Take the buffer solution in a clean glass beaker. Wash the electrode with distilled water and clean with tissue paper. Lower the electrodes in the solution. Measure the temperature of the solution and set the temperature compensator to this value. See the meter pointer to read 7 pH exactly by means of "Set 7" control. Keep the instrument in the proper pH range. Set the pointer to the known pH value of the buffer solution by turning the calibrate control.

Observations:

Sample No:	Temperature	pH		Type of sample
		pH meter	pH paper	

Result:

pH of the given sample of water =

Importance:

1. In the water treatment, pH is a factor to be considered in chemical coagulation, disinfection, and water softening also in corrosion control, because in these processes, certain reactions will take place only in the proper pH ranges.

2. In the wastewater treatment involving biological processes, pH must be controlled within a range favorable to the particular organisms involved. Chemical coagulation of wastewater's, de-watering of sludge, and oxidization of wastes requires the pH to be controlled in the favorable range.

3. For public water supplies, pH value should preferably be between 6.5 and 8.5.

EXPERIMENT NO:2

Determination of Electrical Conductivity

AIM: To determine the specific conductivity of the given water sample**.**

Apparatus: Digital conductivity meter

Digital Conductivity Meter

Reagents:

Standard KCl Solution.

Theory:

The specific conductivity of the water is its ability to conduct electricity. It is determined bymeasuring the conductivity of water at 25^0 C. The unit of specific conductivity is micro

siemens per Cms (µs/Cm) or micro-mhos per Cm (µmhos/Cm)

Principle:

The digital conductivity meter measures the specific conductivity by employing the wheat-stone bridge principle. A **Wheatstone bridge** is an electrical circuit used to measurean unknown electrical resistance by balancing two legs of a bridgecircuit, one leg of which includes the unknown component. The cell and temperature probes of the instruments are dipped into the given sample to find the specific conductivity of the given sample. The specific conductivity multiplied by a conversion factor gives the total dissolved solids.

PROCEDURE:

1. Connect the conductivity cell and temperature probe to the socket ‘CELL’ and ‘TEMP’ respectively provided on instrument.
2. Connect the mains cord to 230V, 50 Hz supply.
3. Immerse the probe into the solution to be tested. The sleeve holes must be completely submerged.
4. Tap the probe repeatedly to remove any air bubbles that may be trapped inside the sleeve.
5. If needed, press RANGE until the desired EC or TDS range is selected on the LCD.
6. Allow for the reading to stabilize. The primary LCD displays the measurement in the selected range, while the temperature is displayed on the secondary LCD.
7. The display directly gives the specific conductivity of the given sample is µs/Cm.

Note:

- If the meter displays only dashes " ", the reading is out of range.
- If the stability indicator (hourglass symbol) blinks, the reading is not stable.
- Make sure the meter is calibrated before taking measurements.
- If measurements are taken successively in different samples, for accurate reading it is recommended to rinse the probe thoroughly with deionized water before immersing it into the sample.
- TDS reading is obtained by multiplying the EC reading by the TDS factor, which has a default value of 0.50. It is possible to change the TDS factor within the 0.40 to 1.00 range by entering setup mode and selecting the "TDS" item.

Observations:

Sample No:	Temperature	Conductivity (µs/Cm)	TDS using TDS Factor

Result:

The specific conductivity of the given sample = µs/Cm

Total dissolved solids present in the given sample = mg/l

EXPERIMENT NO -3

Determination of Total Dissolved Solids (Organic & Inorganic)

Aim:

To determine the total solids of the given sample.

Apparatus Required:

- Evaporating Dishes
- Oven
- Desiccator
- Water bath

Hot Air Oven

Desiccator

Principle:

Total solids are determined as the residue left after evaporation and drying of the unfilteredsample.

Procedure:

1. A clean porcelain dish is ignited in a muffle furnace and after partial cooling in the air, it is cooled in a Desiccator and weighed using precision balance.
2. A 100 ml of well mixed sample (graduated cylinder is rinsed to ensure transfer of all suspend matter) is placed in the dish and evaporated at 100^0 C on water bath, followedby drying in over at 103^0 C for 1 hour.

3. Dry to a constant weight at 103^0 C, cool in a desiccator and weigh in precisionbalance.

Observations:

S. NO.	Volume of sample (ml)	Initial weight of the dish (mg)	Final weight of the dish (mg)	Total solids (mg/l)

Calculations:

$$\text{Total solids} = \frac{(W_2 - W_1) \times 1000}{\text{Volume of sample take}}$$

W_1=Initial weight of the dish in mg.

W_2=Final weight of the dish in mg.

Result:

Total solids of the given sample = mg/l

EXPERIMENT NO -4

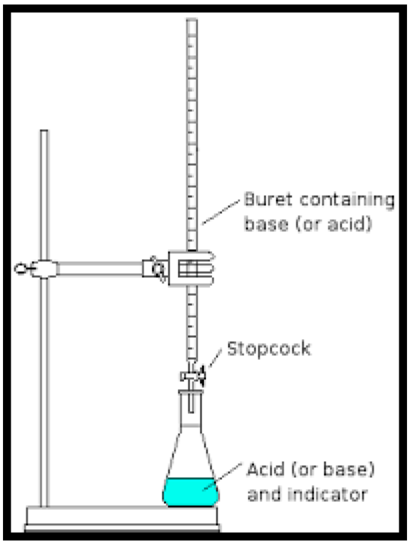
Determination of Acidity

Aim:

To determine the total acidity and mineral acidity of a given water sample.

Apparatus:

- Burette
- Pipette
- Conical flask
- Glazed tile



Titration set up

Reagents:

1. Sodium hydroxide 0.02 N
2. Methyl Orange Indicator
3. Phenolphthalein Indicator

Theory:

Acidity of a liquid is its capacity to donate H+ ions. The presence of acidity invariably indicates water pollution. Its presence indicates the discharge of acidic industrial effluents, acid mine drainages, pickling liquors and from humic acids.

Acidity is classified as mineral acidity (due to H_2SO_4 and HCl) and CO_2 acidity. The acidity present due to free CO_2 has no significance from public health point of view. Water containing mineral acidity is unacceptable.

Principle: The mineral acids present and contributing mineral acidity can be calculated by titrating or neutralizing samples to pH 4.3. The CO2 and bi - carbonate (Carbonic acid) present in the sample can be neutralized completely by continuing the titration to pH 8.3

Interference:

Colour, Turbidity, Iron, Aluminum, and residual chlorine are prime sources of interference.

Procedure:

1. Take suitable volume of sample (20 ml) in 250 ml conical flask.
1. Add 2 drops of Methyl orange indicator. The sample turns pink/orange. Titrate with standard 0.02 N Sodium hydroxide solution till colour changes to yellow, characteristic pH is 4.3 – 4.4.
2. Note down the volume of NaOH required. (A ml)
3. Add 2 - 3 drops of phenolphthalein indicator and continue titration with NaOH till faint pink colour appears indicating pH 8.3
4. Note down the volume of additional NaOH required (B ml)

Observations:

Sl.No	Volume of sample	Methyl orange Indicator			Phenolphthalein Indicator		
		Initial Burette Reading	Final Burette Reading	NaOH used V_1	Initial Burette Reading	Final Burette Reading	NaOH used V_1

Calculation:

$$\text{Mineral acidity as } CaCO_3 \text{ in mg/l} = \frac{A \times 1000}{\text{Vol(ml) of sample taken}}$$

$$CO_2 \text{ acidity as } CaCO_3 \text{ in mg/l} = \frac{B \times 1000}{\text{Vol(ml) of sample taken}}$$

Result:

Mineral acidity of the given sample of water =

CO_2 acidity of the given sample of water =

Total acidity of the given sample of water =

(Mineral acidity + CO_2 Acidity)

EXPERIMENT NO -5

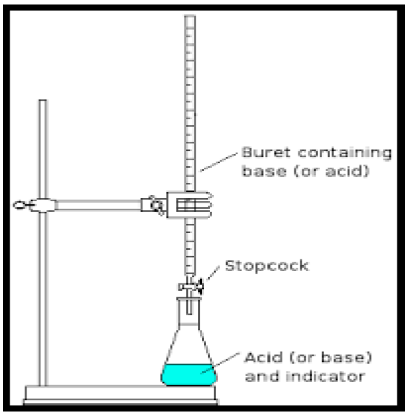
Determination of Alkalinity

Aim:

To determine the alkalinity present in a given water sample.

Apparatus Required:

- Burette
- Pipette
- Conical flask
- Glazed tile



Titration set up

Reagents:

1. Sulphuric acid 0.02 N
2. Methyl orange indicator
3. Phenolphthalein indicator

Theory:

The alkalinity of water is a measure of its capacity to neutralize acids. Although many materials may contribute to the alkalinity of the water, the major portion of the alkalinity in natural waters is caused by Bi-carbonates constitute the bulk quantity of alkalinity as they are formed in considerable amounts by the action of carbonate and hydroxide alkalinity.

Principle:

Alkalinity can be obtained by neutralizing OH^-, CO_3^{--}, HCO_3^- with standard H_2SO_4. Titration to pH 8.3 or de-colorization with the addition of phenolphthalein indicator will show complete neutralization of $OH^-$and 1/2 of CO_3^{--}. Titration to pH 4.4 or sharp change from yellow to pink with the addition of Methyl orange indicator will show total alkalinity, i.e., OH^-, CO_3^{--} and HCO_3^-.

Interference:

Colour, turbidity, iron, aluminum and residual chlorine are prime sources of interference.

Procedure:

1. Take 20ml sample in a conical flask and add 2-3 drops of Phenolphthalein indicator.
2. If pink color develops titrate with 0.02 N H_2SO_4 till the color disappears indicating Ph 8.3. Note the volume of H_2SO_4 required (A ml).
3. Add 2-3 drops of Methyl orange to the same flask. The sample turns yellow / red. Continue titration till yellow / red color changes to orange indicating pH 4.4 – 4.5. Note the volume of H_2SO_4 required (B ml).
4. In case pink color does not appear after addition of phenolphthalein continue as in 3 above.
5. Calculate total (T), Phenolphthalein (P)and Methyl orange (MO) alkalinity as follows and express as mg / l as $CaCO_3$.

Sl. No	Volume of sample (ml)	Phenolphthalein indicator			Methyl orange indicator			Remarks
		Burette reading		Volume of H_2SO_4 run down (ml)	Burette reading		Volume of H_2SO_4 run down (ml)	
		Initial (ml)	Final (ml)		Initial (ml)	Final (ml)		

Calculation:

Calculate the OH^-, CO_3^{--} and $HCO3^-$ forms from the values of P & T alkalinity as shown below

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Values of P&T	Alkalinity due to			
	OH^-	CO_3^{--}	HCO_3^{--}	pH Value
P = 0	**0**	**0**	**T**	**8.2**
P < ½ T	**0**	**2P**	**T-2P**	**8.2 - 10.6**
P = ½ T	**0**	**2P**	**0**	**10.6**
P > ½ T	**2P – T**	**2(T – P)**	**0**	**10.6 –12.0**
P = T	**T**	**0**	**0**	**12.0**

Result:

Hydroxide alkalinity as $CaCO_3$	=	mg/l
Carbonate alkalinity as $CaCO_3$	=	mg/l
Bi-carbonate alkalinity as $CaCO_3$	=	mg/l

Importance

1. High alkaline water does not possess good taste.
2. Alkalinity causes precipitates and sludge's to be deposited in the pipes and heating cubes and also makes the metal brittle.
3. Alkalinity is a major quantity that must be considered in calculating the lime and soda ash requirement in water softening. The alkalinity of softened water is also a requirement for drinking water standards.
4. Chemicals used for coagulation of water and wastewater react with water to give some acids. To destroy the acids released by the coagulant and for effective and complete coagulation, alkalinity must be present in excess.
5. Alkalinity measurements are made to evaluate the buffering capacity of wastewater and sludge.

EXPERIMENT NO -6

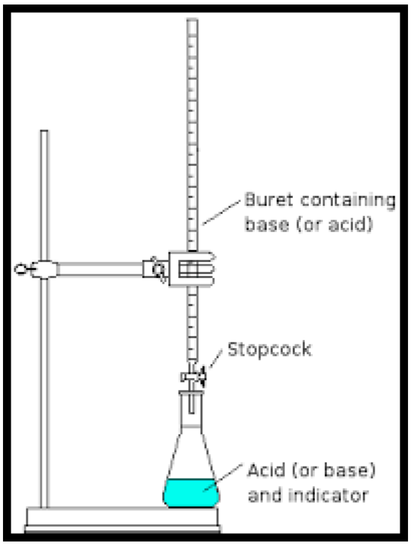
Determination of Hardness (Total, Calcium And Magnesium Hardness)

Aim:

To determine the total hardness of a given sample of water

Apparatus Required:

- Pipette
- Burette
- Conical flask etc.



Titration setup

Reagents:

- Buffer solution
- Inhibitor
- Eriochrome black - T indicator.
- Standard EDTA Solution 0.01M

Theory:

Originally water hardness was understood to be a measure of the capacity of water to precipitate soap. Soap is precipitated chiefly by calcium and magnesium ions present. Hardness is represented by the total concentrations of just the calcium and magnesium ions expressed as $CaCO_3$.

Interference:

Metal ions do interfere but can be overcome by addition of inhibitors.

Procedure:

1. Take 20 ml of well-mixed sample in a conical flask.

   Reagents: Buffer solution; EDTA Titrant; EBT

Measure Ca-Hardness and Total Hardness by titration as described below. Use a different sample for each measurement.

2. Total Hardness:100 ml of the sample and add 2 ml buffer solution in it and add 2- 3 drops of Black Titrate it with standard EDTA solution (with continuous stirring) until the last reddish colour disappears. At the end point the solution turns blue. Note down the volume used. Calculate Hardness as follows:

Hardness (in mg/L as $CaCO_3$) = $(V \times N \times 50 \times 1000) / (SV)$

Where:

V = volume of titrant (mL);

N = normality of EDTA;

50 = equivalent weight of $CaCO_3$

SV = sample volume (mL)

3. **Ca-Hardness:**

   Take 50 ml of the sample and add 1 ml Sodium Hydroxide solution (8%) in it and add pinch of Mercurex Powder. Titrate with standard EDTA solution until the light pink colour of solution converts into light blue color.

Observations:

S. No.	Volume of sample (ml)	Burette Readings		Volume of EDTA sol. rundown (ml)	Remarks
		Initial (ml)	Final (ml)		

Calculation:

Total hardness as $CaCO_3$ in mg/l = A x 1000/ml of sample taken

Result:

Total hardness of the given sample = mg/l

EXPERIMENT NO -7

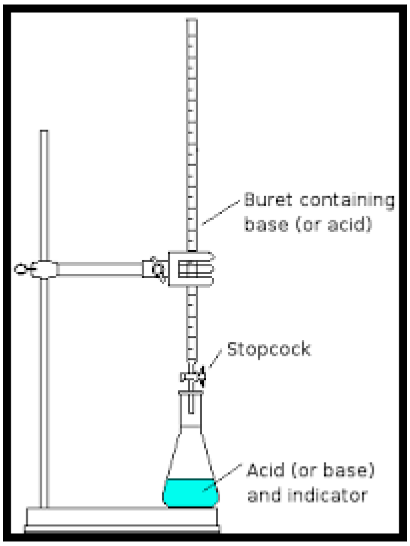
DETERMINATION OF CHLORIDES

Aim:

To Estimate to the amount of chlorides present in the given sample of water.

Apparatus:

- **Pipette**
- **Burette**
- **Conical flask**
- **Glazed Tile**



Titration setup

Reagents:

1. Potassium chromate (K_2CrO_4) indicator
2. Silver nitrate ($AgNO_3$) of 0.0141N

Principle:

Chlorides ion is determined by titration with standard $AgNO_3$ in which $AgCrO_4$ precipitates out. The end of titration is indicated by formation of red silver chromate from excess $AgNO_3$ and potassium chromate used as an indicator in neutral to slightly alkaline solution

Interference:

Bromide, Iodide, Cyanide, Sulphide, Thiosulphate, Sulphate, Iron, Phosphate are prime sources of Interference.

Procedure:

1. Adjust the pH of sample between 7.0 – 8.0.
2. Standardize $AgNO_3$ against standard NaCl solution.
3. Take 20ml well mixed sample and add 1.0ml of K_2CrO_4.
4. Titrate with standard $AgNO_3$ solution till $AgCrO_4$ starts precipitating (pinkish yellow precipitate).
5. For better accuracy titrate 20ml of distilled water in the same way to establish reagent blank.

Observations:

S. No.	Volume ofsample (ml)	Burette reading		Volume of $AgNO_3$run down(ml)	Remarks
		Initial (ml)	Final (ml)		

Calculation:

$$\text{Chlorides } (Cl^-) \text{ in mg/l} = \frac{(A - B) \times N \times 35.45 \times 1000}{\text{Volume (ml) of sample}}$$

Where A = ml of $AgNO_3$ run down for the sample

B = ml of $AgNO_3$ run down for the blank.

N = Normality of $AgNO_3$ us

Result: Chlorides present in the givensample = mg/lit

CYCLE -II

1. Determination of optimum coagulant Dosage
2. Determination of Dissolved Oxygen (Winkler Method)
3. Determination of COD
4. Determination of BOD/DO
5. Determination of Residual Chlorine
6. Total count No.
7. Noise level measurement

EXPERIMENT NO -1

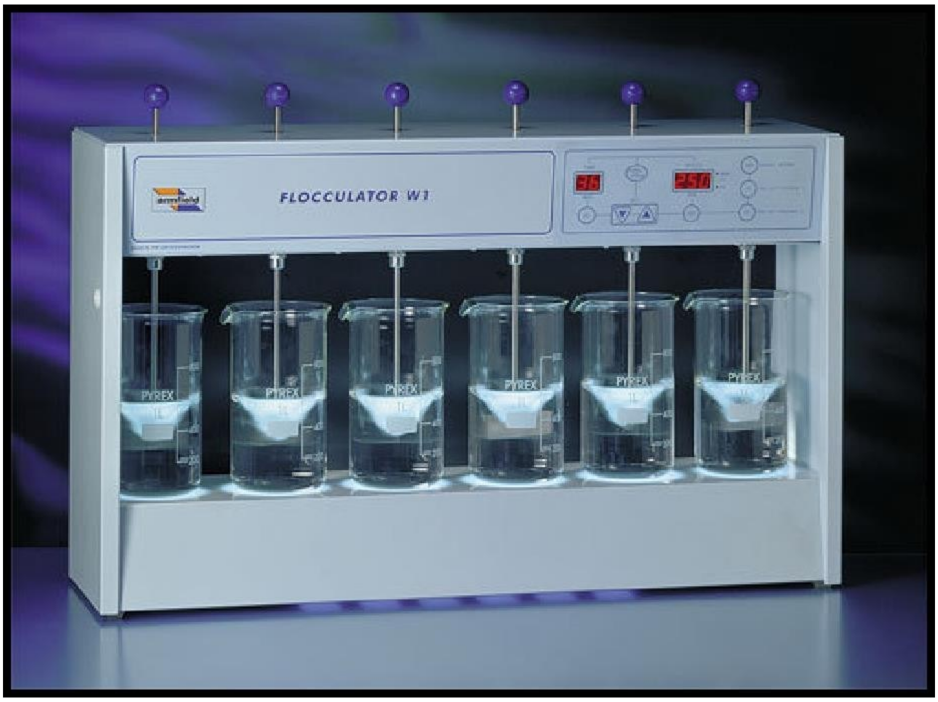
Determination of optimum coagulant Dosage

Aim:

To find the optimum dose of coagulant required for treating the given turbid water sample.

1. **Apparatus:**

- Jar test apparatus
- pH meter
- One liter beakers - 6 Nos
- Graduated pipette
- Turbidity meter



Jar Test Apparatus

Reagents:

Alum as coagulant solution

Principle:

Very fine particles of size 1 to 500 nano meters of clay, micro-organisms, decomposing organic matter, phosphates, fluorides and certain toxicants remain suspended in water without settling**n**and are called colloids.Colloids: Hydrophobic (water hating) Hydrophilic (water loving)

Hydrophobic colloids - Possessing no affinity for water are dependent on electrical charges for their stability in suspension. A coagulant destabilizes these colloids such that they contact agglomerate, form flocs and drop out of solution by sedimentation.Colloid Colloid 2Al $^{+++}$ + Al Flash mixing helps the coagulant intimately get mixed with colloids and then gentle mixing helps the particles to contact, and then to agglomerate.Coagulation is dependent on pH, colour, turbidity, mineral matter, temperature, time of flocculation and degree of agitation.The minimum concentration that effectively removes all the turbidity is the ideal dose of the coagulant.

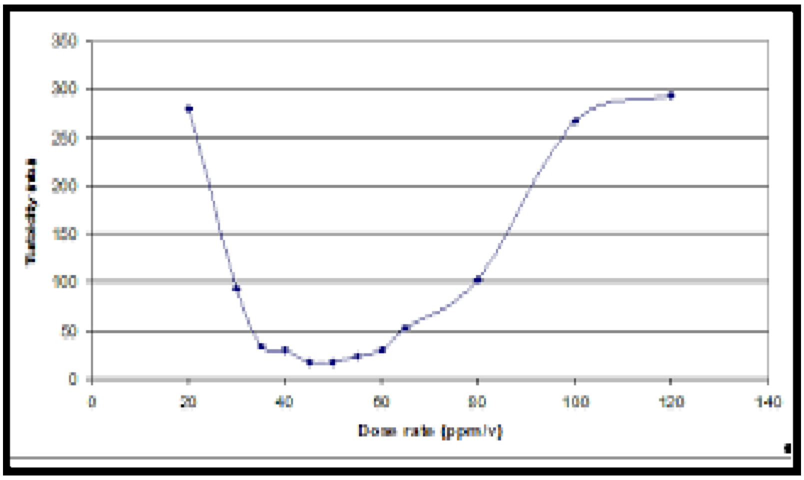
Procedure:

1. Take 1000 ml of given sample in 6 beakers.
2. Find the pH of the sample and adjust it to 6 to 8.5.
3. Now add 1 ml, 2 ml, 4 ml, 8 ml, 10 ml, 12 ml of alum respectively in each one of the beakers.
4. Now insert the paddle of the jar testing apparatus inside the beakers and start it.
5. Switch on the motor and adjust the speed of the paddles to 100 rpm.
6. Allow flash mix (100 rpm) for about 1min to ensure complete dispersion of chemicals.
7. Reduce the speed of paddles to 40 rpm and continue mixing for 15 to 20 min.
8. Switch off the motor and allow the mixture for 30 min to settle the agglomerated particles.
9. Collect the supernatant without disturbing the sediment and find the turbidity
10. Repeat the experiment with higher doses of alum if satisfactory results were notobtained.
11. Plot a graph between "Settled turbidity" Vs "Coagulant dosage" and select the optimum dosage from the graph.
12. Also record the pH, colour, alkalinity and temperature.
13. The optimum value of coagulant dosage from the graph should be reported.

Observations:

S NO:	Sample (Alum Dosage) mg / l	Turbidity (NTU)

Model Graph:



Result :

The optimum dosage coagulant for the sample = mg/lit

EXPERIMENT NO -2

Determination of Dissolved Oxygen

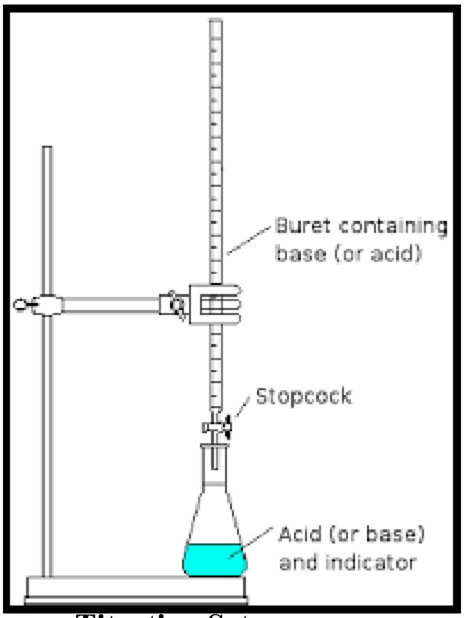
Aim:

To find the quantity of Dissolved oxygen present in the given sample..

Apparatus:

- BOD bottles (capacity 300 ml)
- Sampling device for collection of samples
- Burette

BOD Bottles



Titration Set up

Reagents:

- Manganese Sulphate
- Alkali iodide-azide reagent
- Starch indicator
- Standard sodium thio-sulphate (0.025 N)
- Concentrated sulphuric acid (36 N)

Oxygen present in sample oxidizes the divalent manganese to its higher valency, which precipitates as a brown hydrated oxide after addition of NaOH and KI. Upon acidification, manganese reverts to divalent state and liberates iodine from KI equivalent to D.O. content inthe sample. The liberated iodine is titrated against Na_2

$S_2 O_3$ (0.25N), using starch as an indicator. If oxygen absent in sample, the $MnSO_4$ react with the alkali to from whiteprecipitate Mn $(OH)_2$.

Interference:

Ferrous ion, ferric ion, nitrate, microbial mass and high-suspended solids constitute the mainsources of interference.

Procedure: (Winkler Method)

1. Take 300ml BOD bottle and collect of water sample into it.
2. Add 2ml of manganese sulphate and 2 ml of alkali iodide-azide solution to the BOD bottle. The tip of the pipette should be below the liquid level, while adding these reagents.
3. Restopper with care to exclude air bubbles, and mix repeatedly by inverting the bottle 2 to 3 times.
4. If no oxygen is present, the manganese ion reacts with hydroxide ion to from white precipitate of Mn $(OH)_2$If oxygen is present, some Mn^{++++} and precipitates as a brown coloured manganese oxide.

   Mn^{++} + $2OH^-$Mn $(OH)_2$ (white)

   Mn^{++} +$2OH^-$ + $^1/_2$ O_2MnO_2 (brown) + H_2O.

5. After shaking and allowing sufficient time for all oxygen to react, the chemicalprecipitates are allowed to settle leaving clear liquid within the upper portion.
6. 2ml of concentrated sulphuric acid is added.
7. The bottle is restoppered and mixed by inverting until the suspension is completelydissolved and yellow colour is uniform throughout the bottle.

   $MnO_2 + 2I^- + 4H^+$ -----> $Mn^{++} + I_2 + 2H_2O$.

8. A volume of *203 ml is taken into the conical flask and titrated with 0.025 N sodiumthiosulphate solution until yellow coloured iodine turns to a pale straw colour.
9. Since it is impossible to accurately titrate the sample to a colour less liquid, 1 to 2 mlof starch solution is added.
10. Continue titration to the first disappearance of the blue colour.

Observations:

S.No	Volume ofsample (ml)	Burette Readings		Volume of $Na_2S_2O_3$run down (ml)	D.O in (mg/l)
		Initi al (ml)	Final (ml)		

Calculations:

1 ml of 0.025N $Na_2S_2O_3$ is equivalent to 0.2mg of O_2, since the volume of the sample is 200 ml.

1 ml of sodium thiosulphate is equivalent to $\frac{0.2 \times 1000}{200}$ mg/l = 1 mg/l of DO

Result:

Dissolved oxygen concentration in the given sample= mg/l

EXPERIMENT NO -3

Determination of COD

Aim:-

Determine chemical oxygen demand (COD) of given sewage samples.

Introduction:

Chemical oxygen demand (COD) is used to determine the quantity of pollution in water after wastewater treatment. The higher value of chemical oxygen demand indicates the higher organic pollution in the water sample. Only chemically digest able matter can be determined by the COD test.

COD determination takes less time than the Biological Oxygen Demand test. COD is recommended where the polluted water has toxicity and organic matter can't be determined by biological oxygen demand and useful in water effluent treatment plants.

The organic matter, present in the water sample is oxidized by potassium dichromate in the presence of sulfuric acid, silver sulfate and mercury sulfate to produce carbon dioxide (CO2) and water (H2O). The quantity of potassium dichromate used is calculated by the difference in volumes of ferrous ammonium sulfate consumed in blank and sample titrations. The quantity of potassium dichromate used in the reaction is equivalent to the oxygen (O2) used to oxidize the organic matter of wastewater.

Apparatus Required

- Burette
- conical flask
- pipette
- measuring cylinder

Reagents:

1. Potassium dichromate (K2Cr2O7) Solution: Add 6.13 gm Potassium dichromate (previously dried at 105 °C for at least two hours) into 800 ml distilled water. Shake the flask well to dissolve the content and make up the solution to 1000 ml and mix well.

2. **Silver sulfate-Sulfuric acid Solution:** Dissolve 10 gm Silver sulfate (Ag_2SO_4) in 500 ml concentrated sulfuric acid and make up the solution to 1000 ml swirl the flask to mix well. Allow standing the solution for 24 hours before use.
3. Mercury sulfate Solution: Dissolve carefully 0.1 gm of $HgSO_4$ in 5 ml of concentrated Sulfuric acid.
4. Ferrous ammonium sulfate Solution (0.025 M): Dissolve 9.8 g ferrous ammonium sulfate in a solution of 100 ml of distilled water and 20 ml concentrated Sulfuric acid. Cool the solution and make up the solution to 1000 ml of distilled water. Standardize the solution to determine the actual concentration to calculate the chemical oxygen demand.
5. Ferroin Indicator: Add 3.5 gm of Iron Sulfate heptahydrate and 7.5 gm of Phenanthroline monohydrate to 400 ml of distilled water. Mix well to dissolve and make up to 500 ml of distilled water

Procedure:

1. Take 10 ml of sample into a round bottom reflex flask
2. Add some glass beads to prevent the solution from bumping into the flask while heating.
3. Add 1 ml of Mercury sulfate ($HgSO_4$) solution to the flask and mix by swirling the flask.
4. Add 5 ml of Potassium dichromate ($K_2Cr_2O_7$) solution.
5. Now add slowly and carefully 15 ml Silver sulfate- Sulfuric acid solution.
6. Connect the reflex condenser and digest the content using a hot plate for 2 hours.
7. After digestion cools the flask and rinses the condenser with 25 ml of distilled water collecting in the same flask.
8. Add 2-4 drops of ferroin indicator to the flask and titrate with ferrous ammonium sulfate solution to the endpoint.

9. Make the blank preparation in the same manner as sample using distilled water instead of the sample.

Observation:

S. No.	Sample (ml)	Initial Value (Burette Scale)	Final Value (Burette Scale)	Volume of Titrant Used (ml)
1	Water Sample	--	--	- -
2	Blank	--	--	- -

Calculations:

Calculate the chemical oxygen demand by following formula:

COD = 8*1000*DF*M*(VB - VS) / Volume of sample (in ml)

Where, DF – Dilution Factor (if applicable)

M – Molarity of standardized Ferrous Ammonium Sulfate solution

VB – Volume consumed in titration with blank preparation

VS – Volume consumed in titration with sample preparation

EXPERIMENT NO -4

Determination of BOD

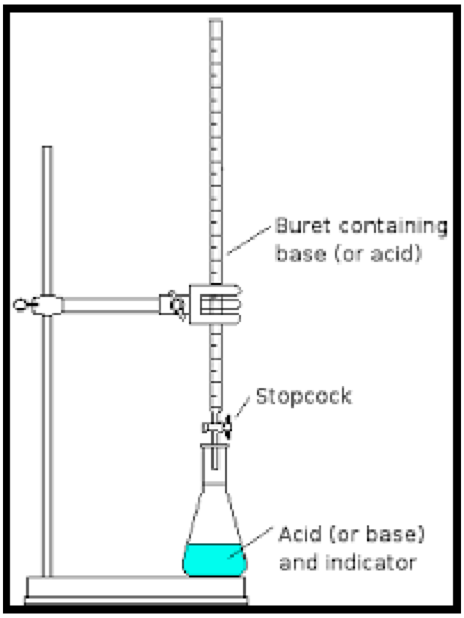
Aim:-

To determine Bio-chemical Oxygen Demand (BOD) exerted by the given waste water sample.

Apparatus Required

- BOD bottles (capacity 300 ml)
- Sampling device for collection of samples
- Incubator
- Burette
- Pipettes

BOD Bottles



Titration Set up

Reagents:

- Distilled water
- Phosphate buffer solution
- Magnesium sulphate solution
- Calcium chloride solution

- Sodium thio-sulphite solution

Principle:

The BOD is an empirical biological test. This BOD test may be considered as wet oxidation PROCEDURE: in which the living organisms serve as the medium for oxidation of the organic matter to carbon-di-oxide and water.

Bacteria

$$C_n H_a O_b N_c + [n + a/4 - b/2 - 3c/4]\ O_2 \quad n\,CO_2 + [a/2 - 3c/2]\ H_2O + cNH_3$$

On the basis of the above relationship, it is possible to interpret BOD data in terms of organic matter as well as the amount of oxygen used during its oxidation.

Interference:

Undesirable oxygen consumption via nitrification can be prevented by addition of 1 ml of an N – allyl thourea solution. Free chlorine, present in some wastewater after chlorination reacts with organic components within about 2 hours and does not interfere. Compounds, which use up oxygen without the presence of micro - organism (e.g. Fe^{++}, sulphite or sulphide ions) are oxidized by leaving the original sample for 2 hours with occasional shaking. Lack of nutrient in dilution water, lack of acclimated seed organisms and the presence of toxic substance can result in very low BOD values despite the presence of sufficient degradable organic materials. In such cases, a series of measurements should be carried out at greater dilutions.

Procedure:

1. Place the desired volume of distilled water in a 5-liter flask. Aeration is done by bubbling compressed air through water.
2. Add 1 ml of phosphate buffer, 1 ml of magnesium sulphate solution, 1 ml of calcium chloride solution and 1 ml of ferric chloride solution for every liter of distilled water (dilution water).
3. In the case of the waste water which are not expected to have sufficient bacterial population, add seed to the dilution water. Generally, 2 ml of settled sewage is sufficient for 1000 ml of dilution water.
4. Highly acidic or alkaline sample are to be neutralized to a pH of 7.0

5. Add 2 to 3 ml of sodium thio-sulphate solution to destroy residual chlorine if any.
6. Take sample as follows.
7. Strong waste:0.1, 0.5 or 1%
8. Settle domestic sewage:1.0, 2.5 or 5%
9. Treated effluents:5.0, 12.5 or 25%
10. River water :25.0 to 100%.
11. Dilute the sample with the distilled water and mix the contents well.
12. Take diluted sample into 2 BOD bottles.
13. Fill another two BOD bottles with diluted (distilled) water alone.
14. Immediately find D.O. of diluted wastewater and diluted water (distilled water).
15. Incubate the other two BOD bottles at 200 C for 5 days. They are to be tightly stopped to prevent any air entry into the bottles.
16. Determine D.O content in the incubated bottles at the end of 5 days (120 hours).

Observation:

S. no	**Volume of Sample (ml)**	**Burette Readings**		**Volume of $Na_2S_2O_3$ run down (ml)**	**D.O in (mg/l)**
		Initial (ml)	**Final (ml)**		

Calculations:

Initial D.O. of diluted sample = D_o =

D.O at the end of 5 days for the diluted sample = D_5 =

Initial D.O. of distilled water (blank) = C_o =

D.O. at the end of 5 days for the distilled water (blank) = C_5 =

D.O. depletion of dilution water = $C_o - C_5$ =

D.O. depletion of the diluted sample = $D_o - D_5$ =

D.O. depletion of due to microbes = $(D_o - D_5) - (C_o - C_5)$

$$\text{BOD of the sample at } 20^0\ C = \frac{[(D_o - D_5) \times \text{Vol. of the Bottle}] - (C_o - C_5)}{\text{Vol (ml) of the sample}}$$

Result:

Bio-Chemical Oxygen Demand for the given sample = mg/l

EXPERIMENT NO -5

Determination Of Residual Chlorine

Aim:-

To determine the residual chlorine in the given water sample.

Apparatus:-

- 500 ml cap. Conical flask
- 250 ml cap. Volumetric flask
- 10ml and 25 ml pipette
- 50 ml Burette

Reagents Used:

1. Standard Sodium thiosulphate solution of 0.025 N and 0.01 N.
2. Potassium Iodide (KI) crystals.
3. Glacial Acetic Acid.
4. Starch indicator Solution.
5. Bleaching powder solution.

Procedure:

1. Prepare a bleaching powder solution of known concentration of Chlorine.
2. Measure 200ml of water sample for which Chlorine demand has to be found out in a series of 500 ml cap. conical flask of say 10 Nos.
3. Add 0.2 ml of bleaching powder solution to first flask and then 0.4 ml bleaching powder solution to second flack and so on in ascending order to the successive portion in series.
4. Mix the solution in each flask gently and allow for contact time of about 30 min. for potable water and suitably higher for polluted water and secondary effluents.
5. After the contact period add 5ml of Acetic acid(glacial) and 1 gm of KI crystals and mix.
6. Now add 1 ml of starch indicator to each flask. Blue color formation indicates the presence of excess Chlorine, no color indicates that Chlorine demand of water is not sufficient.

7. Titrate the sample with 0.01 N $Na_2S_2O_3$ solutiontill blue color disappears. Record the ml of $Na_2S_2O_3$ solution consumed and note down the reading.

Theory:

Chlorine is widely used for disinfection of water and wastewater to eliminate disease causing organisms, taste and odor. Since it is a powerful oxidizing agent and is cheaply available. The chlorine demand of water is the difference between the amount of chlorine applied and amount of free combined or total available chlorine at the end of contact period. The demand varies with amount of chlorine applied, pH and temperature. The smallest amount of residual chlorine considered significant is 0.1 mg/l.

In small treatment plants bleaching powder is added as a disinfectant which obtain in the form of hydro chlorite of calcium which sterilize the water when chlorine is added to water it reacts with water as follows:

Cl_2 + H_2O HOCl (Hypochlorous acid) + HCl HOCl+ OCl^-

The quantity of HOCl and OCl which is present in water is called available chlorine. The killing efficiency of HOCl is about 40 to 80 times more than that of OCl. It ruptures the cell membrane of microbes.

$Ca(OCl)_2$ Ca + 2OCl (Hypochloride ions)

OCl^- + H^+HOCl (Hypochlorous Acid)

Hypochlorous Acid so formed kills the bacteria. The iodometric method considered as the standard against other method. The liberated iodine is titrated against the std. solution of Sodium Thiosulphate.

Calculation:

Flask No.	Sample taken in ml	Concentration of BP solution %	BP solution added	Chlorine added		(b) R-Cl in mg/l	Chlorine Demand (a-b) in mg/l
				200ml	1000ml (a)		
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							

Results:

Sl. No.	Parameter Analyzed	Results
1.	Chlorine demand of given sample of water	____________mg/l

EXPERIMENT NO -6

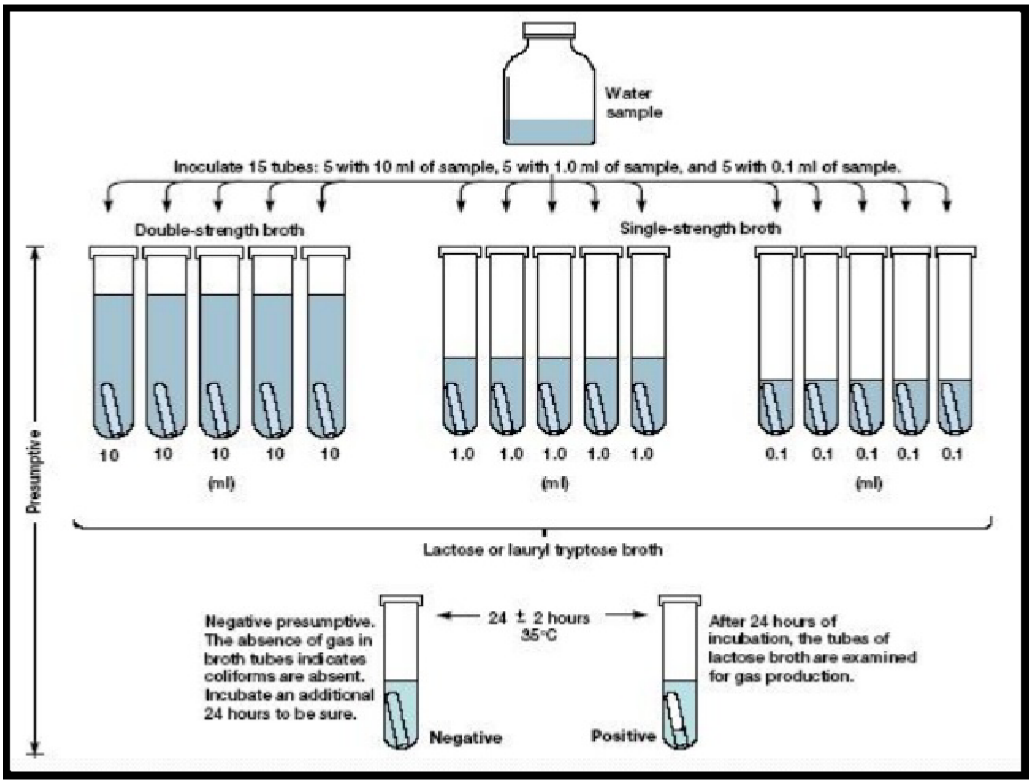
Total Count No (MPN)

Aim:-

To measure the total number of coliforms in given water sample

Apparatus Required

- Glass tubes
- Incubator



Total count no set up

Reagents:

Lactose broth (2N)

Principle:

The presumptive test for the determination of coliforms in food products is based on the inoculation of tubes of lactose broth with specified amounts of the material (A.P.H.A., 1946).Fermentation of the sugar with formation of gas indicates a positive presumptive test for coliforms.

Procedure:

Untreated water samples.

1 ml of water sample has to be inoculated in a tube containing 9 ml of double strength (2 N) lactose broth and further 10 fold dilutions were made up to 10^{-6}. Each inoculated lactose broth dilution tube was placed with an inverted Durhamtube.

The tubes inoculated were incubated at 39°C for 48 hours. Following the incubation period, the dilutions were observed for gas production. If no gas was formed within 48 hours a negative presumptive test was constituted. The presence of 10% or more gas displacement in any of the Durham tubes was considered a positive presumptive test and result recorded by positive tubes in series and interpreted in terms of the lowest positive dilution factor per ml.

In case of chlorinated and sand filtered water samples, the same procedure as for untreated water was used except the addition of a flask containing SO ml double strength (2N) lactose broth. This flask was then added with 25 ml of the water sample to be tested·

Sample inoculation

•Drinking water: no dilution, 10 mL in 10 tubes

•Surface waters: 10,1,0.1 mL in 5 tubes each

•Polluted waters: 1,0.1,0.01 mL in 5 tubes each

•Grossly polluted water: smaller inocula

•Good practice to have more than 3 inocula

Result:

Total No of Coliforms =

EXPERIMENT NO -7

Noise Level Measurement.

Aim:-

To measure noise level using sound meter

Apparatus Required

Sound Level Meter

Sound Level Meter

Principle:

A sound level meter is a measuring instrument used to assess noise or sound levels by measuring sound pressure. Often referred to as a sound pressure level (SPL) meter, decibel (dB) meter, noise meter or noise dosimeter, asound level meter uses a microphone to capture sound. The sound is then evaluated within the sound level meter and acoustic measurement values are shown on the display of the sound level meter. The most common unit of acoustic measurement for sound is the decibel (dB)

The sound pressure level is a measure of the air vibrations that make up sound. All measured sound pressures are referenced to a standard pressure that corresponds roughly to the threshold of hearing at 1 000 Hz. Thus, the sound pressure level indicates how much greater the measured sound is than this threshold of hearing. Because the human ear can detect a wide range of sound pressure levels (10–102 Pascal (Pa)), they are measured on a logarithmic scale with units of decibels (dB).

Procedure

1. . Batteries must be checked before use and during long measuring sessions.
2. A wind shield must be used if the air velocity is noticeable. It should anyway be usedall the time as a dust shield
3. The microphone should be oriented as described previously.
4. All intruding objects such as the body of the sound level meter (SLM) or the operatoritself will degrade the frequency response of the microphone at high frequencies and directivity effects will appear at much smaller frequencies
5. Power on the sound level meter
6. The meter automatically detects sound and it is displayed on the screen. This valuecan be noted down
7. To keep the value from changing constantly; press and hold the hold button.
8. Note down readings for different range of noise and switch off the power.

Observation:

Sl No	Noise level	Remarks

Result:

Noise level =

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