

RGM COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS)

(ESTD-1995)

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Nandyal - 518 501. Kurnool (Dist.) A.P.

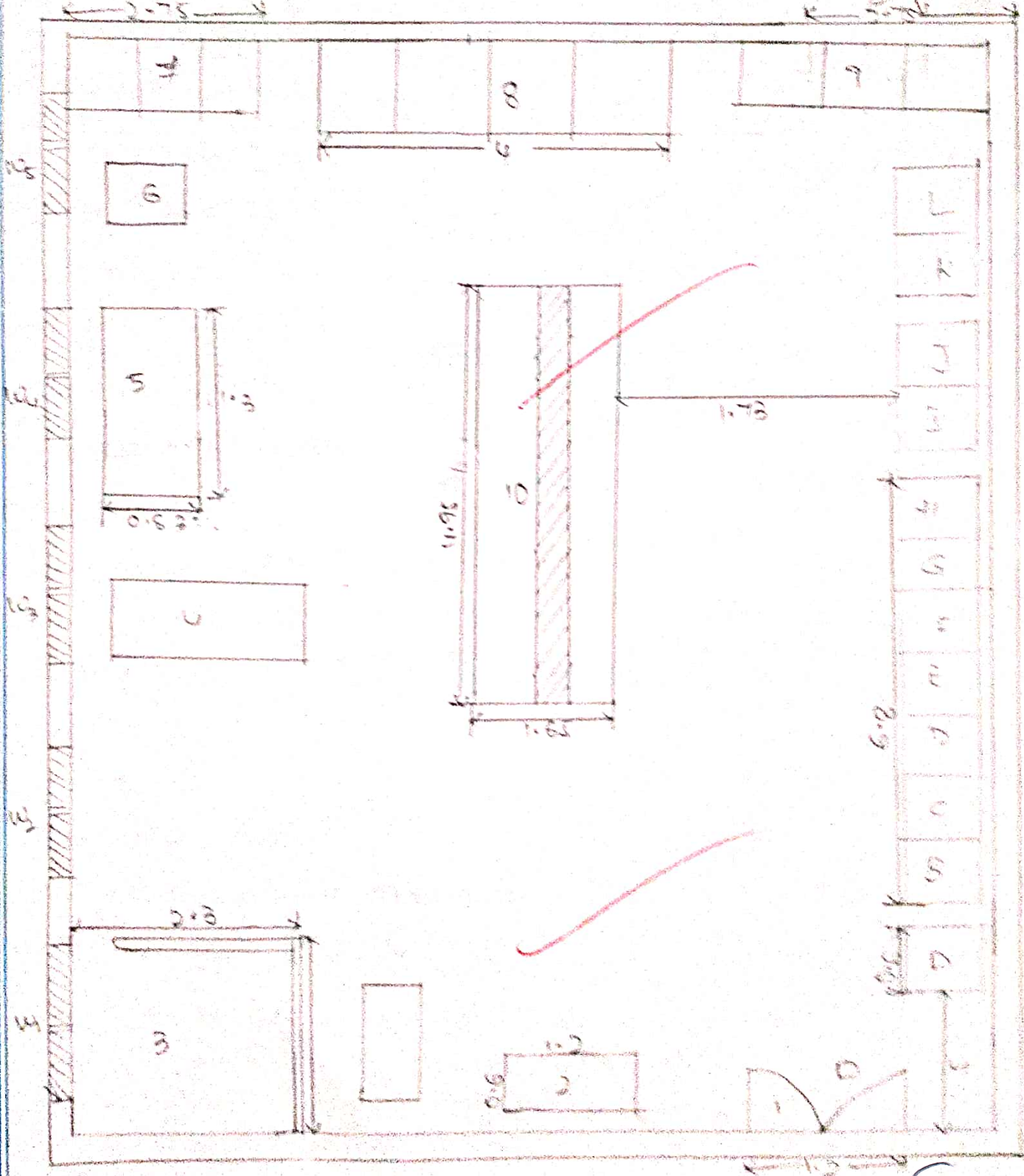


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Layout Of Environmental Engineering laboratory

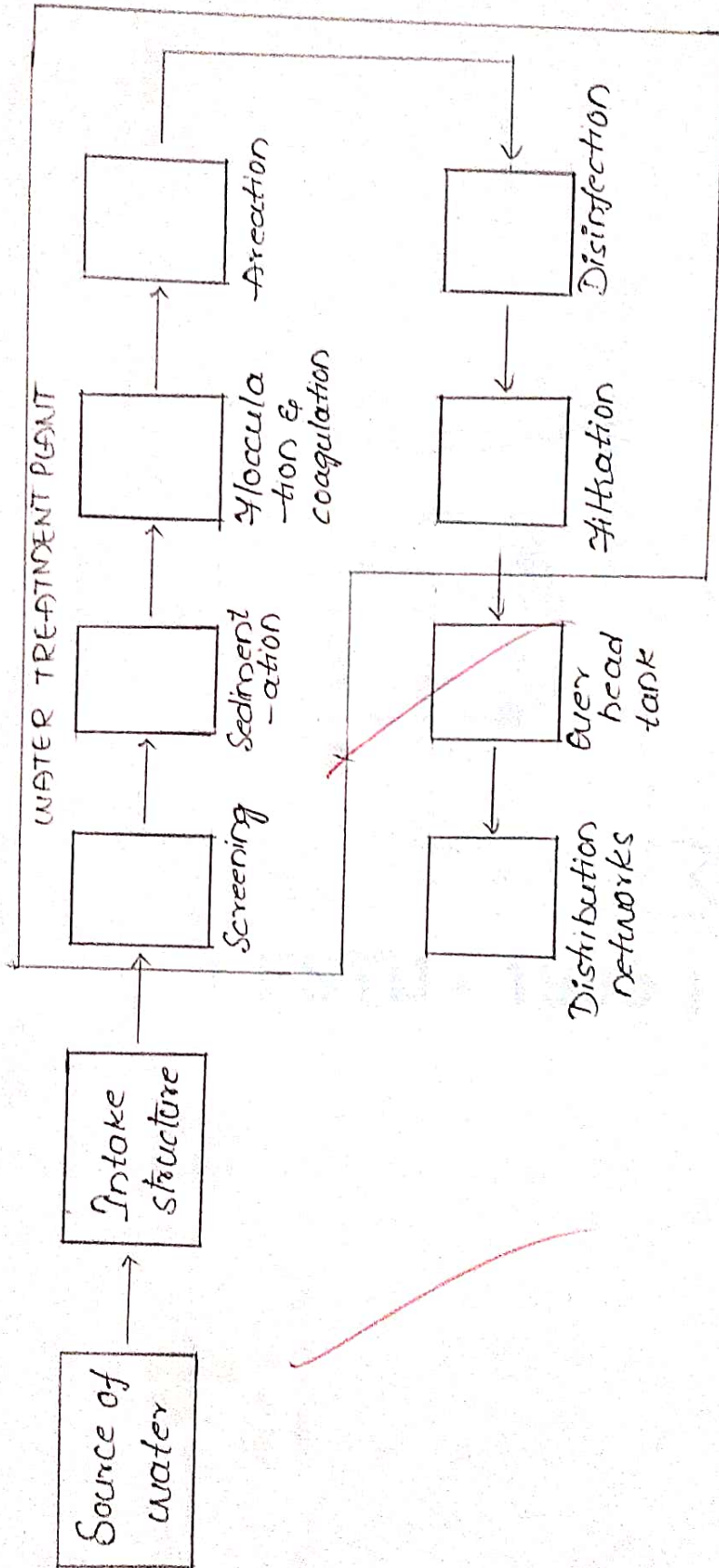
All dimensions are in meters Scale: 1:100



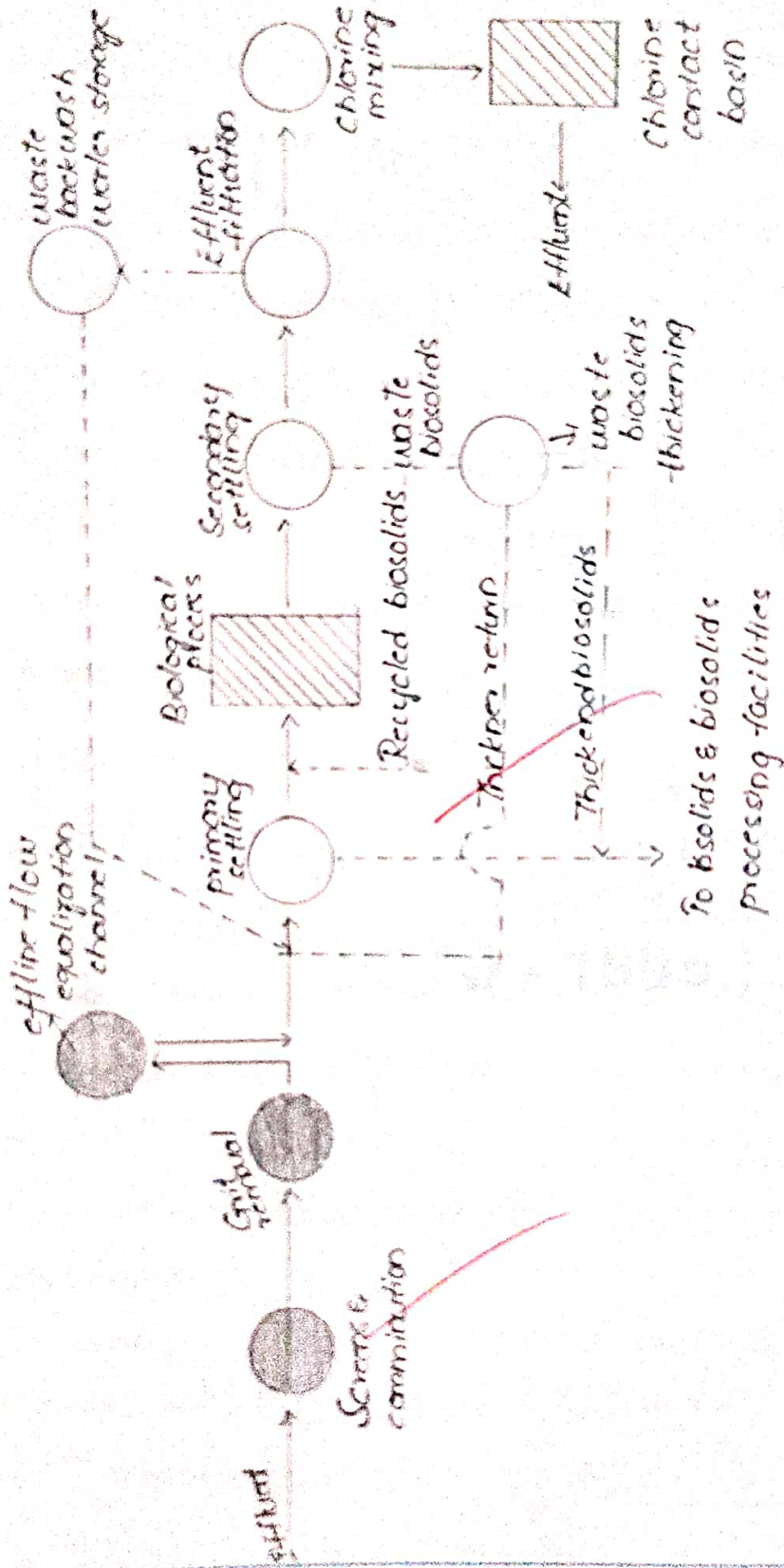
- A → BOD
B → Muffle furnace
C → COD Digester
D → Alum jar test
E → pH tester
F → turbidity tester
G → Nitrogen
H → UV spectrometer
I → Nephelometer
J → Balance (Digital)
K → Balance
L → Distill water
1 → Door
2, 4 → Rack
3 → cabin
5, 6 → Table
7, 9 → Hand wash
8 → racks to store chemicals
10 → experiment table.



WATER TREATMENT PLANT LAYOUT :



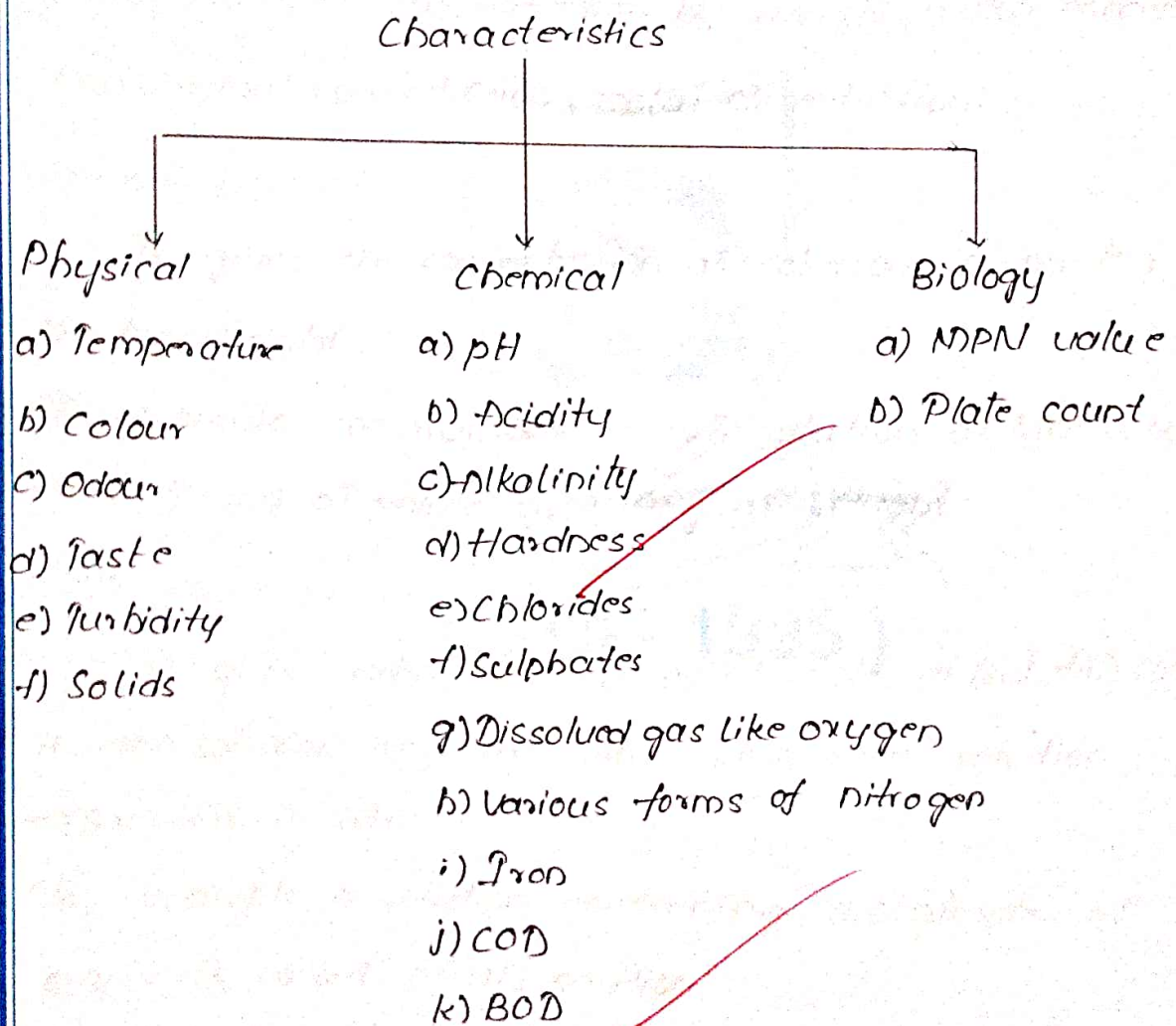
WASTE WATER TREATMENT PLANT LAYOUT



Head

Note:

Collect 2 litre sample for most physical and chemical analysis.



DRINKING WATER STANDARDS (IS: 10500-1991)

S.No	Parameter	Desirable limit mg/l	Permissible limit in the absence of alternate sources
1.	Colour (Hazen Units)	5	25
2.	Odour	unobjectionable	-
3.	Taste	agreeable	-
4.	Turbidity, NT units	5	10
5.	pH	6.5-8.5	No relaxation
6.	Total hardness as CaCO ₃	300	600
7.	Iron as Fe	0.3	1.0
8.	Chloride as Cl	250	1000
9.	Free residual chlorine	0.2	-
10.	Total Dissolved Solids	500	2000
11.	Calcium as Ca	75	200
12.	Copper as Cu	0.05	1.5
13.	Manganese as Mn	0.1	0.3
14.	Sulphate as SO ₄	200	400
15.	Nitrate as NO ₃	45	100
16.	Fluoride as F	1.0	1.5
17.	Phenols as C ₆ H ₅ OH	0.001	0.002



18.	Mercury as Hg	0.001	No relaxation
19.	Cadmium as Cd	0.01	No relaxation
20.	Selenium as Se	0.01	No relaxation
21.	Arsenic as As	0.05	No relaxation
22.	Cyanide as Cn	0.05	No relaxation
23.	Lead as Pb	0.05	No relaxation
24.	Zinc as Zn	5	15
25.	Anionic detergents as MBAS	0.02	1.0
26.	Chromium as Cr ⁺⁴	0.05	No relaxation
27.	Mineral oil	0.01	0.03
28.	Pesticides	Nil	0.001
29.	Radioactive materials		
	- Alpha emitters, B eq/l	-	0.1
	- Beta emitters, pCi/l	-	1.0
30.	Alkalinity as CaCO ₃	200	600
31.	Aluminium as Al	0.03	0.2
32.	Boron	1	5
33.	Faecal streptococci	Nil	-
34.	M, P, N, (in 100ml)	1	10
35.	Cyclopes (or Guinea worms)	Nil	Nil.



EFFLUENT STANDARDS

Suggested ranges for pollutants in mg/l industrial effluents for their discharge into

- i) Inland surface water
- ii) On to land
- iii) Sewers and
- iv) Marine waters.

S.No	Pollutant (mg/l)	Surface waters	land for Irrigation	Public Sewers	Oceans
1.	B.O.D	30	100	350	100
2.	COD	250	-	-	250
3.	Suspended solids	100	200	600	100
4.	Total Dissolved solids	2100	2100	2100	-
5.	Temperature, °C	40	-	45	45
6.	Oil and Grease	10	10	20	20
7.	pH	5.6-9.2	5.6-9.2	5.6-9.2	5.6-9.2
8.	Ammonical nitrogen as N	50	-	50	50
9.	Total Kjeldahl	100	-	-	100
10.	Nitrogen as N	5	-	-	5
10.	Free Ammonia as NH_3	5	-	-	5
11.	Chloride as Cl	1000	600	1000	-



12.	Sulphates as SO_4	1000	1000	1000	-
13.	Total residual chlorine	1.0	-	-	1.0
14.	Arsenic as As	0.20	0.20	0.20	0.20
15.	Mercury as Hg	0.01	-	0.01	0.01
16.	Lead as Pb	0.1	-	1.0	1.0
17.	Cadmium as Cd	2.0	-	2.0	2.0
18.	Chromium as Cr	2.0	-	2.0	2.0
19.	Chromium as Cr^{+6}	0.1	-	2.0	1.0
20.	Copper as C	3.0	-	3.0	3.0
21.	Zinc as Zn	5.0	-	1.5	1.5
22.	Selenium as Se	0.05	-	0.051	0.05
23.	Nickel as Ni	3.0	-	3.0	5.0
24.	Boron as B	2.0	2.0	2.0	-
25.	Sodium as Na	-	60%	60%	-
26.	Cyanide as Cn	0.2	0.2	-	0.2
27.	Fluoride as F	2.0	-	2.0	-
28.	Phosphates as PO_4	5.0	-	15	15
29.	Sulphide as S	2.0	-	-	5.0
30.	Phenolic compounds (C_6H_5OH)	1.0	-	5.0	5.0
31.	Pesticides	nil	nil	nil	nil

7/12/19 MP
25/12/19



Experiment No. 1	Determination of Solids (Suspended, Dissolved, Fixed Solids)	Date: 20-12-19
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Aim: To determine suspended, dissolved and fixed solids.

Apparatus:

1. Imhoff cone
2. Filter papers and funnel with stand.
3. Weighing machine with 1mg least count.
4. Hot air oven.
5. Muffle furnace.

[Principle]

Principle:

Concentration of solids in water depends upon the source of water and the soil strata from which the water is percolating and starts dissolving the soluble salts. Total solid is the term applied to the residue left in the vessel after evaporation of the sample and its drying in the oven at a definite temperature about 103°C to 105°C .



Calculation:

$W_1 =$ empty weight of glass plate = 26.14g

$W_2 =$ empty weight of glass plate + filter paper = 26.5g

$W_3 =$ Weight of glass plate + filter paper (note down the weight after taking it from the oven) = 26.48g

$W_4 =$ empty weight of glass beaker = 115.78g

$W_5 =$ Weight of beaker + dissolved solids = 115.82g

$W_6 =$ empty weight of crucible = 69.81g

$W_7 =$ empty weight of crucible + filter paper with suspended solids = 71.14g

$W_8 =$ weight of crucible + filter solids = 69.85g

Suspended solids = $W_2 - W_3 = 26.5 - 26.48 = 0.02 \text{ gm/ml}$

Dissolved solids = $W_5 - W_4 = 115.82 - 115.78 = 0.04 \text{ gm/ml}$

Total fixed solids = $W_8 - W_6 = 69.85 - 69.81 = 0.04 \text{ gm/ml}$

Volatile solids = fixed - suspended = $0.04 - 0.02 = 0.02 \text{ gm/ml}$

Total solids = suspended + dissolved = $0.02 + 0.04 = 0.06 \text{ gm/ml}$
= 600mg/l

The total solid enclose total suspended solids, is that portion of total solid remain on the filter paper and the total dissolved solids, is that portion which passes through the filter. Dissolved solids are the portion of solids that passes through the normal general size of 5μ under specified conditions and bigger than that will be retained as suspended solids on the filter paper.

Procedure:

1. The sample of water is mixed thoroughly by a stirrer and 1L is filled into a imhoff cone.
2. Allow to settle for one hour.
3. Take a weighed ash less filter paper of suitable grade. Mix the water sample and take in a beaker. Mix the sample using magnetic stirrer in such a speed that the suspended solids should not settle, now pipette out known volume of sample so that the tip of pipette is at the centre of sample avoiding vortex formed and filter the sample through the filter paper. Allow the filter paper to dry in a hot air oven at 103°C over



night. After complete drying of the sample, allow to cool and weigh the filter paper. The difference in weight of the filter paper gives the amount of solids collected on the filter paper. Calculate the total suspended solids present in 1L of sample as mg. Express this as "suspended solids" in mg/L.

4. The water that passes through the filter paper in the above step is collected in a clean beaker whose initial weight is known. Allow the sample to dry in a hot air oven at 115°C over night so that all the liquid is dried up. Weigh the beaker. The difference in weight of the beaker gives the amount of dissolved solids present in the sample taken. Calculate the total dissolved solids present in 1L of sample as mg. Express the difference in weight as "Dissolved solids" in mg/L.

5. Ignite the filter paper with the solids from step-3, in a silica crucible at 600°C in a muffle furnace. Note the difference in weight. The weight lost during ignition represents the "volatile suspended solids" and the solids retained represent the "fixed suspended solids". Calculate and express the results in mg/L.



6. Express the results in terms of suspended solids (mg/l), volatile suspended solids (mg/l), fixed suspended solids (mg/l), dissolved (mg/l) and total solids (mg/l)

Result:

1. Total suspended solids = $0.02 \text{ gm/ml} = 200 \text{ mg/l}$
2. Total dissolved solids = $0.04 \text{ gm/ml} = 400 \text{ mg/l}$
3. Total fixed solids = $0.04 \text{ gm/ml} = 400 \text{ mg/l}$
4. Total volatile solids = $0.02 \text{ gm/ml} = 200 \text{ mg/l}$
5. Total solids = $0.06 \text{ gm/ml} = 600 \text{ mg/l}$

Interference:

According to IS 10500:2012 drinking water specification, acceptable limit for total dissolved solids is 500 mg/l and permissible limit for total dissolved solids is 2000 mg/l . In the given sample total dissolved solids is 400 mg/l , therefore it is within the limit.

Presence of solids in water questions the suitability of potential supply of water for various uses like water softening processes.

The amount of solids in wastewater is frequently used to describe the strength of water. The environmental impacts of solids in all forms have detrimental effects on quality.



Experiment No: 9	Estimation of Dissolved Oxygen	Date: 27/12/19
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Aim: To determine Dissolved Oxygen (DO) in the given water sample.

Apparatus Required:

1. Burette
2. Burette stand
3. 300ml glass stoppered BOD bottles.
4. 500ml conical flask
5. Pipettes with elongated tips
6. Pipette bulb
7. 250ml graduated cylinders
8. Wash bottle

Chemicals Required:

1. Manganous sulphate solution $[MnSO_4]$
2. Alkaline iodide-azide solution $[KI]$
3. (Sulphur) Sulfuric acid, Concentrated $[H_2SO_4]$
4. Starch indicator solution
5. Sodium thiosulphate $[Na_2S_2O_3]$
6. Distilled or deionized water
7. Potassium hydroxide $[KOH]$



8. Potassium Iodide

9. Sodium Azide.

Principle:

The titrimetric principle: Divalent manganese salt in solution is precipitated by strong alkali to divalent manganese hydroxide.

- Addition of potassium iodide (or) potassium hydroxide is added to create a pinkish brown precipitate.

In the alkaline solution, dissolved oxygen present in the sample rapidly oxidized to form trivalent or higher valency hydroxide.

$MnO(OH)_2$ appears as a brown precipitate. There is some confusion about whether the oxidised manganese is tetravalent or trivalent some sources claim that $Mn(OH)_3$ is the brown precipitate but hydrated MnO_2 may also give the brown colour.

Iodide ions are added and acidified which reduces tetravalent hydroxides back to their stable divalent state thereby liberating equivalent amount of iodide.



1. Introduction

Year	Value
2018	100
2019	120
2020	150
2021	180
2022	200

2. Methodology

3. Results and Discussion



[Signature]
Head

School of Civil Engineering
Rajeev Gandhi Memorial College of
Engg. & Tech. (Autonomous)
NANDYAL-518 501.

Thiosulphate solution is used, with a starch indicator, to titrate the iodine.

This iodine is equivalent to dissolved oxygen present in the sample.

Significance:

Drinking water should be rich in dissolved oxygen for good taste. DO test is used to evaluate the pollution strength of domestic and industrial waste. Higher values of DO may cause corrosion of iron and steel. Algae growth in water may release oxygen during its photosynthesis and DO even shoot upto 30mg/l. Oxygen is poorly soluble in water. Its solubility is about 14.6 for pure water at 0°C under normal atmospheric pressure and its drops to 7mg/l at 35°C.



- 8- Potassium Iodide
 7- Sodium Azide.

Procedure:

Standardization of Sodium thiosulfate solution:

Standardize the (soln) sodium thiosulfate solution using 0.025N $K_2Cr_2O_7$ solution. Take 10ml of $K_2Cr_2O_7$ solution in a conical flask. Add 2ml of 2N hydrochloric acid solution and one spatula of potassium iodide (KI) powder. The solution turns brown. Titrate against Sodium thiosulphate solution till colour turns to pale yellow. Add 0.5 to 1 ml starch solution. The colour turns to blue. Continue the titration till blue becomes colorless. Calculate the Normality of Sodium thiosulphate.

Determination of Dissolved Oxygen:

Collect the sample in the BOD bottle upto the neck, taking care to avoid air bubbles while collecting. To this, add 1ml of $MnSO_4$ solution and 1ml of alkali iodide azide solution, holding the pipette tips just above the liquid surface. Stopper the bottle to carefully to exclude air bubble and mix it by inverting 25 to 30



times. Allow the precipitate to settle down to leave a clear supernate above manganese hydroxide floc. Now add 1ml of concentrated sulphuric acid, restopper and mix immediately by inverting the bottle till the precipitate dissolve. Now take 200ml of sample in conical flask titrate against 0.025N $\text{Na}_2\text{S}_2\text{O}_3$ till pale yellow. Add 5 drops of starch continue the titration till the dark blue becomes colourless.

Result:

The dissolved oxygen present in given water sample is 5.88mg/l.

Inference:

The dissolved oxygen present in the given water sample is 5.88mg/l. Hence the water is ^{not} suitable for drinking purposes. Therefore, dissolved oxygen in level of 6-8mg/l is acceptable for drinking (various) purposes. If it fall below 4mg/l it effects aquatic life. If it reaches or more than 8mg/l it will effect on boiler and pipelines (corrosion).

July 20
10/1/20

10/1/20



Experiment
No: 3

JAR TEST

Date:
27/12/19

Significance:

Selection of optimum dosage of coagulants are determined experimentally by jar test instead of qualitatively by formula. Excess dosage of alum may be contribute excess aluminium (Al) in water. Coagulation removes not only turbidity but also colour, micro-organisms, algae, phosphate, taste and odour. Producing substances. The jar test must be performed on each water sample that is to be coagulated must be repeated with each significant change in the quality of a given water. This test is useful to estimate optimum dosage of coagulants required for raw water and waste water.

Principle:

Metal salts hydrolyse in presence of the natural alkalinity to form metal hydroxides. Metal hydroxides are good absorbents and hence remove the suspended particles.

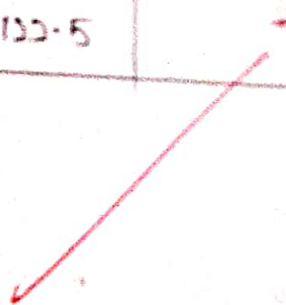


1000
ml/litre

12.35

1000 ml
50 ml

Journal Sample details	ml of 1% alum added	Dosage alum mg/l	pH	Turbidity
	0	0		12.7
	4	40		1.2
	8	80		1.3
	11	110		1
	11.5	115		0.06
	11.75	117.5		2.3
	12	120		0.9
	12.25	122.5		0.9

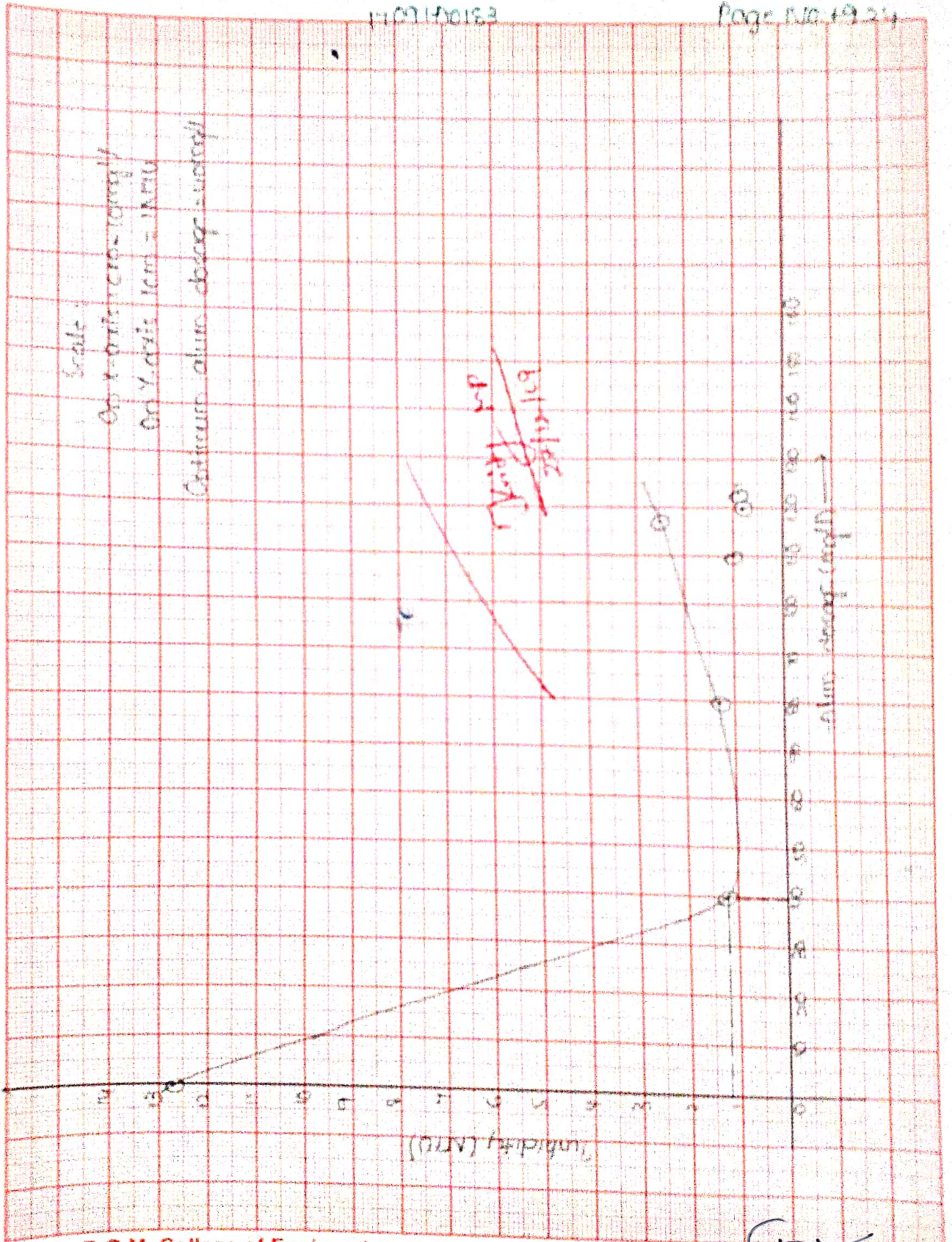


Scale:

On x-axis: 1 cm = 10 mm
On y-axis: 1 cm = 1 kN/m

Continuous beam design - 1000mm

~~1000mm~~
1000mm



Reagents required:

Aqueous solution of alum (Aluminium sulphate)

Procedure:

1. Take 500ml of water sample in each beakers and add different dosage of alum with (0) one as blank.
2. Stir the mixture thoroughly at 100 rpm per one minute and 30 rpm for 30 minutes.
3. At the end of 30 minutes the turbidity of each samples are measured using Nephelometer.
4. Plot a graph of turbidity in NTU against coagulant dosage us determine optimum dosage.
5. Express the optimum dosage of alum in mg/lit.

Result:

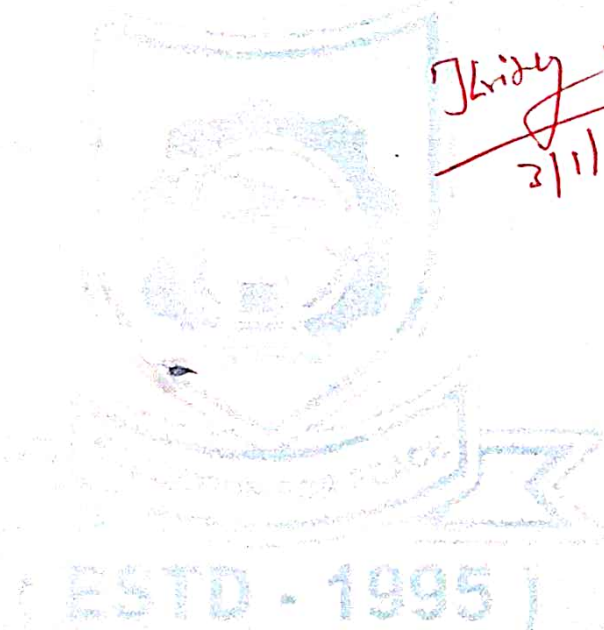
Optimum dosage of alum = 40 mg/l.

(Inter-fe)

Inference:

The dosage corresponding to minimum turbidity is taken as the optimum dosage of alum, which indicates maximum removal. Particles suspended in neutral, untreated water normally carry a negative

electric charge. These particles are attracted to Al^{+3} .
It forms flocs of aluminium hydroxides from the
graph. we infer that turbidity decreases with increase
in alum dosage upto dosage of 40mg/l after which
it increases. This increase in turbidity is due to
alum dosage in addition to optimum dosage.



Jhridy MD
3/1/20

9/10



Experiment
No: 4

Biochemical Oxygen Demand

Date:
03/01/20

Aim: To determine biochemical oxygen demand in the given water sample.

Apparatus:

- * Burette
- * Burette stand
- * 300ml glass stoppered BOD bottles
- * 500ml conical flask
- * Pipettes with elongated (flask) tips
- * Pipette bulb
- * 250ml graduated cylinders
- * Wash bottle

Chemicals required:

1. Manganous sulphate solution
2. Alkaline iodide-azide solution
3. Sulphuric acid, concentrated
4. Starch indicator solution
5. Sodium tetrathionate
6. Distilled or deionized water
7. Potassium hydroxide
8. Potassium iodide
9. Potassium azide



Principle:

The sample is filled in a airtight bottle and incubated at specific temperature for 5 days.

The dissolved oxygen (DO) content of the sample is determined before and after 5 days of incubation at 20°C and the BOD is calculated from the difference between initial and final DO.

The initial DO is determined shortly after the dilution is made; all oxygen uptake occurring after this measurement is included in the BOD measurement.

Significance:

Drinking water should be rich in dissolved oxygen for good taste. DO test is used to evaluate the pollution strength of domestic and industrial waste. Higher values of DO may cause corrosion of iron and steel. Algae growth in water may release oxygen during its photosynthesis and DO may even shoot upto 30mg/l . Oxygen is poorly soluble in water. Its solubility is about 14.6 for pure water at 0°C under atmospheric pressure and it drops to 7mg/l at 35°C .



Observation:

Standardization of sodium tetrathiosulphate solution:

Trial No.	Initial reading	Final reading	Difference
1	0	10.2	10.2
2	10.2	21	10.8
3	21	31.8	10.8

$U_2 = \text{Volume of } Na_2S_2O_3 = 10.6 \text{ ml}$

$N_1 = \text{conc. of } K_2Cr_2O_7 = 0.025 \text{ N}$

$U_1 = \text{Volume of } K_2Cr_2O_7 = 10 \text{ ml}$

$N_1 U_1 = N_2 U_2$

Conc. of $Na_2S_2O_3$, $N_2 = \frac{N_1 U_1}{U_2} = \frac{0.025 \times 10}{10.6}$
 $= 0.023 \text{ N}$

Determination of initial DO:

Trial No.	Initial reading	Final reading	Difference
1	15.3	24	8.7

Volume of $Na_2S_2O_3 = U_{Na_2S_2O_3} = 8.7 \text{ ml}$

Dissolved oxygen as mg/l = $\frac{N_{Na_2S_2O_3} \times U_{Na_2S_2O_3} \times 8000}{\text{Volume of sample}}$

Procedure:

Standardization of sodium tetrathiosulphate solution:

Standardize the sodium tetrathiosulphate solution using 0.025N of $K_2Cr_2O_7$ solution. Take 10ml of $K_2Cr_2O_7$ solution in a conical flask. Add 2ml of 2N HCl solution and one spatula of potassium iodide (KI) powder. The solution turns brown now titrate against sodium tetrathiosulphate solution till colour turns to pale yellow. Add 0.5-1ml starch solution. The colour turns to blue. Continue the titration till the blue becomes colourless. Calculate the normality of sodium tetrathiosulphate.

Determination of initial DO:

Collect the sample in the BOD bottle upto the neck.

Take care to avoid air bubble while collecting. To this add 1ml $MnSO_4$ solution followed by 1ml alkaline iodide azide solution. Holding the pipette takes just above the liquid stopper the bottle carefully to exclude air bubble and mix it by inverting it for 25-30 times. Allow the precipitate to settle down to leave a clear supernat above manganese hydroxide floc. Add 1-2ml concentrated sulphuric acid, restopper and mix immediately by inverting the bottle till all the precipitate dissolve.



$$= \frac{0.02 \times 8.7 \times 8000}{200}$$

$$= 8.084 \text{ mg/l.}$$

Determination of final Dissolved oxygen:

Trial no	Initial reading	Final reading	Difference
1	38.3	44.9	6.6

$$\text{Volume of } \text{Na}_2\text{S}_2\text{O}_3 = 6.6 \text{ ml}$$

$$\text{Dissolved oxygen as mg/l} = \frac{N_{\text{Na}_2\text{S}_2\text{O}_3} \times V_{\text{Na}_2\text{S}_2\text{O}_3} \times 8000}{\text{Volume of sample}}$$

$$= \frac{0.02 \times 6.6 \times 8000}{200}$$

$$= 6.07 \text{ mg/l.}$$

$$\text{BOD}_5 = \frac{(\text{Initial DO} - \text{final DO}) \times \text{volume of diluted sample}}{\text{Volume of sample taken}}$$

$$= \frac{(8.004 - 6.07) \times 1000}{10}$$

$$= 193.4 \text{ mg/l.}$$

Titrate 200ml sample against 0.025N $\text{Na}_2\text{S}_2\text{O}_3$ solution till pale yellow colour. Add 5 drops starch continue the titration till the dark blue becomes colourless.

Determination of final DO:

Collect the sample in the BOD bottle upto the neck. Taking care to avoid any air bubble while collecting. To this add 1ml MnSO₄ solution followed by 1ml alkaline iodide azide solution. Holding the pipette tubes just above the liquid. Stopper the bottle carefully to exclude air bubble and mix it by inverting it for 25-30 times. Allow the precipitate to settle down to leave a clear supernate above manganese hydroxide floc. Add 1-2ml concentrated sulphuric acid, Restopper and mix immediately by inverting the bottle till all the precipitate dissolve.

Titrate 200ml sample against 0.025N $\text{Na}_2\text{S}_2\text{O}_3$ solution upto 1-2ml. Add 5 drops (sat) starch if the colour changes the DO is present in the solution and (chan) continue the titration till the colour becomes colourless or after adding 5 drops of starch if the colour does not change then the DO is absent in the solution (or) DO becomes zero.



Result:

The BOD of given water sample for 5 days = 178.4 mg/l.

Inference:

BOD should be ideally zero upto 5 mg/lit is generally considered as clear for domestic purpose. General standard for discharge of environmental pollutants is 30 mg/lit for inland and surface water. Therefore the given water sample has high levels of BOD. When water containing high BOD is discharged into water, its DO level reduces and affects life of aquatic animals.

July 17
10/1/20 (10/10)

(ESTD - 1995)



Experiment No: 5	Determination of Carbonate, Bicarbonate and Hydroxide Alkalinity	Date: 10/01/20
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Aim: To determine the various types (carbonate, bicarbonate and hydroxide) of alkalinity present in waste water sample.

Apparatus Required:

- * Burette with burette stand and porcelain tile.
- * Pipette with elongated tips.
- * Pipette bulb
- * Conical flask
- * 250ml measuring cylinders
- * Standard flask
- * Wash bottle
- * Beakers.

Reagents Required:

Stock Sulphuric acid, 1N: Add 28ml H_2SO_4 to some D.W., dilute to 1000ml.

Standard sulphuric acid, 0.02N: Dilute 20ml, stock H_2SO_4 to 1000ml.

Standard sodium bicarbonate solution; Na_2CO_3 : Dry Na_2CO_3 at $250^\circ C$ for 4hr. Dissolve 1.06g Na_2CO_3 in D.W. and dilute to 1000ml.



to 3000ml.

Methyl orange indicator. Dissolve 25mg indicator and dilute to 300ml.

Phenolphthalein indicator:

1. Dissolve 5g phenolphthalein disodium salt in DW and dilute to 1L.
2. Dissolve 5g phenolphthalein in 500ml ethyl or isopropyl alcohol and add 500ml DW. If necessary, add 0.2N NaOH till faint pink colour appears.

Significance:

To determination of alkalinity is very useful in water and waste water because it provides buffering to resist changes in pH value. The alkalinity or acidity of water usually changes in natural waters with large algae growth.

Alkalinity is the capacity of a given sample of water to neutralize a standard solution of acid. Alkalinity is due to the presence of bicarbonate and carbonate or hydroxide ions in water. Alkalinity is usually changes in or expressed as Total alkalinity and caustic alkalinity (ie when pH is above 8.3).



Observation:

	Initial burette reading	Final burette reading	Difference
P-alkalinity	0	0.9	0.9
T alkalinity	0.9	21.7	20.8
		Total	21.7

Normality of $H_2SO_4 = 0.02N$

Alkalinity (as $CaCO_3$ (mg/l)) = $\frac{N_{acid} \times V_{acid} \times 50000}{\text{Volume of sample}}$

$$P = P\text{-alkalinity} = \frac{0.02 \times 0.9 \times 50000}{100} \\ = 9 \text{ mg/l as } CaCO_3$$

$$T = T\text{-alkalinity} = \frac{0.02 \times 21.7 \times 50000}{100} \\ = 217 \text{ mg/l as } CaCO_3$$

$$\text{Hydroxide alkalinity as } CaCO_3 (OH^-) = 0 \left(\frac{T}{2} = \frac{217}{2} \right) \\ = 108.5 \text{ mg/l}$$

$\therefore P < \frac{T}{2}$

Principle:

Alkalinity is measured titrimetrically by titrating against dilute sulphuric acid phenolphthalein and methyl orange are used as indicators to indicate pH 8.3 and pH 4.3. The phenolphthalein produces a pink colour when the pH is above 8.3 and colourless when pH is below 8.3. Methyl orange is slightly orange when pH is above 4.3 and becomes wine red when pH is below 4.3. The amount of acid consumed to reach the phenolphthalein end point is used to calculate the Total (T) alkalinity. From the values of 'P' and 'T' the species of alkalinity can be determined as in table (1).

Titration results	Hydroxide alkalinity (OH ⁻) as CaCO ₃	Carbonate alkalinity (CO ₃ ²⁻) as CaCO ₃	Bicarbonate alkalinity (HCO ₃ ⁻) as CaCO ₃
$P=0$	0	0	T
$P < T/2$	0	$2P$	$T - 2P$
$P = T/2$	0	$2P$	0
$P > T/2$	$2P - T$	$2(T - P)$	0
$P = T$	T	0	0

Carbonate alkalinity as CaCO_3 (CO_3) = $2P = 18 \text{ mg/l}$.

Bicarbonate alkalinity as CaCO_3 (HCO_3^-) = $7 - 2P = 199 \text{ mg/l}$.

Alkalinity results	Alkalinity (as CaCO_3)	Carbonate alkalinity (as CaCO_3)	Bicarbonate alkalinity (as CaCO_3)
18	18	18	199
199	199	18	199
217	217	18	199
217	217	18	199

Procedure:

Take a known volume of water sample (100ml) in the conical flask. Add 5 drops of phenolphthalein indicator. The sample turns to pink. Titrate against the sulphuric acid in the burette till the sample turns colourless. Note the volume of acid consumed. This indicates the acid required for phenolphthalein alkalinity.

Continue the titration against the same sample after adding 5 drops of methyl orange colour turns to pale yellow. Continue the titration the sample becomes wine red in colour. Note down the volume of acid consumed from the beginning (including acid consumed for P-alkalinity) and determine the total alkalinity (T).

Result:

Hydroxide alkalinity (OH^-) as $\text{CaCO}_3 = 0 \text{ mg/l}$.

Carbonate alkalinity (CO_3^{2-}) as $\text{CaCO}_3 = 1 \text{ mg/l}$.

Bicarbonate alkalinity (HCO_3^-) as $\text{CaCO}_3 = 199 \text{ mg/l}$.

Inference:

- According to IS: 10500-2012 (Drinking water specification), accepted and permissible limit are 200 and 600 mg/l respectively. Therefore given sample is within limits.

- Alkalinity is important for both fish and aquatic life because it protects as buffers against rapid pH changes.

Strong alkaline water has an objectionable 'soapy' taste. High alkaline water can cause Nausea, vomiting.

24/1/20

10/11

(ESTD - 1995)

b) Determination of acidity:

Aim: To determine the acidity present in waste water sample.

Apparatus required:

- x Burette with burette stand and porcelain tile
- x Pipette with elongated tip.
- x Pipette bulb
- x Conical flask
- x 250ml measuring cylinders
- x Standard flask
- x Wash bottle
- x Beakers.

Reagents Required:

Stock sulphuric acid, 1N: Add 28ml H_2SO_4 to some DW, dilute to 1000ml.

Standard sulphuric acid; 0.02N: Dilute 20ml, stock H_2SO_4 to 1000ml.

Standard sodium bicarbonate solution, Na_2CO_3 : Dry Na_2CO_3 at $250^\circ C$ for 4hr. Dissolve 1.069 Na_2CO_3 in DW and dilute to 1000ml.

Methyl orange indicator: Dissolve 25mg indicator and dilute to 100ml.

Phenolphthalein indicator:

1. Dissolve 5g phenolphthalein disodium salt in D.W and dilute to 1l.
2. Dissolve 5g phenolphthalein in 500ml ethyl or isopropyl alcohol and add 500ml D.W. If necessary, add 0.02N NaOH till faint pink colour appears.

Procedure:

1. Methyl orange of acidity:

Take 25ml of given sample in conical flask add 2 drops of methyl orange indicator till the sample turns to yellow colour on addition of methyl orange indicator it implies that there is no partial acidity. If the sample turns to orange colour it means mineral acidity is present.

Titrate it with 0.02N NaOH till the solution turns yellow in colour. It indicates the endpoint. Note down the volume of NaOH consumed.

2. Phenolphthalein indicator:

Take 25ml of given water sample in a conical flask add 3 drops of phenolphthalein indicator. If the solution turns to pink colour it indicates that acidity is absent in the



sample. If the solution does not keep any colour (i.e. acidity is present). Titrate with 0.02N NaOH solution till the solution turns to pink indicating end point. Note down the volume of NaOH consumed.

Result:

The acidity value of the given sample is 0.

Inference: After adding the methyl orange indicator to the given sample colour changes to yellow colour. It represents absence of acids.

By adding phenolphthalein indicator to water sample the sample turns to pink colour. It indicates the absence of acids in the given water sample.

✓
July 15
24/01/20



Experiment No: 6	Estimation of Hardness of water by EDTA Titration Method	Date: 24-01-20
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Aim:

To determine the total hardness, calcium and magnesium in the given sample.

Apparatus:

100ml beaker, burette, 250ml conical flask, pH meter, and

Reagents:

1. Buffer solution (of ammonia)
2. Eriochrome black 'T' indicator
3. Standard EDTA solution 0.01M
4. Standard calcium solution
5. Murexide indicator
6. Sodium hydroxide 2N.

Theory:

Hardness is the ability of water to cause precipitation of insoluble calcium and magnesium salts of higher fatty acids from soap solution. The principle hardness causing cations are calcium and magnesium. Hardness can be classified into two types.



1. Temporary hardness

2. Permanent hardness

Temporary hardness is due to presence of bicarbonate of calcium and magnesium. Permanent hardness is non-carbonate hardness and is caused due to the presence of sulphate, fluorides and nitrites of calcium and magnesium.

Significance:

Hardness of water is important in determining the suitability of water for industrial and domestic uses.

The relative amount of calcium and magnesium hardness, carbonate and non-carbonate hardness present in the water are the factors while determining the most economical type of softening process.

Determination of hardness serve as a basis for proper control of softening process.

Degree of hardness	mg/l of CaCO_3
Soft	0-50
Moderately hard	50-100
Hard	150-300
Very hard	>300



Observation:

Total hardness for distilled water sample:

Trial No.	Initial reading	Final reading	Difference
1.	9.8	9.8	0

Total hardness for river water sample:

Trial No.	Initial reading	Final reading	Difference
1.	9.8	15.4	5.6

Calcium hardness for river water sample:

Trial No.	Initial reading	Final reading	Difference
1	15.4	17.4	2

Total hardness (mg/l) as CaCO_3

$$= [\text{EDTA of river water} - \text{EDTA of distilled water}] \times \frac{1000}{\text{volume of sample taken}}$$

$$= (5.6 - 0) \times \frac{1000}{50}$$

$$= 112 \text{ mg/l.}$$

Calcium hardness as CaCO_3

$$= \text{EDTA value for river water} \times \frac{1000}{\text{volume of sample taken}}$$

$$= 2 \times \frac{1000}{50}$$

$$= 40 \text{ mg/l.}$$

Procedure:

Total Hardness Determination:

1. Take 50ml well mixed sample in conical flask.
2. Add 1-2ml buffer solution of ammonia.
3. To each aliquot add a pinch of Eriochrome Black-7 powder (indicator) or 2 drops of Eriochrome Black-7. The aliquots are wine-red in colour.
4. Titrate each aliquot using the standard EDTA (0.01N) solution in burette.
5. At the end point the aliquots change colour from wine-red to blue.
6. Note down the volume of EDTA required.
7. Run a reagent blank if buffer is not checked properly. Note the volume of EDTA required for blank.
8. Calculate the volume of EDTA required for sample.
9. Value of volume of EDTA required for blank may taken as 0, if double distilled water and AR grade chemicals are used.

Procedure for Calcium Hardness Determination:

1. Take a 50ml of sample in conical flask.
2. Add 1ml NaOH solution to raise pH to about 12.0
3. Add a pinch of ammonium purpurate (murexide) powder (indicator).



Magnesium hardness (mg/l) as CaCO_3

$$= \text{Total hardness} - \text{calcium hardness}$$

$$= 112 - 40$$

$$= 72 \text{ mg/l}$$

4. Titrate using the standard EDTA solution (in burette) until color change occurs from pink to purple.
5. Note the volume of EDTA used.

Result:

Total hardness as $\text{CaCO}_3 = 112 \text{ mg/l}$.

Calcium hardness as $\text{CaCO}_3 = 40 \text{ mg/l}$.

Magnesium hardness as $\text{CaCO}_3 = 72 \text{ mg/l}$.

Inference:

As per IS 10500-1991 desirable limits for total hardness is 300 mg/l and permissible limits is 600 mg/l . Total hardness for given water sample is 112 mg/l , which is within the limits. The given water sample is moderately hard.

Jhily m.p.
6/2/20 (9/10)

Head

Experiment No: 7	- Available Chlorine in Bleaching Powder	Date: 06-02-20
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General: Chlorine and its derivatives inactivate the enzymatic system of pathogenic bacteria present in water. It also oxidizes the organic substances and soluble iron and manganese at higher dosage. For efficient chlorination, water should be intermixed thoroughly with chlorine added and let to stay in contact with the reagent for at least 30 minutes (60 minutes, when chlorination is combined with ammonization) before it will be delivered to consumer. Chlorine may be applied in gaseous form (Cl_2) or in the form of bleaching powder [$Ca(OCl_2)$].

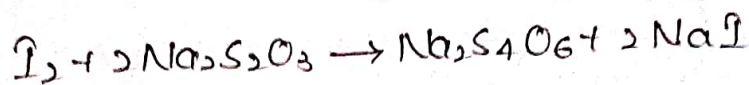
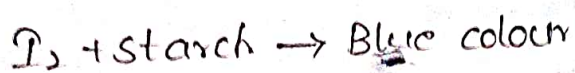
Significance:

Chlorine available in different stages, gaseous, liquid and also as a solid. Bleaching powder is a slaked lime through which chlorine is introduced into water. This test is useful to assess the quality of bleaching powder. Also it is useful to estimate

the amount of bleaching powder required for effective disinfection of water.

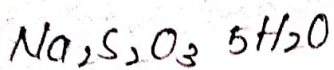
Principle:

Chlorine is a strong oxidizing and liberates iodine from iodine ion. Starch gives blue colour with iodine. The liberated iodine is titrated with standard solution of sodium sulphate a reducing agent. The disappearance of reaction with free iodine is converted back to iodide.



Reagents:

Standard sodium thiosulphate solution, 0.025N



Dissolve 0.25g $\text{Na}_2\text{S}_2\text{O}_3$ in freshly boiled D.W and dilute it up to 1L. Use after at least 2 weeks of storage to allow oxidation of any bisulphite ions present. To minimize bacterial decomposition, add a few ml of chloroform CHCl_3 .



Standard potassium dichromate, $K_2Cr_2O_7$ solution, 0.025N

Dissolve 1.256g anhydrous potassium dichromate $K_2Cr_2O_7$ in D.W and dilute to 1000 ml.

Hydrochloric acid, 3N HCl:

Add 166ml of concentrated hydrochloric acid to D.W mix it and dilute to 1L.

Sulfuric acid solution, 3N H_2SO_4 :

Add 56ml of concentrated sulfuric acid to D.W mix and dilute to 1L.

Bleaching powder solution, 2.5g/l:

Mix 2.5g fresh bleaching powder in about 150 to 200ml D.W. thoroughly, allow to settle, transfer supernatant solution to volumetric flask. Add again D.W to the remaining and continue the above procedure till the volume reaches to 1L.

Potassium iodide powder:

Freshly prepared starch solution, 2%:

Make a paste of 5g starch with little cold D.W, add to 250ml boiling D.W, stir it and allow overnight to settle, use clear supernatant solution.



Observation:

Normality of $\text{Na}_2\text{S}_2\text{O}_3 = 0.025 \text{ N}$

S.No	Initial burette reading	Final burette reading	Difference
1.	0.8	2.3	1.5
2.	2.3	4.1	1.8
3.	4.1	5.7	1.6
4.	5.7	7.1	1.4

Avg: 1.575

Available chlorine in bleaching powder = $\frac{\text{Percentage}}{\text{Weight}}$

$$= \frac{N_{\text{Na}_2\text{S}_2\text{O}_3} \times V_{\text{Na}_2\text{S}_2\text{O}_3} \times 35.46 \times 100}{\text{Volume of sample} \times \text{wt. of bleaching powder}}$$

Volume of sample x wt. of bleaching powder

$$= \frac{0.025 \times 1.575 \times 35.46 \times 100}{10 \times 2.5}$$

$$= 5.58\%$$

Available chlorine in solution (mg/lit)

$$= \frac{N_{\text{Na}_2\text{S}_2\text{O}_3} \times V_{\text{Na}_2\text{S}_2\text{O}_3} \times 35460}{\text{Volume of sample taken}}$$

Volume of sample taken

$$= \frac{0.025 \times 1.575 \times 35460}{10} = 139.62 \text{ mg/lit}$$

Procedure:Standardization of sodium thiosulphate solution:

Standardize the sodium thiosulphate using 0.025N $K_2Cr_2O_7$ solution. Take 10ml of $K_2Cr_2O_7$ solution in a conical flask. Add 5ml of 5N hydrochloric acid solution and one spatula of potassium iodide (KI) powder. The solution turns brown. Titrate against sodium thiosulphate solution till the blue becomes colorless. Calculate the normality of sodium thiosulphate.

Determination of available chlorine present in bleaching powder:

Take 10ml of bleaching powder solution in a conical flask. Add 5ml of 5N sulfuric acid solution and one spatula of potassium iodide (KI) powder. The solution turns brown. Titrate against sodium thiosulphate solution till colour turns to pale yellow. Add 0.5 to 1ml starch solution. The colour turns to blue. Continue the titration till the blue becomes colorless.



Result:

Available chlorine in solution is 139.62 mg/l.

Available chlorine in % by weight is 6.68%

Inference:

1 Bleaching powder is commonly used as disinfectant. The chlorine present in the bleaching powder gets reduced with time. So, to find the exact quantity of bleaching powder required, the available chlorine amount in the sample must be found out.

Liquid bleaches sold for domestic use are typically 3-10% active chlorine. Active chlorine indicates bleaches containing substantial amounts of chlorine in the form of chloride ions, which have no bleaching (powder) properties. Liquid bleaches should be diluted to 1-2% active chlorine before use. Commercial domestic bleaching powder is typically about 40% active chlorine.

Thilly rn
27/12/20 (10)



Experiment
No: 8

TURBIDITY TEST

Date:
06-02-20

Significance:

Turbid waters are unaesthetic and are not accepted by consumers. Turbidity will also interfere in sewer treatment processes and will increase the consumption of chemicals.

Apparatus:

1. A laboratory (or) process nephelometer consisting of a light source and one or more photo electric detectors with a readout device to indicate intensity of light scattered at 90° to the path of incident light.
2. Light source - Tungsten filament lamp operated at a color temperature between 2200 and 3000°K .
3. Sample cells or tubes of clear colourless glass or plastic.

Reagents:

1. Stock primary standard formazin suspension.
2. Solution 1 - Dissolve 1.00 gm hydrazine sulphate $(\text{NH}_2)_2\text{HSO}_4$ in distilled water and dilute to 100 ml in a volumetric flask.



Caution: Hydroxine sulphate is a carcinogenic.

Avoid inhalation, ingestion and the skin contact.

v. Solution 2 - Dissolve of 10.00gm of hexamethylenetetramine $(CH_2)_6N_4$ in distilled water and dilute to 100ml in a volumetric flask.

x In a flask, mix 5ml solution 1 & 5.0ml solution 2. Let stand for 24 hours at $25 \pm 3^\circ C$. This results in a 4000 NTU suspension.

y. Secondary standards (certified by the manufacturer or an independent testing organization) that will give the same results obtained by the primary standard, may also be used.

Procedure:

1. Measure the turbidity immediately after collecting the sample.
2. Calibrate the nephelometer in the required range.
3. Gently agitate sample, wait till air bubbles disappear and pour sample into sample cell. Read turbidity directly.
4. Report turbidity readings as follows:

Turbidity ranges	Report to nearest
0-1	0.05
1-10	0.1
10-40	1
40-100	5
100-400	10
400-1000	50
>1000	100

Result: Tap water = 2.5 NTU

River water = 25 NTU

Inference:

According to IS: 10500:2012 drinking water specification, the permissible limit of turbidity is 1 NTU and in absence of alternative source it is 5 NTU.

So, given water sample is not in permissible for drinking, whereas tap water is permissible for drinking.

Turbidity is excess of 5 NTU is objectionable i.e. due to aesthetic reasons. In case of lakes and ponds, due to contamination and algae growth turbidity of sea water is also high due to huge amount of suspended particles.

July 20
27/2/20

9

Experiment No. 9	Estimation Of Chloride Concentration	Date: 27-02-20
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Aim:

To determine the chlorides of given water sample.

Apparatus Required:

1. Burette with burette stand and porcelain tile.
2. Pipettes with elongated tips.
3. Conical flask (Erlenmeyer flask)
4. Standard flask.
5. Beaker
6. Wash bottle

Chemicals Required:

1. Silver nitrate
2. Phenolphthalein Indicator
3. Sodium chloride
4. Potassium chromate

Principle:

The amount of chloride present in water can be easily determined by titrating the given water sample with silver nitrate solution.

The silver nitrate reacts with chloride ion according to 1 mole of AgNO_3 reacts with 1 mole of chloride. The titrant concentration is generally 0.02M.

Silver chloride is precipitated quantitatively, before red silver chromate is formed.

The end of titration is indicated by formation of red silver chromate from excess silver nitrate.

The results are expressed in mg/l of chloride (Cl^- with a molecular weight of ~~35.453~~ g/mol).

Significance:

- * Chlorides associated with sodium (sodium chloride) exert salty taste when its concentration is more than 250mg/l. These impart a salty taste to water. Chlorides are generally limited to 250mg/l. in water supplies intended for public water supply.
- * In many areas of the world where water supplies are scarce, sources containing as much as 2000 mg/l are used for domestic purposes without the development of adverse effect, once the human system becomes adapted to the water.
- * It can also corrode concrete. Magnesium chloride in water generates hydrochloric acid after heating which



- is also highly accurate and creates problem in bottles.
- chloride determinations in natural waters are useful in the selection of water supplies for human use.
- chloride determination is used to determine the type of desalting apparatus to be used.
- chloride determination is used to control pumping of ground water from locations where intrusion of seawater is a problem.
- chlorides interfere in the determination of chemical oxygen demand (COD).

Procedure:

Preparation of Reagents:

1. Potassium chromate ($K_2Cr_2O_7$) indicator.
2. N/35.5 silver nitrate solution.

Potassium chromate indicator solution: Dissolve 5g $K_2Cr_2O_7$ in about 5ml distilled water (dH_2O). Add a few drops of silver nitrate until a definite red precipitate forms. Let stand 12 hours, filter and dilute to 100ml with dH_2O .

Standard sodium chloride (0.01N): Dissolve 824.0 mg $NaCl$ (dried at $140^\circ C$) in dH_2O and dilute to 500ml. One milliliter of this solution contains how many milligrams of chloride?



Observation:

for distilled water

Sample No.	Volume of sample	Burette Reading (ml)		Volume of AgNO ₃
		Initial	Final	
1.	10ml	30	30.5	0.5
2.	10ml	30.5	31.1	0.6

Aug: 0.55ml.

for tap water:

Sample No.	Volume of sample	Burette Reading (ml)		Volume of AgNO ₃
		Initial	Final	
1.	20ml	31.1	36.5	5.4
2.	20ml	36.5	41.6	5.1

Aug: 5.25ml

Calculation:

Volume of silver nitrate for sample (V_s) = 5.25ml.

Volume of silver nitrate for blank (V_B) = 0.55ml.

Normality of silver nitrate = 0.0141N.

Volume of sample = 20ml.

Standard silver nitrate titrant (0.0141N): Dissolve 2.3989 g of dry AgNO_3 in dH_2O and dilute to 1000ml. Standardize against 0.0141N NaCl . One milliliter of this solution will react with how many milligrams of chloride? (1ml of 0.0141N $\text{AgNO}_3 = 0.5 \text{mg Cl}$).

Testing of water sample:

- * Before starting the titration rinse the burette with silver nitrate solution.
- Fill the burette with silver nitrate solution of 0.0141N.
- Adjust to zero and fix the burette in stand.
- * Take some of the sample in a clean 250ml conical flask.
- * Add 1ml of Potassium Chromate indicator to get light yellow color.
- * Titrate the sample against silver nitrate solution until the color changes from yellow to brick red. i.e. the end point.
- * Note the volume of silver nitrate added.
- * Repeat the procedure for concordant values.

Blank Titration:

- * Take some of distilled water in a clean 250ml conical flask.
- * Add 1ml of Potassium chromate indicator to get light yellow color.

Equivalent weight of chlorine = 35.45

$$\text{Chlorides mg/l} = \frac{(V_s - V_B) \times 35.45 \times N \times 1000}{\text{Volume of sample taken}}$$

$$= \frac{(5.25 - 0.55) \times 35.45 \times 0.0141 \times 1000}{20}$$

$$= 117.463 \text{ mg/l}$$

x Titrate the sample against silver nitrate solution until the color changes from yellow to brick red i.e the end point.

x Note the volume of silver nitrate added for distilled water

Result:

Chlorides of the given sample = 117.463 mg/l ✓

(Concd)

Inference:

As per IS 10500-1991 desirable limit for chloride as Cl should be 250 mg/l for sample water. The permissible limit in the alternate sources is 1000 mg/l. For the given water sample the chloride as Cl is 117.463 mg/l. Hence the chloride for given water is within the limits. Therefore it can be used for drinking purpose.

July 17
5/2/20 (9)

Experiment
No: 10

Determination of Electrical
Conductivity

Date:
27-02-20

Aim: To determine the electrical conductivity of water sample by using digital conductivity meter.

Apparatus Required:

1. Conductivity meter with electrode
2. Magnetic stirrer with stirring bead
3. Standard flask
4. Measuring jar
5. Beaker, 250ml
6. Funnel
7. Tissue paper

Principle:

This method is used to measure the conductance generated by various ions in the solution/water. Rough estimation of dissolved ionic contents of water sample can be made by multiplying specific conductance (in s/cm) by an empirical factor which may vary from 0.55 to 0.90 depending on the soluble components gives rapid and

practical estimate of the variations in the dissolved mineral contents of a water body.

Environmental significance:

- x Electrical conductivity measurements are often employed to monitor desalination plants.
- x It is useful to assess the source of pollution.
- x In coastal regions, conductivity data can be used to decide the extent of intrusion of sea water into ground water.
- x Conductivity data is useful in determining the suitability of water and waste water for disposal on land. Irrigation waters up to 2 millisiemens/cm conductance have been found to be suitable for irrigation depending on soils and climatic characteristics.
- x It is also used indirectly to find out inorganic dissolved solids.

Procedure:

Calibration:

1. Switch ON the instrument half an hour before the conduction of experiment.
2. Electrode/probe is to be washed with distilled water and do not dip in any solution.



- Press ENTER for selection mode. Select mode as (EC) using direction keys (\uparrow or \downarrow) and press ENTER.
3. Enter cell constant value as 1.00 (Press ESC key, if cell of different cell constant say 0.5, is being used and enter the cell constant value.) and press Enter.
 4. If automatic temperature measurement is desired and thermo probe is not connected in which case connect it and press Enter key to get temperature.
 5. If the temperature is desired to be entered manually, press ESC key and enter temperature.
 6. If the actual temperature is not what is displayed as default, measure the temperature with a thermometer, press ESC key and enter the temperature.
 7. Keep the sample-filled-container near the cell/probe stand and lower the (handling) holding clamp to dip the sensor part of the cell in the sample. Insert thermo-probe also into the sample.
- Press ENTER key and it display cell constant value as 1.00 and then dip the cell in the sample and press Enter. There temperature and EC values are displayed.



Result:

Electrical conductivity of water sample is 1021 ms at 25°C temperature.

Inference:

Conductivity is a measure of water's capability to pass electric flow. This ability is directly related to concentration of ions in water. These conductive ions come from dissolved salts and inorganic materials such as alkalis, chlorides, sulphides and carbonate compounds.

Conductivity gives measure of total dissolved solids. Tap water has lower conductivity, so less total dissolved solids, better for drinking. Water sample has higher conductivity, more dissolved solids, so not suitable for drinking.

July 17
5/2/20 (9)

Experiment No: 11	Determination of Total Dissolved Solids	Date: 27-02-20
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Aim: To determine the TDS of the water sample by using Digital TDS meter.

Apparatus Required:

1. Conductivity Meter with Electrode
2. Magnetic stirrer with stirring bead
3. Standard flask
4. Measuring jar
5. Beaker 250ml
6. Funnel
7. Tissue Paper

Principle:

Residue left (oven) after the evaporation and subsequent drying in oven at specific temperature $103-105^{\circ}\text{C}$ of a known volume of sample are total solids. Total solids include "Total suspended solids" (TSS) and "Total dissolved solids" (TDS). Where loss in weight on ignition of the same sample at $500^{\circ}\text{C} \pm 50^{\circ}\text{C}$, in which organic matter

is converted to CO_2 and H_2O while at controlled temperature to prevent decomposition and volatilization of inorganic matter as much as consistent with complete oxidation of organic matter, are volatile solids.

Procedure:

Calibration:

1. Switch ON the instrument half an hour before the conduction of experiment.
2. Electrode/probe is to be washed with distilled water and do not dip in any solution.
3. Press ENTER for getting SELECTION MODE. Select mode as (TDS) using direction keys (\uparrow or \downarrow) and press ENTER.
4. Enter TDS factor as 0.50. (Press ESC if it is desired to enter a different TDS factor say 0.56.) and press Enter.
5. Enter cell constant value as 1.00. (Press ESC key, if cell of different cell constant say 0.5, is being used and enter the cell constant value) and press Enter.
6. If automatic temperature meant is desired and thermo probe is not connected in which case connect it and press Enter key to get temperature.



7. If the temperature is desired to be entered manually, press ESC key and enter temperature.
8. If the actual temperature is not what is displayed as default, measure the temperature with a thermometer, press ESC key and enter the temperature.
9. Keep the sample-filled container near the cell/probe stand and lower the holding clamp to dip the sensor part of the cell in the sample. Insert thermo-probe also into the sample.
Press ENTER key and it display cell constant value as 1.00 and then dip the cell in the sample and press Enter. There temperature and TDS values are displayed.

Result :

TDS count of the water sample is 445.7 ppt.

Inference:

According to IS 10500-2012 drinking water specification acceptable limit for total dissolved solids is 500ppm and permissible limit for total dissolved solids is 2000ppm. In the given sample total dissolved solids is 400mg/l, therefore it is within the limit. Hence the water can be used for drinking purpose.

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Experiment No: 12	Determination of pH value of the water sample	Date: 05-03-20
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Aim: To determine the pH of the given water sample.

Apparatus Required:

1. pH meter
2. Standard flasks
3. Magnetic stirrer
4. Funnel
5. Beaker
6. Wash bottle
7. Tissue paper
8. Forceps

Chemicals Required:

1. Buffers solutions of pH 4.0, 7.0 and 9.2
2. Potassium chloride
3. Distilled water.

Principle:

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The pH electrode used in the pH measurement is a combined glass electrode. It consists of sensing half cell and reference half cell, together form an electrode system. The sensing half cell is a thin pH sensitive semi permeable membrane, separating two solutions viz., the outer solution, the sample to be analysed and the internal solution enclosed inside the glass membrane and has a known pH value. An electrical potential is developed inside and another electrical potential is developed outside, the difference in the potential is measured and is given as the pH of the sample.

Significance:

Determination of pH is one of the important objectives in biological treatment of the waste water. In anaerobic treatment, if the pH goes below 5 due to excess accumulation of acids, the process is severely affected. Shifting of pH beyond 5 to 10 upsets the aerobic treatment of the waste water. In these circumstances, the pH is generally adjusted by addition of suitable acid or alkali to optimize the treatment of the waste water.

pH value or range is of immense importance for any chemical reaction. A chemical shall be highly effective at a particular pH. Chemical coagulation, disinfection, water softening and corrosion control are governed by pH adjustment.

Detoxification of sludges, oxidation of cyanides and reduction of hexavalent chromium into trivalent chromium also need a favorable pH range. It is used in the calculation of carbonate/bicarbonate, CO_2 , corrosion, stability index and acid base equilibrium:

Lower value of pH below 4 will produce sour taste and higher value above 8.5 a bitter taste. Higher values of pH hasten the scale formation in water heating apparatus and trihalomethanes, which are causing cancer in human beings.

Procedure:

Three major steps are involved in the experiment.

They are:

1. Preparation of Reagents
2. Calibrating of instrument
3. Testing of sample.

Calculation:

To determine the value of pH of the given water sample, the readings obtained are required to be tabulated.

Table:

Sample No.	Sample description	Temperature of sample ($^{\circ}\text{C}$)	pH
1	Tap water	27 $^{\circ}\text{C}$	6.3
2	River water	27 $^{\circ}\text{C}$	9.14

Preparation of Reagents :

1. Buffer Solution of pH 4.0

- * Take 100ml standard measuring flask and place a funnel over it.
- * Using the forceps carefully transfer one buffer tablet of pH 4.0 to the funnel.
- * Add little amount of distilled water, crush the tablet and dissolved it.
- * Make up the volume to 100ml using distilled water.

2. Buffer Solution of pH 7.0:

- * Take 100ml standard measuring flask and place a funnel over it.
- * Using the forceps carefully transfer one buffer tablet of pH 7.0 to the funnel.
- * Add little amount of distilled water, crush the tablet and dissolved it.
- * Make up the volume to 100ml using distilled water.

3. Buffer Solution of pH 9.2:

- * Take 100ml standard measuring flask and place a funnel over it.
- * Using the forceps carefully transfer one buffer tablet of pH 9.2 to the funnel.



x Add little amount of distilled water, crush the tablet and dissolved it.

x Make up the volume to 100ml using distilled water.
calibrating the instrument:

Using the buffer solutions calibrate the instrument.

Step-1:

In a 100ml beaker take pH 7.0 buffer solution and place it in a magnetic stirrer, insert the Teflon coated stirring bar and stir well.

Now place the electrode in the beaker containing the stirred buffer and check for the reading in the pH meter.

If the instrument is not showing pH value of 7.0, using the calibration knob adjust the reading to 7.0.

Take the electrode from the buffer, wash it with distilled water and then wipe gently with soft tissue.

Step-2:

In a 100ml beaker take pH 4.0 buffer solution and place it in a magnetic stirrer, insert the Teflon coated stirring bar and stir well.

Now place the electrode in the beaker containing the stirred buffer and check for the reading in the pH meter.



If the instrument is not showing pH value of 4.0, using the slope knob adjust the reading to 4.0.

Take the electrode from buffer, wash it with distilled water and then wipe gently with soft tissue.

Step-3:

In a 100ml beaker take pH 9.2 buffer solution and place it in a magnetic stirrer, insert the Teflon coated stirring bar and stir well.

Now place the electrode in the beaker containing the stirred buffer and check for the reading in the pH meter.

If the instrument is not showing pH value of 9.2, using the slope knob adjust the reading to 9.2.

Take the electrode from the buffer, wash it with distilled water and then wipe gently with soft tissue.

Now the instrument is calibrated.

Testing of sample:

* In a clean dry 100ml beaker take the water sample and place it on a magnetic stirrer, insert the teflon coated stirring bar and stir well.

* Now place the electrode in the beaker containing the water sample and check for the reading in the pH meter. Wait until you get a stable reading.

* The pH of the given water sample is given.

* Take the electrode from the water sample, wash it with distilled water and then wipe gently with soft tissue.

Result:

The pH of given tap water is 6.3

The pH of given river water is 9.14

Inference:

As per IS 10500-1991 drinking water specification, the desirable limit for pH of drinking water is 6.5 to 8.5. The pH of pure water is 7. As per the specification the pH of both tap water and river water are not within the limits. Hence both the water samples can not be used for drinking water.

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