|| Jai Sri Gurudev ||
Adichunchanagiri Shikshana Trust (R)
BGS INSTITUTE OF TECHNOLOGY
Department of Civil Engineering

CO-PO & CO-PSO Mapping (15 Scheme)

Programme	Course Code	Course Name	Credits	L-T-P	Assessment		Exam Duration
					SEE	CIE	
B.E	15C406	Environmental EngineeringLaboratory	2	1I+2P	80	20	3Hrs

15C406.1	The students will be able to conduct experiments, interpret and analyze data, and report results.
15C406.2	Determine physical, chemical and characteristics of water and wastewater.
15C406.3	Determine degree of treatment achieved by various treatment units for water and waste water.
15C406.4	Have knowledge of water and wastewater characteristics and their suitability for treatment or disposal.
15C406.5	Have knowledge of Noise level and Air quality determination method and its importance.

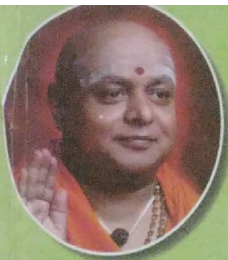
PSO-1: Graduates will be able to analyze, design and execute the civil engineering structures effectively for the sustainable development.
PSO-2: Graduates will acquire critical thinking abilities and technical skills for the usage of modern tools in development of civil engineering structures.
PSO-3: Graduates will be able to get opportunities for their professional growth, demonstrate communication and aptitude skills to face the challenges and needs of our society.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
15C406.1	2	2	-	-	-	-	1	-	-	-	-	-	-	2	1
15C406.2	2	2	1	1	1	-	-	-	-	-	-	-	-	2	-
15C406.3	3	3	2	-	-	1	-	-	-	-	-	-	2	2	1
15C406.4	2	2	-	-	-	1	2	-	-	-	-	-	2	-	1
15C406.5	1	1	-	-	-	-	-	-	-	-	-	-	1	-	-
15C406	2	2	1.5	1	1	1	1.5	-	-	-	-	-	1.66	2	1

Course Owner

HOD

Head, Dept of Civil E.
B G S Institute of Technolo
B G Nagara - 571448



|| Jai Sri Gurudev ||

Sri Adichunchanagiri Shikshana Trust (R.)

BGS INSTITUTE OF TECHNOLOGY

[Affiliated to VTU, Belgaum; Approved by AICTE, New Delhi and Recognized by Govt. of Karnataka]

BG Nagara – 571 448 (Bellur Cross)
Nagamangala Taluk, Mandya District

Practical Record

Name : Jeevitha C Gowda
Branch : Civil Sem : VII
USN : 4BW16CV016
Subject : Environmental Engg lab

CET Code : 142

|| Jai Sri Gurudev ||

Sri Adichunchanagiri Shikshana Trust (R.)

BGS INSTITUTE OF TECHNOLOGY

[Affiliated to VTU, Belgaum; Approved by AICTE, New Delhi and Recognized by Govt. of Karnataka)

BG Nagara – 571 448 (Bellur Cross)
Nagamangala Taluk, Mandya District

Certificate

This is to certify that ~~Mr~~/Ms. Jeevitha C. Gowda

*USN: 4BW*16CV016 *has satisfactorily completed the course of experiments*

in Environmental Engineering *Laboratory (Course Code:* 15CVL76*)*

prescribed by the Visvesvaraya Technological University, Belagavi for 7th

Semester, BE Civil *Engineering,*

*of this College in the year 20*19- 2020

Record Marks : 11 *Test Marks :* 06

IA Marks : 17	

Date : 28/11/19

Head, Dept of Civil Engg,
B G S Institute of Technology,
B G Nagara - 571448

28/11/19

Staff Incharge

Head of the Department

Rubrics for CIE of Practical Subject

1. For 20 Marks

Sl.No.	Description	Marks
1	a) Observation write up & punctuality	02
	b) Conduction of experiment and output	04
	c) Viva voce	02
	d) Record write up	04
2.	Internal Test	08
	Total	20

2. For 40 Marks

Sl.No.	Description	Marks
1	a) Observation write up & punctuality	05
	b) Conduction of experiment and output	10
	c) Viva voce	05
	d) Record write up	10
2.	Internal Test	10
	Total	40

INDEX

Name of the Student Jeevitha C. Gowda Class .... Sem. VII

Expt. No.	Date	Tittle of the Experiment	Page No.	Marks obtained					Sign. of the Staff
				a	b	c	d	Total	
01	6/8/19	Introduction	1-6.	2	4	1	4	11	13/8/19
02	13/8/19	Determination of pH	7-9.						
02(b)	13/8/19	Determination of acidity	10-12						
02(c)		Determination of alkalinity	13-15	2	3	1	4	10	20/8/19
03.	20/8/19	Determination magnesium and Total hardness of calcium.	16-18	2	4	1	3	10	27/8/19
04	27/8/19	Determination of chlorides	19-20	2	4	1	4	11	11/9/19
05	3/9/19	Determination of percentage of available chlorine in Bleaching powder and residual chlorine							
5(a)		Available chlorine	21-23						
5(b)		Residual chlorine	24-25	2	3	2	4	10	21/9/19
6	17/9/19	Determination of dissolved oxygen	26-28	2	4	1	4	11	24/9/19
7	24/9/19	Determination of Biochemical oxygen demand	29-31	2	3	2	4	11	1/10/19

INDEX

Name of the Student .... Class .... Sem. ....

Expt. No.	Date	Tittle of the Experiment	Page No.	Marks obtained a	b	c	d	Total	Sign. of the Staff
08	1/10/19	Determination of Solids							
ⓐ		Total solids	32 33						
ⓑ		Total dissolved solids	34-35						
ⓒ		Total settleable solids	40	2	2	0	4	08	8/10/19
09	15/10/19.	Determination of Iron	36-39	2	4	1	4	11	16/10/19
10	22/10/19	Determination of optimum dosage of							
		alum using Jar test apparatus	41-42	2	3	2	4	11	20/10/19
11	22/10/19	Determination of turbidity by							
		Nephelometer	43-44	2	3	2	4	11	30/10/19
12.	31/10/19	Determination of Sodium and							
		Potassium using Flame Photometer							
ⓐ		Sodium	45-46						
ⓑ		Potassium	47-48	2	3	2	3	10	5/11/19
13.	5/11/19	Determination of COD	49-50	2	4	2	4	12	12/11/19
14	12/11/19	Air Quality Monitoring	51-52	2	4	2	4	12	19/11/19
15	19/11/19	Determination of Sound by							
		Sound level meter at different							
		location	53-55	2	4	2	4	12	26/11/19

92

Juvitha. C. Gowda.
USN : 1BW16CV016
Date : 19/11/19

6/8

1. ✗
2. ✗
3. ✓ viva
4. ✗

Chlorides : DO ✗ 5,3 26.8

① Determination of chlorides in given sample.

Aim : To determine the chlorides present in a given water sample.

06/08
19/11/19

Apparatus : Burette, conical flask, pipette

Reagents : Standard silver nitrate solution, potassium chromate, Sodium thiosulphate distilled water

Procedure :

- Take a 100ml sample in a conical flask and.
- Maintain pH at same temperature by adding sodium thiosulphate
- Add [illegible] 1 or 2 drops of potassium chromate reagent to the sample.
- Titrate against standard silver nitrate solution untill solution colour changes from yellow to brick red, take as volume V_1.
- Note down the required silver nitrate solution
- Take blank solution titrate against and note down the value as V_2.

①

Tabular Column

Sample. ~~Chloride~~	Vol of Sample	Initial burette reading	Final burette reading	Volume of silver nitrate solution required.
Tap water	25 ml.	14.1	27.6	13.5
Distilled water				

~~Concentration of available chlorine~~
concentration of chloride $= \dfrac{(A-B) \times 35.45 \times N}{\text{ml of sample taken.}} \times 1000$

$$= \frac{(13.5-0) \times 35.45 \times 0.0141}{25} \times 1000$$

$$= 269.91 \text{ mg/L.}$$

Result : The amount of chloride present in given sample 269.91 mg/L.

Determination of dissolved oxygen

Aim : To determine the dissolved oxygen in a given water sample

Apparatus : Burette, conical flask, pipette, BOD bottle

Reagents : Standard sodium thiosulphate, concentrated sulphuric acid, oxalic acid, buffer solution, Manganese sulphate, alkali-azide solution, starch solution.

Procedure :

- Take a BOD bottle and fill 300ml of water to it. and add 2ml of manganese sulphate and 2ml of alkali-azide solution and 2ml of concentrated sulphuric acid without touching the tip of the bottle

- Wait untill the oxygen present in the bottle to react and tilt the bottle 2-3 times untill the brown colour appears.

- After the appearance wait for 2-3 minutes for the reaction of oxygen.

- Take 203 ml of sample into conical flask and titrate against the standard sodium thiosulphate solution untill the pale straw colour appears.

- It is impossible to obtain a straw colour perfectly titrate the sample. add - 1-2 drops of starch solution
- Note down the required sodium thiosulphate solution rice
-

Tabular Column

Vol of Sample.	Dilution ratio	Initial burette reading	final burette reading	Dissolved oxygen in mg/L..

Result : The amount of DO present in the given sample

19/11/19

Standards for Drinking water

Parameters	Indian standards IS 10500 - 1983		ICMR		WHO	
	(P)	(E)	(P)	(E)	(P)	(E)
	Physical					
colour (units)	10	50	5	25	5	50
Taste and odour	unobjectionable		Nothing disagreeable		Unobjectionable	
Turbidity (NTU)	10	25	5	25	5	25
	Chemical					
pH.	6.5-8.5	6.5-9.2	7-8.5	6.5-9.2	7-8.5	6.5-9.2
Total solids	-	-	-	500		1500 -
Total hardness	300	600	300	600	-	-
Calcium	75	200	75	200	75	200
Magnesium	30	100	50	150	50	150
Copper	0.05	1.5	1.0	3.0	1.0	1.5
Iron	0.3	1.0	0.3	1.0	0.3	1.0
Manganese.	0.1	0.5	0.1	0.5	0.1	0.5
Chlorides	250	1000	250	1000	200	600
Sulphates	-	400	200	400	200	400
Nitrate	45	-	20	50	-	50-100
Fluoride	0.5-1.2	-	1.0	2.0	0.5	1.0-1.5
	Toxic					
Arsenic	0.05	-	-	0.2	-	0.2.
cadmium	0.05	-	-	0.05	-	0.05
Cyanide	0.05	-	-	0.01	-	0.01
Lead	0.1	-	-	0.1	-	0.1
Zinc	5.0	10.0	-	-	-	-
Mercury	0.01	-	-	-	-	-
Bacteriological	1 coliform per 100ml		1 coliform per 100ml		1 coliform per 100ml.	

Name of Experiment ....

Experiment No. ....

Date : 6/8/19

INTRODUCTION

The reserve of water on earth are immense, but this is mostly salt water which is unfit for drinking or for irrigation purpose. The amount of fresh water is huge as well, but its distribution over the globe is uneven. The demand for drinking water and other domestic need is a modern town varies from 100 to 500 liter a day per person. As man uses water he pollutes and when the water is returned to open bodies it contaminates the natural waters.

The quality of water is now concern of experts in all countries of the world. The decision of WHO's 29th session emphasis that water delivered to the consumer should meet the high requirement of modern hygiene and should at least be free from pathogenic organisms and toxic substances. High content of dissolved solids, flourides, iron and manganese are the special characteristics of some ground water acquired though geo contamination and sea water intrusion. For effective management of water resource, continuous monitoring and appropriate strategies are immense

Radioactivity

Alpha emitter (µc/ml)	10^{-3} -- -- 10^{-3} -- 10^{-3}
Beta emitter (µc/ml)	10^{-7} -- -- 10^{-8} -- 10^{-8}

P = permissible limit
E = Excessive limit

Goals for Examination of water and wastewater

The specification of the analytical methods for water and waste water of course depends on related aims and expectations. The goals must be well defined before embarking on intensive and costly measurement programs in order to attain an optimal on cost-benefit relationship and a rapid supply of information. In general following goals may be formulated for the examination of water and waste water.

Water:

1. Determination of physical, chemical and biological characteristic of water.
2. Determination of pollution sources.
3. Assessment of suitability of water for various purpose such as drinking, industrial, irrigation, fishery and concrete.
4. Establishment of size of various treatment units.
5. Preparation for water technical processes.
6. Determination of amount of chemical required for purification and conditioning of water for industrial usage.

Standards for irrigation water

Sl no	parameters	Tolerable concentration
1	total salts	2000
2	sulphates	480
3	chlorides	355
4.	sodium percentage	60
5.	Boron	2 .
6.	Electrical conductivity	2250×10^{-5} mhos
7.	Aluminium	1.0 (20C)
8.	Arsenic	1.0 (10C)
9.	Cadmium	0.005 (0.05)
10.	Chromium	5.0 (20.0).
11.	Beryllium	0.5 (20.0)
12.	cobalt	0.2 (10.0)
13.	copper.	0.2 (10.0)
14.	Flouride	1.0 (1.0)
		1.0 (1.0)
15.	Iron.	5.0 (20.0)
16.	Lead.	2.0 (20.0)
17.	Manganese.	0.5 (2.0)
18.	Nickel.	5.0 (10.0)
19.	Zinc	10.0 (10.0)
20	Cadmium.	5.0 (10.0)

Waste water

1. Estimation of pollution load and their potential damaged caused by introduction into the water bodies and on land for irrigation
2. Estimation of potential damage to sewers and sewage treatment plants
3. Preliminary assessment for planning and operation of waste water treatment plants
4. Testing of selected detrimental parameters for calculation of discharge cess by regulation authorities
5. To find out the presence of toxic constituents such as cyanide, cadmium, mercury etc and to evaluate the degree of toxicity in the treatment system
6. To find out the substance that causes difficulties in treatment as foam, non-biodegradable organics.
7. To find out the treatability constants and to arrive design parameters for an effective treatment plant unit sizes for a specific wastes

Sampling :

The collection of water samples may seem relatively simple task However to obtain representative water samples and to preserve their integrity until they are analyzed in the laboratory requires a series of steps, procedures and practices

Tolerable concentration of Impurities in mixing water of concrete.

Sl no	Parameters	Tolerable concentration
01	pH	6 to 8.
02	Acidity [as $CaCO_3$]	50
03	Alkalinity [$CaCO_3$]	250
04.	Organic solids	200
05	Inorganic solids	3000
06.	Sulphates	500
07.	chlorides	2000 for plane concrete. 3000 for RCC.
08.	Suspended matter	2000
09.	Free CO_2	25
10.	Sodium & potassium	10000
11.	Carbonates and bicarbonates	10
12.	Magnesium	200
13.	Sulphide	no detectable
14.	Humid acids and hydrocarbons	no detectable

relatively homogeneous where as many water bodies have significant spatial and temporal variations and the collection of a representative sample becomes much more complex.

The objective of the sampling is to collect a portion of materials small enough in volume to be conveniently transported to and handled in the laboratory while still accurately representing the material being sampled. This implies first that the relative portions of the concentration of all pertinent components must be same in the samples as in the material being sampled and second, that the sample must be handled in such a way that no significant changes in composition occurs before the tests are performed.

The analysis is generally intended to reveal the composition of waters at the time or over the period of sampling. Consequently errors are introduced if changes take place between taking of the sample and analysis being carried out. There is in fact, a strong likely hood that such changes will occur in most of the waters. The arrangement should be such that these are prevented or at least minimized.

Types of Samples :

1 **Grab or Catch sample :**

A sample collected at a particular time and place can represent only the composition of the source at that time and place. However when a source is known to fairly constant in composition over a considerable period of time then the samples may be said to represent a larger time period or larger volume or both than the specific point at which it was collected.

When a source is known to vary with time, grab samples collected at suitable intervals can be of great value in documenting the extent, frequency, and duration of these variations. In case the composition of source varies in space rather than in time, a set of sample collected from the locations with less emphasis on timing may provide the most useful information.

2 **Composite Samples :**

The term composite refers to a mixture of grab samples collected at the same sampling point at different time. Sometimes the term time composite is used when it is necessary to distinguish this type of sample from other

Name of Experiment .... Date : ....

Experiment No. .... Page No. 6

Time composite sample are most useful for observing average concentrations, as an alternative to the separate analysis of a large number of samples, followed by computation of average and total results.

Mixture of grab samples collected from different points simultaneously or as nearly as possible is called integrated sample. Such sample are useful for river or stream that varies in composition across its width and depth. The need for integrated samples may exists if combined treatment is proposed for several separate waste water stream. Prior knowledge about volume, movement and composition of various parameters of the water being sampled is also required.

11/12

13/8/18

Observation

Description of sample	pH	
	pH meter	universal indicator
Tap water	7.51	7.50
	7.50	7.50
	7.51	7.50
Acidic acid solution	5.4	5.50
	5.6	5.50
	5.4	5.50
NaOH solution	10.1	10.00
	10.2	10.00
	10.1	10.00

Determination Of ~~p^H~~ pH

Aim: To determine p^H of the given sample.

Principle :

pH is measured by a pH meter using a glass electrode which generates a potential varying linearly with the pH of the solution in which it is immersed. It is a nernstian concentration cell with potential controlled by the activities of H^+ on either side of a thin glass membrane. The latter is the bottom part of a bulb at the end of a glass tube containing a reference solution of fixed a^+H.

$$E = \text{constant} + \ln$$
$$= \text{constant} + 0.058\,pH \text{ at } 20^\circ$$

A calomel or Ag|AgCl|KCl reference electrode is usually located around the glass electrode stem for sample separation.

Apparatus :

1. pH meter along with electrodes
2. Buffer solution

3 Thermometer
4 Universal indicator

Preparation of reagents

1. Buffer solution of pH 4.01
2. Buffer solution of pH 7.
3. Buffer solution of pH 9.2.

Procedure :

1. Calibrate the electrode with 2 standard buffer solution of pH 4.0 and 9.2 [A buffer solution is a solution offering resistance to change in pH and whose pH value is known].
2. The sample temperature is determined at the same time and is entered into the meter to allow for a temperature correction.
3. Rinse the electrode thoroughly with de-ionized distilled water and carefully wipe with a tissue paper.
4. Dip the electrode into the sample solution, swirl the solution and wait up to one minute for steady reading. A pH meter reading within ±0.1 pH unit will be adequate for such work.

5 The reading is taken after the indicated value remains constant for about a minute

Results:

The pH of the given tap water is = 7.51
The pH of the given acidic solution = 5.4
The pH of the NaOH solution = 10.1

Comments:

According to BIS drinking water standards [IS 10500 - 1983] the permissible limit of pH is 6.5 - 8.5 the obtained result is 7.51 which is within permissible limit which is safe for drinking under this parameter. If the pH is more it results in scale formation. high pH results in formation of trihalomethane which causes cancer. If pH is below 6.5 which results in corrosion of pipe.

If the pH level of water is high it can be reduced by adding hydrochloric acid.

Observation and Calculation

Sample details	Volume of sample taken (ml)	Methyl orange indicator			Phenolphthalein indicator		
		IBR (ml)	FBR (ml)	vol of NaOH (ml) V_1	IBR (ml)	FBR (ml).	Vol of NaOH (ml) V_2
Tap water	10	4.2	4.2	0.0	4.2	4.6	0.4
		4.6	4.6	0.0	4.6	4.8	0.2
		4.8	4.8	0.0	4.8	5.1	0.3
Distilled water	10	5.1	5.1	0.0	5.1	5.2	0.1

Name of Experiment Determination of Acidity Date : 13/8/19
Experiment No. 1(b)

Acidity

Aim: To determine acidity [base capacity] of the given sample.

Principle:

The mineral acids present in the sample which are contributing mineral acidity can be calculated by titrating or neutralizing samples with strong base NaOH to pH 4.3. The CO_2 and bicarbonates [carbonic acid] present and contribute CO_2 acidity in the sample can be neutralized completely by continuing the titration to pH 8.2.

Apparatus:

1. Burette
2. Conical flask.
3. Pipettes

Reagents

1. Standard sodium hydroxide (0.02N): Dissolve 8gm of NaOH in 100ml distilled water
2. Phenolphthalein indicator
3. Methyl orange indicator
4. Sodium thiosulphate (0.1N)
5. Carbon dioxide free distilled water

Calculations :

Mineral acidity due to mineral acids [as $CaCO_3$] (mg/L) $= \dfrac{V_1 \times N_1 \times 50}{\text{ml of sample}} \times 1000$

$$= \frac{(0-0) \times (0.02 \times 50)}{10} \times 1000$$

$= 0$ [nill]

CO_2 acidity due to CO_2 [as $CaCO_3$] (mg/L) $= \dfrac{V_2 \times N_2 \times 50}{\text{ml of sample taken}} \times 1000$

$$= \frac{(0.3-0.1)(0.02 \times 50)}{100} \times 1000$$

$= 20$ mg/L.

Total acidity due to CO_2 [as $CaCO_3$] $=$ mineral acidity $+$ CO_2 acidity

$= 0 + 20$

$= 20$ mg/L.

Procedure :

01 CO$_2$ acidity [phenolphthalein acidity]

1. Pipette out 100ml of sample in a conical flask
2. Add 3 drops of phenolphthalein indicator
3. If the sample gives a pink colour on addition of phenolphthalein indicator, acidity is not available
4. If the colour doesn't change, titrate against 0.02N NaOH from burette until the first permanent pink colour appears.
5. Record the amount of 0.02N NaOH used in ml [V$_1$].

02 Mineral acidity [methyl orange acidity]

1. Pipette out 100ml of sample in a conical flask.
2. Add 2 drops of methyl orange indicator
3. If it gives orange colour mineral acidity is present
4. Titrate against 0.02N NaOH from a burette until the colour changes from orange to pale yellow (V$_2$).

Result :

Mineral acidity of given sample (mg/L) = 0
CO_2 acidity of given sample (mg/L) = 20
Total acidity of given water sample (mg/L) = 20

Comments :

According to BIS drinking water standards [IS 10500 - 1983], acidity should not exceed 50 mg/L for RCC works. The obtained results is 20 mg/L which is within the limit

Observation and Calculations :

Sample details	Vol of sample taken (ml.	Phenolphtalein			Methyl orange		
		IBR (ml)	FBR (ml)	H_2SO_4 used V_1(ml)	IBR (ml	FBR (ml).	H_2SO_4 used V_2 (ml)
Tap water.	10	2.0	3.7	1.7	3.7	7.1	3.4
		7.1	8.1	1.0	8.1	12	3.9
		12	12.8	0.8	12.8	16.9	4.1
Distilled water	10	16.9	16.9	0.0	16.9	17.8	0.9.

Name of Experiment Determination of Alkalinity Date : 13/8/19

Experiment No. 1(c.) Page No. 13

Alkalinity

Aim : To determine the alkalinity of the given sample.

Principle : Alkalinity can be obtained by neutralizing OH^-, CO_3^- and HCO_3^- with standard H_2SO_4. Titration to pH 8.3 or decolourization of phenolphthalein indicator will show complete neutralization of OH^- and ½ of CO_3^{--}, while to pH 4.4 or sharp change from yellow to pink of methyl orange indicator will indicate total alkalinity i.e, OH^-, CO_3^{--} and HCO_3^-

Apparatus :

1. Burette
2. Conical flask.
3. Pipettes

Reagents :

1. Standard sulphuric acid [0.02N] : prepare 0.1N H_2SO_4 by diluting 3ml concentrated sulphuric acid to 1000ml in a volumetric flask. Standardize it against standard 0.1N sodium hydroxide. Pipette 20ml of concentrated 0.1N sulphuric acid and add slowly along the sides of the standard flask. Then make up

phenolphalein alkalinity (P) in mg/L as $CaCO_3$ $= \dfrac{V_1 \times N \times 50}{\text{ml of sample}} \times 1000$

$$= \frac{(1.2 - 0)(0.02 \times 50)}{10} \times 1000$$

$$= 120 \text{ mg/L}$$

Total alkalinity (T) in mg/L as $CaCO_3$ $= \dfrac{V_2 \times N \times 50}{\text{ml of sample}} \times 1000$

$$= \frac{(4 - 0.9) \times (0.02 \times 50)}{10} \times 1000$$

$$= 310 \text{ mg/L.}$$

Value of P and T	Alkalinity due to		
	OH^-	CO_3^{--}	HCO_3^-
$P = 0$	0	0	T
$P < 1/2\,T$	0	0	$T - 2P$
$P = 1/2\,T$	0	$2P$	0
$P > 1/2\,T$	$2P - T$	$2T - 2P$	0
$P = T$	T	0	0

Then make up the volume up to 1000 ml mark. Now the strength of this solution is 0.02N.

2. Phenolphthalein indicator
3. Methyl orange
4. Carbon dioxide free distilled water
5. Sodium thiosulphate [0.1N]

Procedure :

Partial Alkalinity [phenolphthalein Alkalinity]

1. Take 100ml of given sample in a conical flask
2. Add 1 drop of 0.1N sodium thiosulphate solution to remove the free residual chlorine if present.
3. Add 2 drops of phenolphthalein indicator the sample turns pink.
4. Run down 0.02N standard sulphuric acid till the solution turns to colourless.
5. Note down the volume of H_2SO_4 added (V_1)

Total Alkalinity [Methyl orange Alkalinity]

6. Add 2 drops of methyl orange indicator. The sample turns to yellow.
7. Resume titration till the colour of the solution turns to orange.
8. Note down the total volume of the H_2SO_4 added (V_2).

Name of Experiment

Date : 13/8/19

Experiment No.

Result :

Hydroxide alkalinity of the given sample = nill
Carbonate alkalinity of given sample = 240 mg/L
Bicarbonate alkalinity of given sample = 70 mg/L
Partial alkalinity of given sample = 120 mg/L
Total alkalinity of given sample = 310 mg/L

Comments.

According to BIS drinking water standards std [IS 10500-1983] the permissible limit of alkalinity is should be less than 250mg/L for domestic consumption. The obtained results is more than the limit which is not safe for drinking purpose, in which it imparts a bitter taste to water., it also causes skin irritation and too much alkalinity may also agitate the body's normal pH leading to metabolic alkalosis [Nausea]. To reduce the high alkalinity use sodium bicarbonate over a period of time.

10/10

20/8/19

Observation and Calculations :

	Sample details	IBR. ml (1)	FBR ml (2)	Volume of EDTA (ml) (2)-(1)
Total hardness	Tap water	38.1	39.8	1.7
		39.8	41.6	1.8
		41.6	43.8	1.8
	distilled water	43.4	43.8	0.4.
Calcium hardness	Tap water	0.0	1.6	1-6
		1-6	3.4	1-8
		3.4	5	1.6
	distilled water	5	5.3	0.3

volume of sample taken = 10ml.

Name of Experiment .... Date : 20|8|19

Experiment No. 2

Determination Magnesium And Total Hardness of Calcium Hardness

Aim: To determine the total hardness, calcium and magnesium of the given sample.

Principle: In alkaline condition, EDTA reacts with Ca and Mg to form a soluble chelated complex. Ca and Mg ions develop wine red colour with chrome black T under alkaline condition. When EDTA is added as a titrant, Ca and Mg divalent ions get complexed resulting in a sharp change from wine red to blue which indicates end point of the reaction

$Ca^{++} + Mg^{++} + EDTA \xrightarrow{pH 10\pm0.1} CaEDTA + MgEDTA$.

M^{+2} + Erio chrome Black T. [M Erio chrome Black T wine-red]

The pH for this titration has to be maintained at 10±0.1. At a higher pH i.e., at about 12 Mg^{++} ion precipitates and only Ca^{++} ion remain in solution. At this pH Murexide indicator forms a pink colour with Ca^{++}. When EDTA is added Ca^{++} get complexed resulting in a change from pink to purple which indicates end point of the reaction

Calculation

Total hardness (mg/L) as $CaCO_3$ = (A - B) × molarity of EDTA × molecular wt of $CaCO_3$ × 1000 / ml of sample taken

$$= \frac{(1.8 - 0.4) \times (0.01 \times 100)}{10} \times 1000$$

= 140 mg/L

Calcium hardness (mg/L) as $CaCO_3$ = A_1 × 1000 / ml of sample.

where A_1 = volume of EDTA used by sample.

$$= \frac{(1.6 - 0.3)(0.01 \times 100)}{10} \times 1000$$

= 130 mg/L.

Magnesuim hardness (mg/L) as $CaCO_3$ = Total hardness (mg/L) as $CaCO_3$ - calcuim hardness (mg/L) as $CaCO_3$

= 140 - 130

= 10 mg/L

Date : 20/8/19

Reagents :

1. Buffer solution
2. Eri chrome black T- indicator
3. Standard EDTA solution 0.01M
4. Standard calcium solution
5. Murexide indicator
6. Sodium hydroxide 2N.

Preparation of reagents :

1. Buffer solution
2. Erichrome black T
3. Standard EDTA solution
4. Standardisation of EDTA.

Procedure :

A Total hardness :

1. Take 100ml well mixed sample in conical flask.
2. Add 1 to 2ml buffer solution followed by 1ml inhibitor.
3. Add 2 drops of Eri chrome black T and titrate with standard EDTA (0.01M) till wine-red colour changed to blue.
4. Note down the volume of EDTA required
5. Run a reagent blank to get better accuracy Note the volume of EDTA required for blank (B)
6. Calculate the volume of EDTA required for sample (A-B).

Comments :

According to BIS drinking water standards [IS 10500 -1983] the permissible limit of total hardness is 300 - 600 mg/L. The obtained result is 140mg/L which is less than the permissible limit which is not safe for drinking under this parameter. If the hardness of water is less than 300 mg/L we should have raise the calcium hardness and it causes formation of scales as inner coating of pipe lines prevents corrosion.

Name of Experiment .... Date : 20/8/19

Experiment No. .... Page No. 18

B Calcium Hardness and Magnesium hardness :

1. Take 25 to 30ml of sample in conical flask.
2. Add 1ml of NaOH to rise pH to 10 and pinch of murexide indicator.
3. Titrate with EDTA till pink colour changes to purple. Note the volume of EDTA used (A$_1$)
4. Calculate the calcium hardness using formula and by calculation the total hardness magnesium hardness can be calculated by

Magnesium hardness = Total hardness - Calcium hardness

Result :

Total hardness (mg/L) as $CaCO_3$ = 140mg/L

Calcium hardness (mg/L) as $CaCO_3$ = 130mg/L

Magnesium hardness (mg/L) as $CaCO_3$ = 10mg/L

10/12

27/8/19

Observation and Calculation

Sample details	Volume of sample taken (ml)	Observation		
		IBR (ml)	FBR (ml)	$AgNO_3$ used (ml)
Tap water	10	25	29.3	4.3
	10	29.3	33.6	4.3
	10	33.6	37.8	4.2
Distilled water	10	37.8	39	1.2

$$\text{Chloride in (mg/L)} = \frac{(A-B) \times 35.45 \times N}{\text{ml of sample}} \times 1000$$

$$= \frac{(4.3-1.2)\times(0.0141\times35.45)}{10} \times 1000$$

$$= 155 \text{ mg/L}$$

Name of Experiment ....

Date : 27/8/19

Experiment No. 03

Determination Of Chlorides

Aim : To estimate the content of chlorides in the given water sample.

Principle :

Chlorine ion is determined by Mohr's method titration with standard silver nitrate solution in which silver chloride is precipated at first. The end of titration is indicated by formation of red silver chromate from excess AgNO3 and potassium chromate is used as a indicator in neutral to slightly alkaline solution

$AgNO_3 + Cl_2 \longrightarrow AgCl + NO_3$ (white).

$2AgNO_3 + K_2CrO_4 \longrightarrow Ag_2CrO_4 + 2KNO_3$ (red)

Apparatus :

1. Burette
2. Conical flask.
3. Pipettes

Reagents :

1. Chloride free distilled water
2. Potassium chromate indicator 0.25N
3. Standard silver nitrate (0.0141N)

Comments

According to BIS drinking water standard, [IS -10500- 1983], the chlorine concentration should be below 250mg/L 250mg/L. If the chloride content is high which causes heart problems results on high blood pressure, hence the obtained result are within the limit which is desirable for drinking in this parameter

Procedure :

1. Take 100ml of sample in conical flask
2. Adjust its pH to be between 7 and 8 either with sulphuric acid or sodium hydroxide solution. Otherwise AgOH is formed at high pH. level or CrO_4^{-2} is converted $Cr_2O_7^{-2}$ at low pH levels.
3. Add 1ml of potassium chromate to get light yellow colour.
4. Titrate with standard silver nitrate solution till colour changes from yellow to brick red.
5. Note the volume of silver nitrate added
6. For accuracy, titrate distilled water in same manner.
7. Note volume of silver nitrate added for distilled water.

Result :

The content of chlorides in the given water sample = 155 mg/L

11/15

16/9/19

Observation and Calculation :

Sample details	Burette readings		Volume of sodium thiosulphate solution
	Initial(ml)	Final(ml)	
chlorinated water (V_1)	0	0.4	0.4
	0.4	0.7	0.3
	0.7	1.0	0.3
Blank solution (V_2)	1.3	1.3	0

Concentration of available chlorine (mg/L) $= \frac{(V_1 - V_2) \times 0.025 \times N}{\text{ml of sample}} \times 1000$

$$= \frac{(0.3 - 0) \times (0.025 \times 35.45)}{10} \times 1000$$

$$= 26.58 \text{ mg/L}$$

Name of Experiment ....

Date : 3|9|19.

Experiment No. H(a)

Determination of Percentage of Available chlorine in Bleching powder. Residual chlorine.

Available Chlorine

Aim : To determine the % avaible chloride in the given sample of bleching powder.

Principle : Chlorine is strong oxidizing agent and liberates iodine from iodide ion.

$Cl_2 + 2KI \longrightarrow I_2 + 2KCl$ [scratch gives blue colour with iodine]

I_2 + starch, Blue colour.

The liberated iodine is titrated against with standard sodium thiosulphate which is a reducing agent

$I_2 + 2Na_2S_2O_4 \longrightarrow Na_2S_4O_4 + 2NaI$

The disappearance of blue colour indicate the complition of reaction with free iodine is converted back to iodide

$$\% \text{ available chlorine} = x = \frac{\text{concentration of available chlorine (mg/L)}}{\text{concentration of Bleaching powder (mg/L)}} \times 100$$

$$= \frac{26.58}{100} \times 100$$

$$= 26.58\%$$

Date : 3/9/19

Apparatus :

Conical flask, pipette, burette

Reagents :

1. Stock sodium thiosulphate [0.1N]
2. Standard sodium thiosulphate [0.025N]
3. Concentrated acidic acid, potassium iodide crystals, sodium thiosulphate [0.025N], bleaching powder.

Procedure :

1. Take 1g of fresh bleaching powder add small quantity of water to it and prepare fine paste add some water. Stir and allow to settle for a few minutes dilutes it with distilled water to make upto 1lt and stopper the contain
2. Take 10ml of bleaching powder solution in a conical flask and pinch of KI
3. Add 2ml of acetic acid and allow the reaction to complete.
4. Titrate the sample with standard sodium thiosulphate solution untill the yellow colour of the liberated iodine is almost fadeout.
5. Add 1ml of starch solution and titrate until the blue colour disappears
6. Note down the quantity of sodium thiosulphate added V_1.

7. Repeate the same procedure for distilled water
8. Note down the volume of sodium thiosulphate added V_2.

Result :

The % available chlorine in the given sample of bleeching powder = 26.58%.

Comments

A normal house hold bleach contains 5-6% of available chlorine. The ~~obtained~~ results is more than permissible value. It causes respiratory problem such as asthama

Observation

Sample details	Burette readings		Volume of sodium thiosulphate consumed in ml.
	Initial ml.	Final ml	
	0	0	0
Chlorinated water V_1			
Blank Solution V_2	0	0	0

Calculation :

$$\text{Concentration of chlorine} = \frac{(V_1 - V_2) \times 0.025 \times N}{\text{ml of sample}} \times 1000$$

$$= \frac{(0-0) \times (0.025 \times 35.45)}{10} \times 1000$$

$$= 0 \text{ (nill)}$$

Residual Chlorine

Aim : To find out the amount of residual chlorine available in the given water sample.

Apparatus : Conical flask, pipette, Burette

Reagent : Acetic acid, starch indicator, potassium iodide crystals, Sodium thiosulphate (0.0025N)

Procedure :

1 Take 100ml of water sample in a conical flask and pinch of KI.
2. Add 5ml of acetic acid and allow the reaction to complete.
3. Titrate the sample with standard sodium thiosulphate solution until the yellow colour of the liberated iodine is almost fading out
4 Add 1ml of starch solution and titrate until the blue colour disappears.
5. Note down the quantity of sodium thiosulphate added V_1
6. Repeat the same procedure for distilled water

Name of Experiment ....

Date : 3/9/19

Experiment No. ....

7. Note down the volume of sodium thiosulphate added V_2.

Results:

Amount of the residual chlorine is the given sample is = 0

Comments

The amount of residual chlorine when reaches the consumers tap should be between 0.01-0.02 but the obtained results is nill, there may be chances of entry of microbes during the distribution. The chlorine is mainly used as a disinfectant to kill the microbes. Hence the chlorine should be added in the desirable amount.

10/10

4/9/19

Observation :

Sample details	Vol of sample taken ml	Initial burette reading ml	Final burette reading ml	ml of $Na_2S_2O_3$ solution used	DO in mg/L.
Tap water	203	2.7	5.4	3.7	3.7.

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.

1ml solution thiosulphate is equivalent to

$$\frac{0.2 \times 1000}{200} \text{ mg/L} = 1 \text{mg/L}$$

Name of Experiment Determination of D.O. Date : 17/9/19

Experiment No. 05 Page No. 26

Determination of Dissolved Oxygen

Aim: To find the quantity of dissolved oxygen present in the given sample.

Principle: 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 DO content in the sample. The liberated iodine is titrated against $Na_2S_2O_3$ (0.25N), using starch as an indicator. If oxygen absent in sample, the $MnSO_4$ react with the alkali to form white precipitate $Mn(OH)_2$

Apparatus:

1. BOD bottles [capacity 300ml]
2. Burette
3. Pipettes

Reagents

1. Manganous sulphate
2. Alkali iodide - azide reagent
3. Starch indicator
4. Standard sodium thiosulphate [0.025N]
5. Concentrated sulphuric acid

Procedure:

1. Take a 300ml BOD bottle and collect water sample in it completely.
2. Add 2ml of manganous sulphate and 2ml 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 by repeatedly inverting the bottle 2-3 times
4. If no oxygen is present, the manganous ion reacts with hydroxide ion to form white precipitate of $Mn(OH)_2$. If oxygen is present, some Mn^{++} is oxidized to M^{++} and precipitates as a brown coloured manganic oxide.
5. After shaking and allowing sufficient time for all oxygen to react, the chemical precipitates are allowed to settled leaving clear liquid within the upper portion

Comments

The minimum DO for the survival of the aquatic life is 4-5 mg/L. The obtained results is 3.7 mg/L which is less than the permissible limit, which is sufficient for the aquatic life to survive. DO can be increased by supplementing wind and wave action adding plants to water and exposing water to purified oxygen. Drinking water should be rich in DO for good taste.

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

$Mn^{++} + 2(OH)^- + 1/2 O_2 = MnO_2$ (brown) $+ H_2O$

6. 2 ml of concentrated sulphuric acid is added

7. The bottle is restoppered and mixed by inverting until the suspension is completely dissolved 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 0.025N sodium thiosulphate solution until yellow coloured iodine turns to pale straw colour.

$$\frac{200 \times 300}{(300-4)} = 203 \text{ ml.}$$

9. Since it is impossible to accurately titrate the sample to a colourless liquid, 1 to 2 ml of starch solution is added.

10. Continue titration to the first disappearance of the blue colour.

Results.

14/10 Dissolved oxygen content of the given water sample is = 3.7 mg/L.

01/10/19

Observation and Calculation

Let initial DO of dilute sample = $D_0 = 6.4$

DO at end of 5 days for diluted sample = $D_5 = 2.5$

Initial DO of distilled water (blank) = $C_0 = 6.2$

DO at end of 5 days for the distilled water (blank)

$= C_5 = 2.7.$

DO depletion due to microbes = $(O_0 - D_5) - (C_0 - C_5)$

$= (6.4 - 2.5) - (7.4 - 6.2)$

$= 2.7$ mg/L.

BOD at 20°C of the sample $= \left[\frac{(O_0 - D_5)\,\text{volume of sample}}{\text{ml of raw sample taken}} \right] - (C_0 - C_5)$

$= \left[\frac{(6.4 - 2.5)\,300}{30} \right] - (6.2 - 2.7)$

$= 38.2$ mg/L.

Name of Experiment ....

Date : 24/9/19

Experiment No. 06

Page No. 29

Determination of Biochemical Oxygen Demand [BOD]

Aim: To determine Biochemical Oxygen demand [BOD] exerted by the given waste water sample.

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 CO_2 and H_2O

$$C_nH_aO_bN_c + O_2 \xrightarrow{bacteria} CO_2 + H_2O + NH_3$$

Reagents:

1. Distilled water
2. Phosphate buffer solution
3. Magnesium sulphate solution
4. Calcium chloride solution
5. Ferric chloride solution
6. Sodium thiosulphate solution

Reagents:

1. Phosphate buffer solution
2. $MgSO_4$ solution
3. $CaCl_2$ solution
4. Ferric chloride solution

Tabular Column :

Sl No	Volume of Sample (ml)	Dilution ratio	Initial DO of Sample mg/L	Final DO of sample mg/L	Initial DO of blank mg/L	Final DO of blank mg/L	5 days BOD @ 20°C mg/L
1	300		6.4	2.5	7.4	6.2	38.2

Date : 24|9|19

5 Quantity of distilled water

Procedure :

1 Place the desired volume of distilled water in a 5 litre flask. Aeration is done by bubbling compressed air through water.

2. Add 1ml of phosphate buffer, 1ml of magnesium sulphate solution, 1ml of calcium chloride solution and 1ml of ferric chloride solution for every litre of distilled water.

3. In case of waste water which are not expected to have sufficient bacterial population add seed to dilution water. Generally 2ml of settled sewage is sufficient for 100ml of dilution water.

4 Highly acidic or alkaline samples are to be neutralized to a pH of 7.

5 Add 2-3ml of sodium thiosulphate solution to destroy residual chlorine, if any.

6 Take samples as follows.
Strong waste : 0.1, 0.5 or 1%.
Settle domestic sewage : 1, 2.5, or 5%.
Treated effluent : 5%, 12.5 or 25%.
River water : 25% to 100%.

7 Dilute the sample with distilled water and mix the contents well.

8. Take diluted sample into 2 BOD bottles
9. Fill another two BOD bottles with diluted [distilled] water alone]
10. Immediately find DO of diluted water and diluted waste water.
11. Incubate the other two BOD bottles at 20°C for 5 days. They are to be tightly stopper to prevent any air entry into the bottles.
12. Determine DO content in the incubated bottle at the end of 5 days [120 hours]

Result :-

BOD at 20°C of the sample = 38.2 mg/L.

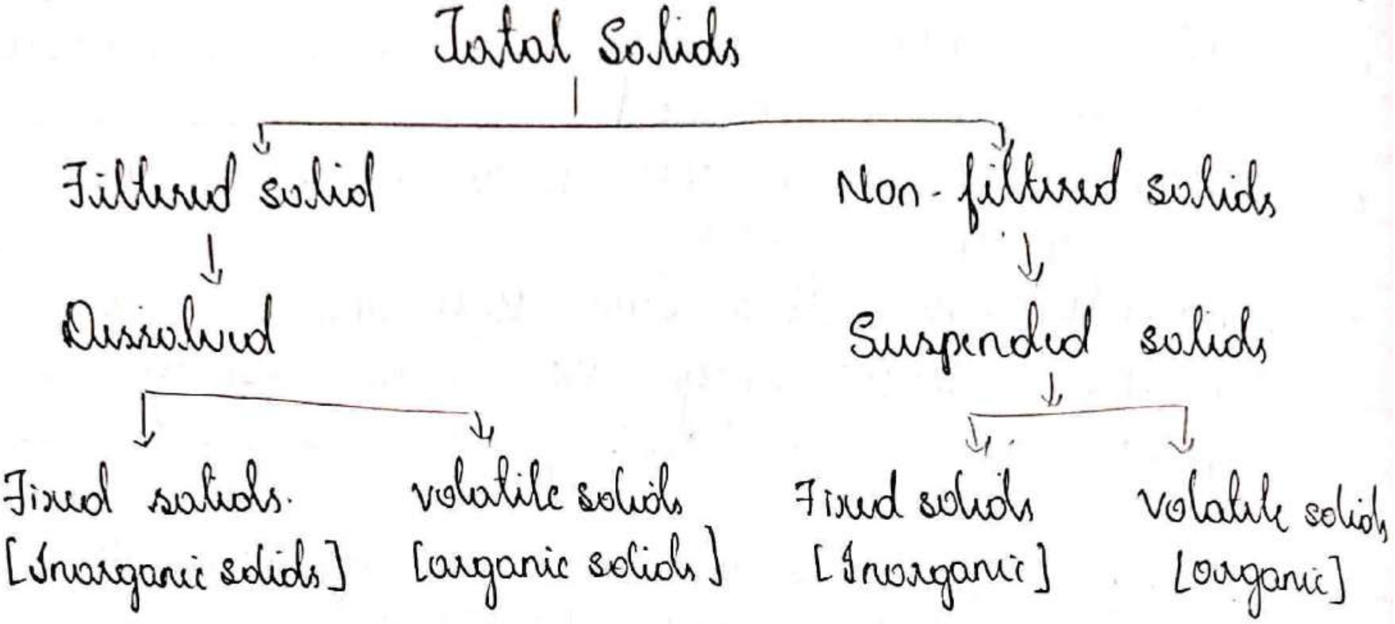
Comments:

Effluent discharged into natural bodies of water should have BOD less than 30mg/L. Hence the given waste water sample is more than 30mg/L which is not within the permissible limit. If the BOD level is high which indicates polluted water. Nitrates and phosphates in a water body can contribute to high BOD. BOD can be removed from water through introduction of oxygen and micro-organisms during treatment

14/15

1/10/19

Concept structure



Calculations:

Initial weight of the dish = W_1 = 44.84g.
Final weight of the dish = W_2 = 45.01g
Final weight of the after evaporation in muffle furanan
in mg = W_3 = 44.975g.

ⓐ Total solids (T.S) mg/L = $(W_2 - W_1) * 1000 * \frac{1000}{\text{ml of sample taken}}$

$$= \frac{(45.01 - 44.84) \times 1000}{50} \times 1000$$

$$= 3400 \text{ mg/L}$$

Determination of Solids in Sewage

a. Total Solids

Aim: To determine the total solids, total volatile and fixed solids of the given sample.

Principle: Total solids are determined as the residue left after evaporation and drying of the unfiltered sample.

Apparatus:

1. Evaporating dishes [Pyrex, porcelain or platinum]
2. Oven.
3. Desiccator
4. Water bath

Procedure:

A. Total solids

1. A clean porcelain dish is ignited in a muffle furnance and after cooling in the desiccator and weighed (w₁)
2. A 100ml of well mixed sample [graduated cylinder is rinsed to ensure transfer of all suspended matter]: is placed in the

ⓑ Total volatile solids (TVS) mg/L $= (W_2 - W_3) \times 1000 \times 1000 / \text{ml of sample to be taken}$

$$= \frac{45.01 - 44.975 \times 1000 \times 1000}{50}$$

= 700 mg/L.

ⓒ Total fixed solids (TFS) mg/L = T.S - T.V.S

= 3400 - 700

= 2400 mg/L.

dish and evaporated at 103°C for 24 hours and cool in a desiccator and weigh (W_2)

3. Ignite the residue at 600°C in the muffle furnace to constant weight in 10-15 minutes

4. Allow the dish to cool and moisten the ash with few drops of distilled water.

5. Dry to a constant weight at 100°C cool in a desiccators and weigh (W_3)

Results :

Total solids of a given sample = 3400mg/L.
Total volatile solids of a given sample = 700mg/L.
Total fixed solids of a given sample = 2400mg/L

Calculation :

Total dissolved solids TDS (mg/L) $= \dfrac{(W_4 - W_5) * 1000 \times 100}{\text{ml of sample taken}}$

Final weight of the dish $= (W_4) = 42.76g$.

Initial weight of the dish $= W_5 = 42.83g$.

$$= \frac{(42.83 - 42.76) * 1000 * 1000}{50}$$

$$= 1400 mg/L.$$

Total suspended solids TSS in the given water sample in (mg/L) $= TS - TDS$

$= 3400 - 1400$

$= 200 mg/L.$

Name of Experiment ....

Date : 1/10/19

Experiment No. 07 (b)

Page No. 34

Total Dissolved Solids

Aim : To find out total dissolved solids of the given sample.

Principle : Total dissolved solids are determined as the residue left after evaporation and drying of the filtered sample.

Apparatus :

Evaporating dishes
Oven.
Desiccators
Whatman filter paper no. 44.
Water bath.

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 (w_1)
2. A 100ml of filtered sample is placed in the dish and evaporated at 100°C on water bath, followed by drying in oven at 103°C for 24 hour.

3 Dry to a constant weight at 103°C, cool in a desiccators and weigh (w5)

Result :

Total dissolved solids TDS in the given water sample is = 1400mg/L

Total suspended solids TSS in the given water sample is = 2000 mg/L.

Observation and Calculation

Sl. no	Volume, ml	Mass of Fe, mg(x)	Absorbance (y)
1	1	0.01	0.026
2	2	0.02	0.142
3	3	0.03	0.402
4	4	0.04	0.568
5	Sample		0.155

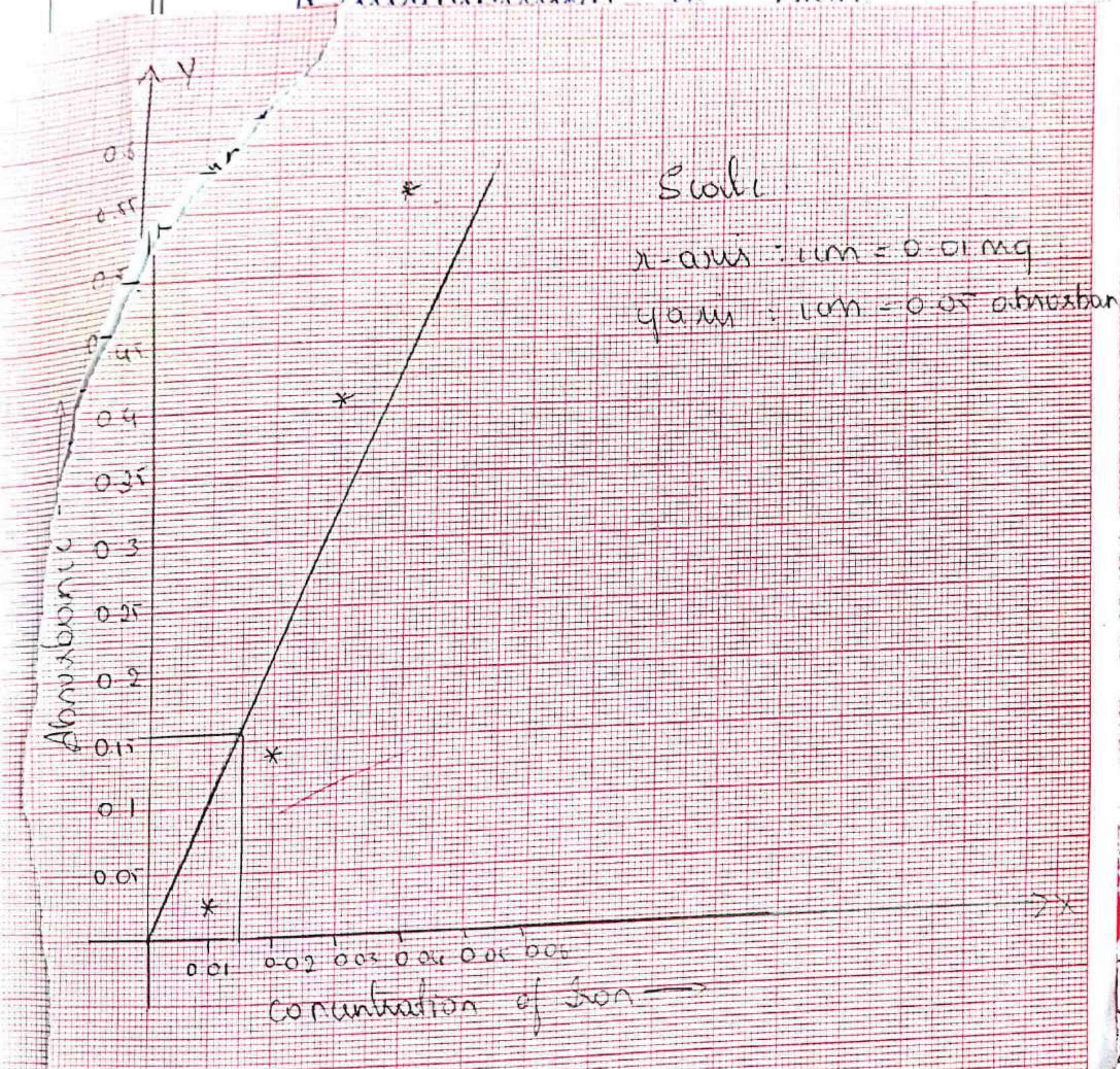
$$\text{Concentration of Iron (mg/L)} = \frac{\text{conc of Fe graph}}{\text{ml of sample}} \times 1000$$

$$= \frac{0.015}{50} \times 1000$$

$$= 0.38 \text{ mg/L.}$$

$$= 0.3 \text{ mg/L}$$

Determination of Iron



esent

reduced
acid
1, 10-
lecules
ous
nplex.
its
to a.
pid
in.
are

nts
noves
would
minate
ons of

strong oxidising reagents. In the presence of interfering metal ions, use a larger excess of phenanthroline to replace that complexes by the interfering metals.

Name of Experiment .... Date : 15/10/19

Experiment No. 8 Page No. 36

Determination of Iron

Aim: To determine the quality of iron present in the given sample.

Principle: Iron is brought into solution reduced to the ferrous state by boiling with acid and hydroxylamine and treated with 1, 10-phenanthroline at pH 3.2 to 3.3. Three molecules of Phenanthroline chelate each atom of ferrous iron to form an orange-red complex. The coloured solution obeys Beer's law; its intensity is independent of pH from 3 to 9. A pH between 2.9 and 3.5 insures rapid colour development in the presence of an excess of Phenanthroline. Colour standards are stable for at least 6 months.

The initial boiling with acid converts polyphosphates to orthophosphate and removes cyanide and nitrite that otherwise would interfere. Adding excess hydroxylamine eliminates errors caused by excessive concentrations of strong oxidising reagents. In the presence of interfering metal ions, use a larger excess of phenanthroline to replace that complexes by the interfering metals.

Where excessive concentrations of interfering metal ions are present, the extraction method may be used. Ashing may be carried out in silica, porcelain crucibles that have been boiled for several hours in 1+1 HCl. The presence of excessive amounts of organic matter may necessitate digestion before use of the extraction procedure.

Minimum detectable concentration : Dissolved or total concentrations of iron as low as 10μg/L can be determined with a spectrophotometer using cells with a 5cm or longer light path. Carry a blank through the entire procedure to allow for correction.

Apparatus : Nesslers tube, conical flask, pipette

Reagents :

Concentrated HCl.
Hydroxyl amine solution
Sodium acetate solution
Phenanthroline solution
Standard iron solution

Preparation of reagents :

Hydroxylamine HCl Solution
Stock Iron solution
Standard Iron solution

Ammonium Acetate Buffer :
Phenanthroline Solution

Procedure :

1. Take 0 1 2 3 4 and 5 ml of (0, 0.2, 0.4, 0.6, 0.8 and 1mg/L) Standard solution
2. Add 1ml of conc HCl and 1ml of Hydroxyl amine solution
3. Add a few glass beads and heat of boiling To insure dissolution of all the iron, continue boiling until volume is reduced to 15-20ml [If the sample is ashed, take up residue in 2mL conc HCl and 5ml water)
4. Cool to room temperature and transfer to a 50 or 100mL volumetric flask or Nessler's tube
5. Add 5ml of sodium acetate / Ammonium acetate solution and 2ml of phenanthroline solution indicator which imparts red colour with iron and dilute to 100ml mark with distilled water
6. Mix thoroughly and allow at least 10 to 15 min to maximum colour development.
7. Take 50ml of water sample in a conical flask. Follow the same procedure for sample for maximum color development.

8. Set the wavelength of calorimeter to 510nm and note down the absorbance
9. Find out the concentration of iron mg/L using standard graph.

Result :

The quantity of iron present in given sample is ~~[illegible]~~ 0.3 mg/L.

Comments :

According to BIS drinking water standards [IS 10500 -1983], the iron concentration should be 0.3 - 1 mg/L. The obtained result is 0.3mg/L which is safe for drinking under this parameter. Deficiency of iron causes anemia. When water with high levels of iron content flow through pipes, iron residue builds up inside them. This can cause pipes to clog up.

11/12

16/10/19

Calculations

Total settleable solids in the given sample is (ml/L).
3 ml/L of water for 1 hr detention period

Name of Experiment ....
Date : 1/10/19
Experiment No. 7 (d)
Page No 40

Total Settleable Solids

Aim : To find out total settleable solids of the given sample.

Principle : The particles in suspension whose specific gravity greater than that of water will settle under quiescent conditions.

Apparatus :

1. Imhoff cone.
2. Holding device

Procedure :

1 Gently fill the imhoff cone with the thoroughly well mixed sample usually one litre and allow it to settle

2 After 45 minutes, gently rotate the cone between hands to ensure that all solids adhering to the sides are loosened.

3 Allow the solids to settle for 15 minutes more to make up for a total period of 1 hour.

4 Read the volume of the sludge which has settled in the apex.

5. Express the result in ml settleable solids per litre of sample per hour.

08/12

14/10/19

Observations:

Sample details Jar no	Dosage of coagulant	Dosage of coagulant (mg/L)	Initial turbidity A (NTU)	Final turbidity B (NTU)	% Removal
1	1	10	164	91	43.71
2	1.5	15		69	57.92
3	2	20		61	60.97
4	2.5	25		54	67.07
5	3	30		55	66.46
6	3.5	35		62	62.19.

$$\% \text{ Removal} = \frac{(\text{Initial turbidity} - \text{Final turbidity})}{\text{Initial turbidity}} \times 100$$

1. $\% \text{ removal} = \frac{164-91}{164} \times 100 = 43.71\%.$

2. $\% \text{ removal} = \frac{164-6.9}{164} \times 100 = 57.92\%.$

3. $\% \text{ removal} = \frac{164-61}{164} \times 100 = 60.97\%.$

4. $\% \text{ removal} = \frac{164-54}{164} \times 100 = 67.07\%.$

5. $\% \text{ removal} = \frac{164-55}{164} \times 100 = 66.46\%.$

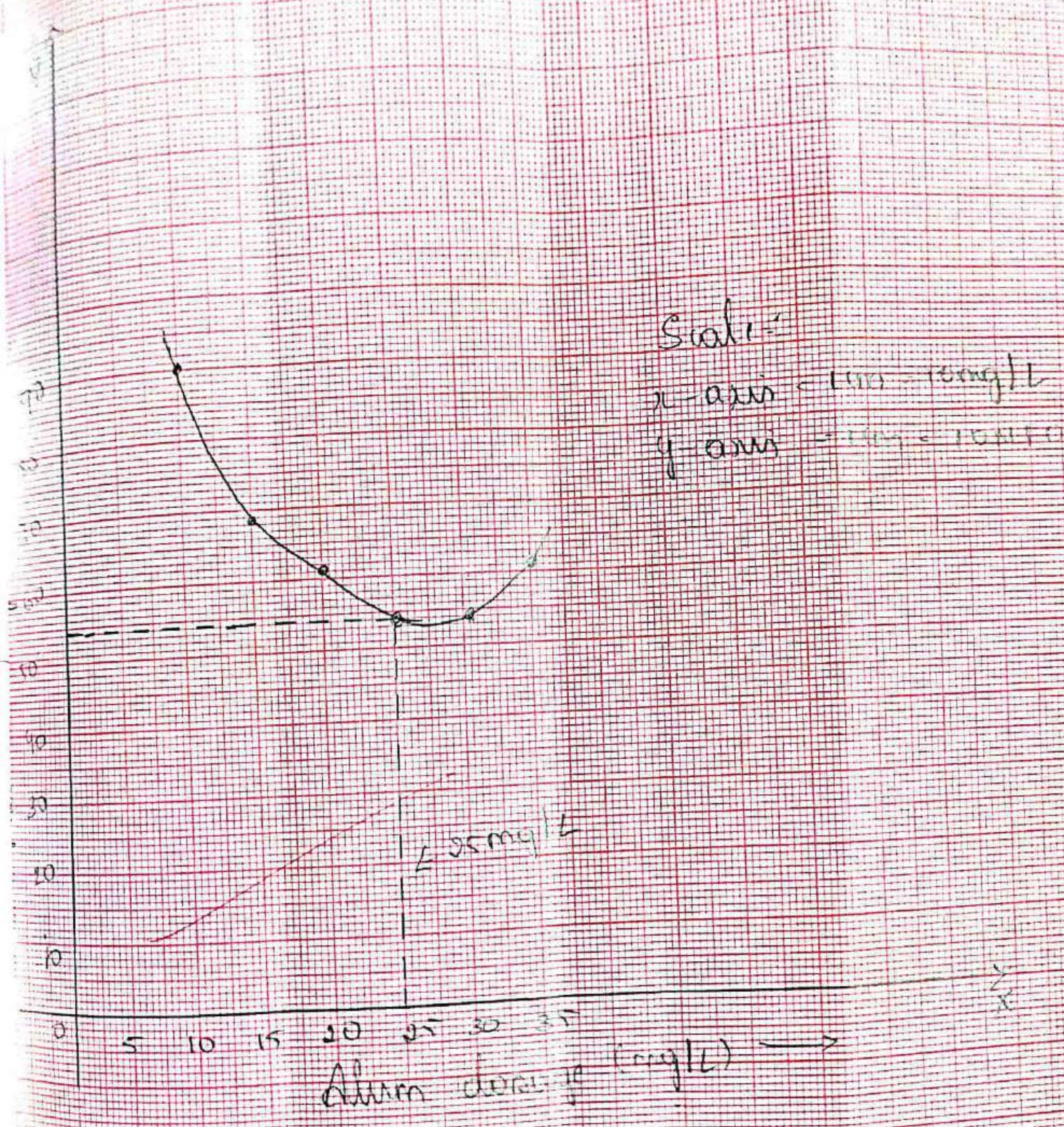
6. $\% \text{ removal} = \frac{164-62}{164} \times 100 = 62.19\%.$

lum

gulant

of the
oxides

good
d



t

concentration of 10g/L].

Name of Experiment ....

Experiment No. 9

Date : 22/10/19

Page No. 41

Determination of Optimum Dosage of Alum using Jar Test Apparatus.

JAR TEST APPARATUS

Aim : To find the optimum amount of coagulant required to treat the turbid water.

Principle : Metal salts hydrolyze in presence of the natural alkalinity to form metal hydroxides. The divalent cations can reduce the zeta-potential, while the metal hydroxides are good absorbents and hence remove the suspended particles by enmeshing them.

Apparatus:

1. Jar test apparatus
2. Beakers.
3. Pipettes
4. Turbidity meter
5. pH meter.

Reagents

Alum solution [$AgSO_4 \, 18H_2O$] [coagulant concentration of 10g/L]

Comments :

Alum is used for the purification of drinking water as a chemical flocculant. The concentration of alum depends on the water to be treated. However there should be optimum amount of alum to treat water, because excess dosage of alum may contribute excess aluminium is neurotoxin and less dosage of alum does not remove turbidity in water which increase loading on the filters

Therefore alum should be added in optimum dosage to prevent the above problems. Coagulation removes not only turbidity but also colour, micro-organism algae, taste & odour phosphates

Procedure :

1. Take 1 litre of sample into each of the 6 beakers.
2. Switch on the motor and adjust the speed of paddles 100 rpm.
3. Add varying doses of alum solution i.e., 1ml, 2ml, 3ml, 4ml or 6ml to different beakers simultaneously [The doses vary with turbidity in water sample].
4. Allow flash mix [at 100 rpm] for 1 minute
5. Reduce the speed paddles to 40 rpm and continue mixing for 10 minutes
6. Switch of the motors and allow 20 minutes for settling
7. Collect the supernatant without disturbing the sediment and find the turbidity of each.
8. Repeat the experiment with high doses of alum, if satisfactory result is not obtained
9. Plot the graph of final turbidity versus alum dosage and find out the ideal dose of the coagulant for excellent flock formation

11/12

Result : Optimum amount of coagulant to treat turbid water = 25 mg/L

Observation and Calculations

Sample details	Turbidity (NTU)
waste water	164.

Name of Experiment ....

Date : 22/10/19

Experiment No. 10

Page No. 43

Determination of Turbidity by Nephelometer

Aim : To find out turbidity of the given sample.

Principle : When light is passed through a sample having suspended particles some of the light is scattered by the particles. The scattering of light is generally proportional to turbidity. The turbidity of sample is thus measured from the amount of light scattered by the sample taking a reference with turbidity suspension

Apparatus

1. Nephelo - turbidity meter
2. Sample tube

Reagents

1. Hydrazine sulphate
2. Hexamethylenetetramine

Procedure

a Calibration

1 Switch the Nephelo - turbidity meter and allow for 10 - 15 minutes warm up

Comments :

According to BIS drinking water standard (IS10500-1983) the permissible limit of turbidity for drinking water is 10-25 NTU. The obtained result is 5NTU for drinking water and 164NTU for the waste water. The obtained turbidity for drinking water is less than the permissible limit which is safe for drinking under this parameter. In drinking water, turbidity can indicate the presence of high bacteria levels, pathogens or particles that can shelter harmful organism from disinfection process. Turbidity can be used as quality control to monitor efficient of treatment

Turbidity is caused by particle suspended in water that scatter light making water appear cloudy or murky. Particular matter can include sediment - clay, silt, fine organic, soluble and other microscopic organism.

Lesser turbidity water is more healthfull. higher turbidity can lead gastrointestinal disease, too many particle in water can be hazardous to health.

Reverse osmosis or ultrafiltration membrane techniques are used to remove turbidity

Set the calibration to max in clockwise

2. Fill the sample tube with distilled water and insert into cell holder and close the cap.

3. Adjust set zero control on the display

4. Remove the sample tube and replace the content of it by standard solution of appropriate range.

5. Adjust calibration control such that it displays the appropriate standard solution value.

b. Measurement of turbidity of the sample.

6. Remove the sample tube containing standard and wash with turbid free water and fill sample to be analyze and insert in sample chamber and note down the reading

7. If the value is out of range, dilute the sample with turbid free water and again read the turbidity

Result :

Turbidity of drinking water = 5 NTU

Turbidity of waste water (NTU) = 164 NTU

Determination of Sodium and Potassium using Flame Photometer

Sodium

Aim : To determine the sodium content in the given sample.

Apparatus : Photo cell, flame photometer with accessories.

Reagents :

Stock sodium solution : Dissolve 2.542 g dry sodium flouride in 1000ml distilled water

Working sodium solution dilute 10ml of stock solution to 1 litre.

Procedure

1. Follow manufacturers recommendation for selecting the proper photo cell and wave length appropriate fuel and air [589nm for Na] or oxygen pressure and the steps for warm up corrections for frame background igniting sample
2. Prepare a blank and sodium calibration standards of 0 to 10mg/L < for low concentration maximum 2 standards > and 0 to 100mg/L < for high concentration maximum 5 standard >

3. After entering the concentration values of series of prepared standards feed corresponding standards

4. Feed the sample of which concentration is to be determining after feeding reference solution < distilled water >

5. Note down the concentration value which is in mg/L

Result:

Sodium content in the given water sample is 22 mg/L

Potassium

Aim : To determine the potassium content in the given sample.

Apparatus : Photo cell, flame photo meter with accessories.

Reagents :

Stock potassium solution : Dissolve 1.907 of Pottasium Chloride (KCl) dry (110°C) 1ml = 1mg K.
Working potassium solution : Dilute 10ml of the stock solution to 1litre 1ml = 0.10mg K

Procedure :

1 Follow manufacture recommendation for selecting the proper photo cell and wavelength, appropriate fuel and air [wavelength 766.5 nm for K] vs oxygen pressure. and the steps for warm up correcting for frame background igniting sample.

2 Prepare a blank and potassium calibration standards of 0 to 100mg/L < for low concentration maximum of 9 standards > and 0 to 100mg/L < for high concentration maximum 5 standards

3 After entering the concentration values of series of prepared standards feed corresponding standards

4. Feed the sample of which concentration is to be determining after feeding reference solution

5. Note down the concentration value which is in mg/L.

Results :

Potassium content in the given water sample is 4.97mg/L

10/12

5/5

Calculation

Quantity of FAS added for blank = A ml.
Quantity of FAS added for sample = B ml.
Normality of FAS solution N =

$$COD = \frac{(A - B) * N * 8 * 1000}{ml \text{ of sample taken}}$$

Determination of COD - Demonstration

Chemical oxygen Demand - Demonstration

Aim : To find out chemical oxygen demand (COD) of given wastewater sample

Theory : Chemical oxygen demand (COD) test determines the oxygen requirements equivalent of organic matter that is susceptible to oxidation with the help of a strong chemical oxidant. It is important, rapidly measured parameters as a means of measuring organic strength for streams and polluted water bodies. The test can be related empirically to BOD, organic carbon or organic matter in samples from a specific source taking into accounts its limitations. COD results can be obtained in 3-4 hrs as compared to 3-5 days required for BOD test.

Principle : The organic matter present in sample gets oxidized completely by $K_2Cr_2O_7$ in the presence of H_2SO_4 to produce CO_2 and H_2O. The excess $K_2Cr_2O_7$ remaining after the reaction is treated with $Fe(NH_4)_2(SO_4)_2$. The dichromate consumed gives is oxygen required to oxidation of the organic matter.

Name of Experiment .... Date : 5/11/19

Experiment No. ....

Apparatus

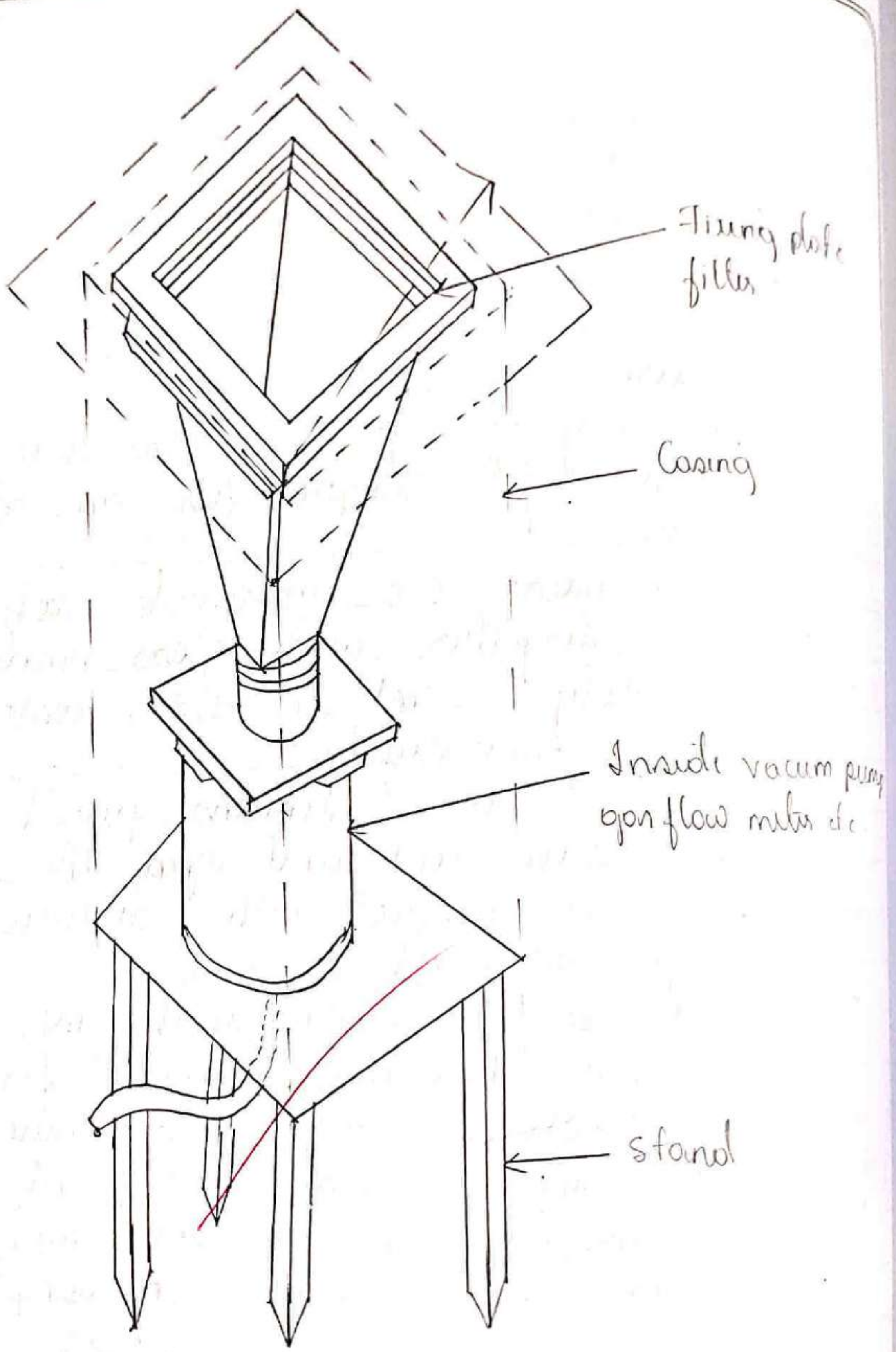
1. Autoclave.
2. BOD bottle
3. burette

Procedure:

1. Place 0.4 g of $HgSO_4$ in the BOD bottle
2. Add 2ml of sample for an aliquot diluted to 20ml.
3. 10 ml of more conc dichromate solution are added together with glass beads
4. Add slowly 30ml of H_2SO_4 containing Ag_2SO_4 and mix thoroughly.
5. Reflux for a minimum period of 2 hours in autoclave cool and open the autoclave.
6. Dilute the sample with distilled water to make up to 140ml and cool.
7. Titrate excess $K_2Cr_2O_7$ with 0.1N ferrous ammonium sulfate, $Fe(NH_4)_2SO_4$ using ferroin indicator sharp colour changes from blue green to wine red indicates the end point
8. Reflux the blank in the same manner using distilled water instead of sample.

10/10

12/11/19


Fixing plate filter
Casing
Inside vacum pump
gas flow meter etc
Stand

Air Quality Monitoring Determination [Ambient, stack monitoring, Indoor Air) - Determination Demonstration

Aim: To determine the ambient air quality monitoring using high volume air sample unit

Theory: The high volume air samples is a popular and frequently used equipment for the determination of suspended particulate matter [SPM) in air. The principle involved in this method is that the particles are filled from known volume of an air sample by a section apparatus [a vaccum pump] and the particles are made to deposit on a porous filter paper. The commonly used high volume sample.

Procedure:

1. The filter plate provides the base for sitting the filter paper of size 200mmx250mm through which air sample is collected by creating section in the filter area
2. This section is created by a vaccum pump with a flow rate of 25Lpm. These conditions will permits the sampling of ambient air for a period of 8h.

Calculation of the result:

$$C = \frac{W_1 - W_t}{V} \times 10^6 .$$

where,

C = concentration of suspended particulate matter (SPM) in micrograms per cubic meter.

W_1 = weight of filter paper before sampling, or Initial mass of filter g.

W_t = weight of filter paper after sampling, g

V = volume of air sampled in cubic meter at STP = $\left(\frac{Q_1 + Q_t}{2}\right) * t$.

3. The suspended particles of size less than 10 microns and greater than 3 microns are retained on the filter.

4. The duration of sampling is measured in an elapsed time meter which is placed in series with the blower.

5. A rotameter or a manometer is provided to measure the volume of air passed through the filter. Generally 'Whatman make' filter papers are widely used.

6. The concentration of the pollutants is expressed as micrograms per cubic meter which is calculated from the observed data as given below.

10/12

18/11

Name of Experiment .... Date: 19/11/19

Experiment No. ....

Determination of Sound by Sound level meter at different location - Demonstration

Sound Level Meter - Demonstration

Aim: Determination of noise at different sources using sound meter

Theory: Noise level measurement procedure are processes which are followed while monitoring sound level or acoustic energy levels have started to become a major threat to public health. Noise in simple terms can be defined as unwanted or unpleasant sound which disturbs the environment and has a significant impact on the quality of life. We significant impact on the quality of life. We all very well known how exposure to high noise level can result in hearing impairment, headache.

Noise level measurement procedure:

*. Must be check the battery full before goes onside monitoring.

*. Switch ON of equipment and wait for one minute

*. SLM has two modes of operation selection via the menu key

Fiild data sheet of Noise monitoring sampling

Client name :
Address :

Details of sample collection

Sampling instrument
Date of sampling
Sampling Done by.

Noise monitoring results.

Sl No	Sample location name	unit	observed value.

- Two mode: (1) In continuous mode (2) In recording mode (3) In continuous mode: for only onsite observation
- In recording mode: For recording the data in sound level meter.
- Select the appropriate mode of sound level.
- Set the slow or fast time as per site condition
  Slow time is applicable for normal measurement
  Fast time is applicable for specific measurement of those like moving train.
- Adequate distance (1-3m) maintain between source and equipment.
- Take reading for at least one minute at on location
- When we change the location, off the machine and again switch ON of equipment!!

Place of the Instrument:

Many factors need to be taken into account when measuring because sound levels vary at different heights above ground level. They will also vary depending on the distance b/w the measurement point and facades and obstacles. These are some important factors for doing monitoring

a. Away from facades.
b Away from obstacles
c. With the microphone 1.2 - 1.5 meter above ground level

Area code	category of area/zone	limits in bd(A)	
		Day time	Night tim
A	Industrial area.	75	70
B	commercial area.	65	55
C	residential area.	55	45
D	sicence zone.	50	40

d. Monitoring inside industrial facility distance from source shall be 1.5 meters

Monitoring locations:

The locations for monitoring to assess the ambient noise levels shall be mix up of all zones i.e. Residential, commercial and industrial to find the variation with different zones. The monitoring schedule carried out on working days and weekend to differentiate the noise levels between normal days to weekend days. The sampling locations should be sufficient enough provide representative samples for the project.

Comparison with noise standards

Once we get the monitoring records then we can compare them with standards to understand if noise levels are exceeding the standards and if they are then by how much. In India, the standards extensively used are prescribed by central pollution control Board (CPCB).

10/10

BGS INSTITUTE OF TECHNOLOGY

BG Nagara – 571 448 (Bellur Cross), Bengaluru – Hassan National
Highway (NH-48), Nagamangala Taluk, Mandya District,
Karnataka State, INDIA. **Phone:** 08234 – 288418
Fax: 08234 – 288419 **Email:** principalbgsit@rediffmail.com

||Jai Sri Gurudev||

BGS Institute of Technology

BG Nagara - 571448, Nagamangala Taluk, Mandya District, Karnataka.

Department of Civil Engineering

E-mail: hodcv@bgsit.ac.in, Website: www.bgsit.ac.in

Subject Name- Environmental Engineering Lab
Subject Code- 15CVL77
Faculty Name- Shruthi R

Semester: VII
Academic Year: 2019-20

Course Outcomes:

The students will be able to

1. Conduct experiments, interpret and analyze data, and report results.
2. Determine physical, chemical and characteristics of water and wastewater.
3. Determine degree of treatment achieved by various treatment units for water and waste water.
4. Have knowledge of water and wastewater characteristics and their suitability for treatment or disposal.
5. Have knowledge of Noise level and Air quality determination method and its importance.

CO Attainment

CO	**CO 1**	**CO 2**	**CO 3**	**CO 4**	**CO 5**
Attainment	2.64	2.66	2.68	2.63	2.67
Percentage (%)	88.0	88.7	89.3	87.7	89.0
Target (%)	**70**				
Faculty Comments	It is observed that all the CO attainment values have met the target level.				
Remarks by HOD	CO Adviced to maintain the Consistency.				

Sign of Staff in charge

Sign of HOD

Head, Dept of Civil Engg,
B G S Institute of Technology,
B G Nagara - 571448