15.0 EXPERIMENT ON DETERMINATION OF TOTAL DISSOLVED AND SUSPENDED SOLIDS IN WATER

15.0 EXPERIMENT ON DETERMINATION OF TOTAL DISSOLVED AND SUSPENDED SOLIDS IN WATER

PREAMBLE:

"**How to determine total dissolved and suspended solids in Water and Wastewater**".

Test procedure is in accordance to IS: 3025 (Part 16 & Part 17).

In addition to our Indian Standard, we also discuss in brief regarding the procedure stated in

(1) APHA Standard Methods for the Examination of Water and Wastewater - 20th Edition. Method 2540 C and 2540 D.

(2) Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, USEPA, Method 160.1.

15.1 AIM

To determine total dissolved and suspended solids in the given water sample with the stipulations as per **IS: 3025 (Part 16 & Part 17).**

15.2 INTRODUCTION

The term total dissolved solids refer to materials that are completely dissolved in water. These solids are filterable in nature. It is defined as residue upon evaporation of filterable sample. The term total suspended solids can be referred to materials which are not dissolved in water and are non filterable in nature. It is defined as residue upon evaporation of non filterable sample on a filter paper.

15.2.1 ENVIRONMENTAL SIGNIFICANCE

- Dissolved minerals, gases and organic constituents may produce aesthetically displeasing colour, taste and odour.
- Some dissolved organic chemicals may deplete the dissolved oxygen in the receiving waters and some may be inert to biological oxidation, yet others have been identified as carcinogens.
- Water with higher solids content often has a laxative and sometimes the reverse effect upon people whose bodies are not adjusted to them.
- High concentration of dissolved solids about 3000 mg/L may also produce distress in livestock. In industries, the use of water with high amount of

dissolved solids may lead to scaling in boilers, corrosion and degraded quality of the product.

- Estimation of total dissolved solids is useful to determine whether the water is suitable for drinking purpose, agriculture and industrial purpose.
- Suspended material is aesthetically displeasing and provides adsorption sites for chemical and biological agents.
- Suspended organic solids which are degraded anaerobically may release obnoxious odours.
- Biologically active suspended solids may include disease causing organisms as well as organisms such as toxic producing strains of algae.
- The suspended solids parameter is used to measure the quality of wastewater influent and effluent.
- Suspended solids determination is extremely valuable in the analysis of polluted waters.
- Suspended solids exclude light, thus reducing the growth of oxygen producing plants.

15.3 PRINCIPLE

A well mixed sample is filtered through a standard glass fiber filter, and the filtrate is evaporated to dryness in a weighed dish and dried to constant weight at 179-181°C. The increase in dish weight represents the total dissolved solids.

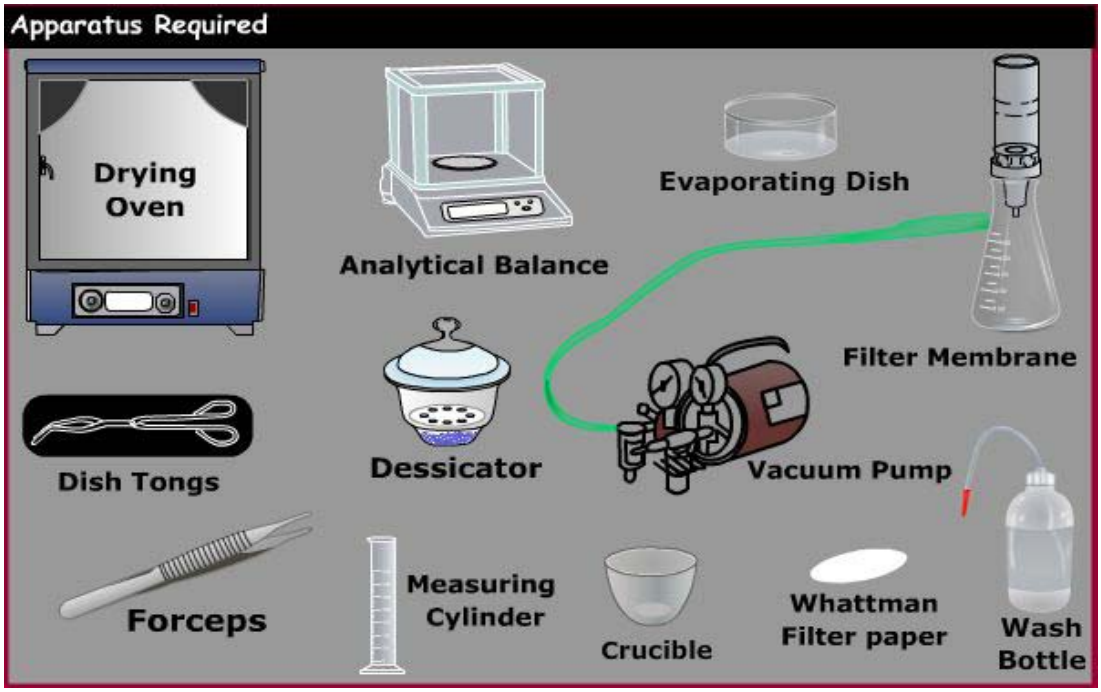
A well mixed sample is filtered through a weighed standard glass fiber filter and the residue retained on the filter is dried to a constant weight at 103-105°C. The increase n weight of the filter represents the total suspended solids. If the suspended material clogs the filter and prolongs filtration, the difference between the total solids and total dissolved solids may provide an estimate of the total suspended solids.

15.4 MATERIALS REQUIRED

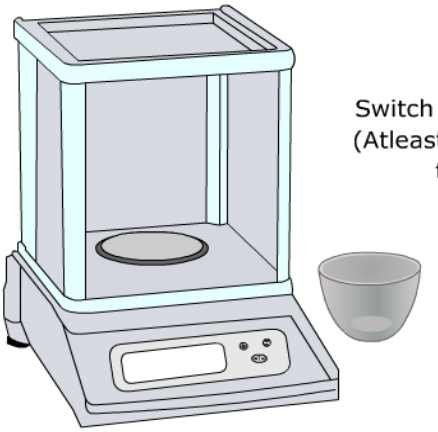
15.4.1 APPARATUS REQUIRED

1. Evaporating Dish
2. Water Bath
3. Oven
4. Desiccators
5. Analytical Balance

6. Graduated Cylinders
7. Dish Tongs
8. Gooch Crucibles
9. Filter
10. Vacuum Pumps
11. Crucible tongs
12. Forceps, Smooth -tipped



PROCEDURE CHART

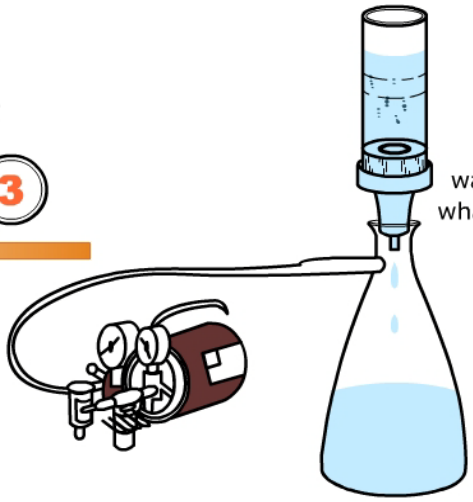


Switch on the balance (Atleast 30 min before the test)

1

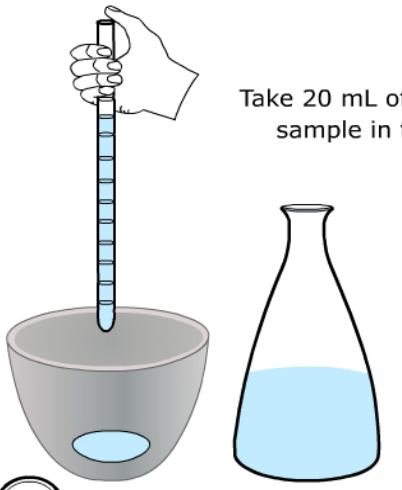
Note down the intial dry weight of the crucible

2



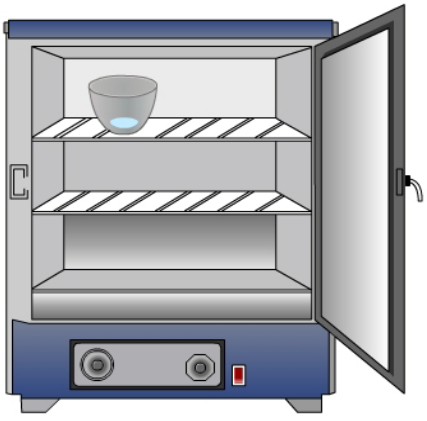
Filter the field water sample using whattman filter paper

3



Take 20 mL of filtered water sample in the crucible

4



Place the crucible inside the oven at 103^{0}C

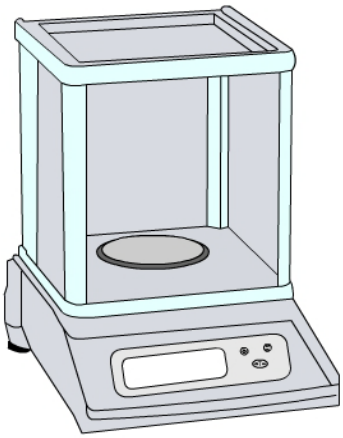
5

After drying in the oven cool to room temperature in dessicator

6

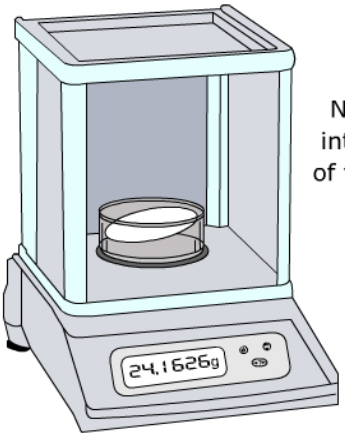
Note down the final dry weight of the crucible

PROCEDURE CHART



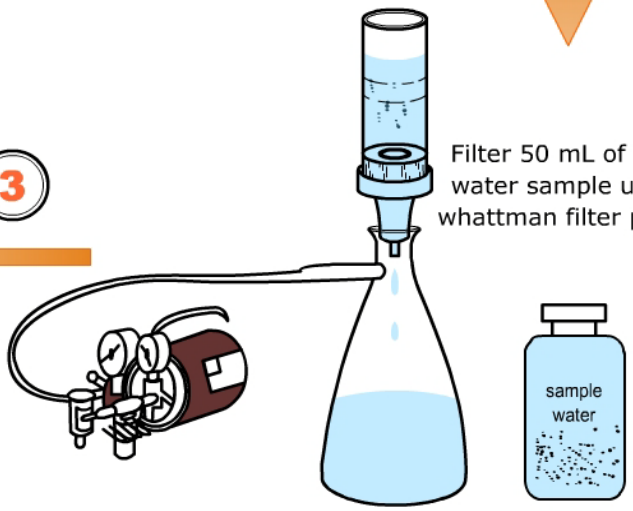
Switch on the balance (Atleast 30 min before the test)

1



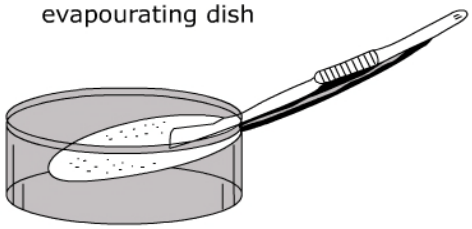
Note down the intial dry weight of the filter paper

2



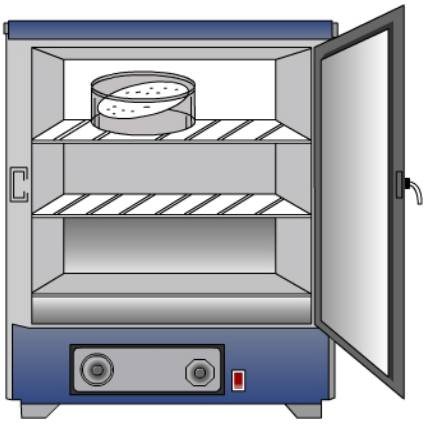
Filter 50 mL of field water sample using whattman filter paper

3



Take the filter paper and place it on the evapourating dish

4

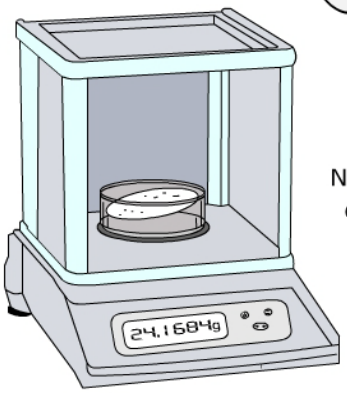


Place the evapourating dish inside the oven at 103^{0}C

5

After drying in the oven cool to room temperature in dessicator

6



Note down the final dry weight of the filter paper

15.5 SAMPLE HANDLING AND PRESERVATION

Preservation of sample is not practical. Because biological activity will continue after a sample has been taken, changes may occur during handling and storage.

Both the characteristics and the amount of solids may change.

To reduce this change in samples taken for solids determinations, keep all samples at 4^0 C.

Do not allow samples to freeze.

Analysis should begin as soon as possible.

15.5.1 PRECAUTIONS

The following precautions should be observed while performing the experiment:

- Water or Wastewater samples which contain high concentrations of calcium, chloride, magnesium or sulfate can rapidly absorb moisture from the air.
- Such samples may need to be dried for a longer period of time, cooled under proper desiccation and weighed rapidly in order to achieve a reasonable constant weight.
- We should be aware prolonged drying may result in loss of constituents, particularly nitrates and chlorides.
- Volume of sample should be adjusted to have residue left after drying as 100 to 200mg. It is mainly to prevent large amount of residue in entrapping water during evaporation.
- Samples with high concentrations or bicarbonate require additional drying at 180ºC to ensure that all of the bicarbonate is converted to carbonate.

15.6 PROCEDURE

15.6.1. TESTING OF SAMPLE FOR TOTAL DISSOLVED SOLIDS

To measure total dissolved solids, take a clean porcelain dish which has been washed and dried in a hot air oven at 180(C for one hour.

- Now weigh the empty evaporating dish in analytical balance. Let’s denote the weight measured as W1 = 35.4329 g.
- Mix sample well and pour into a funnel with filter paper. Filter approximately 80 -100 mL of sample.

- Using pipette transfer 75mL of unfiltered sample in the porcelain dish.
- Switch on the oven and allowed to reach 105°C. Check and regulate oven and furnace temperatures frequently to maintain the desired temperature range.
- Place it in the hot air oven and care should be taken to prevent splattering of sample during evaporation or boiling.
- Dry the sample to get constant mass. Drying for long duration usually 1 to 2 hours is done to eliminate necessity of checking for constant mass.
- Cool the container in a desiccator. Desiccators are designed to provide an environment of standard dryness. This is maintained by the desiccant found inside. Don't leave the lid off for prolonged periods or the desiccant will soon be exhausted. Keep desiccator cover greased with the appropriate type of lubricant in order to seal the desiccator and prevent moisture from entering the desiccator as the test glassware cools.
- We should weigh the dish as soon as it has cooled to avoid absorption of moisture due to its hygroscopic nature. Samples need to be measured accurately, weighed carefully, and dried and cooled completely.
- Note the weight with residue as W_2 = 35.4498 g.

15.6.2 TESTING OF SAMPLE FOR TOTAL SUSPENDED SOLIDS

- Place filtration apparatus with weighed filter in filter flask.
- Mix sample well and pour into a graduated cylinder to the selected volume.
- Apply suction to filter flask and seat filter with a small amount of distilled water.
- Pour selected volume into filtration apparatus.
- Draw sample through filter into filter flask.
- Rinse graduated cylinder into filtration apparatus with three successive 10 mL portions of distilled water, allowing complete drainage between each rinsing.
- Continue suction for three minutes after filtration of final rinse is completed.
- Dry filter in an oven at 103-105°C for at least 1 hour.

- Cool filter in desiccator to room temperature.
- When cool, weigh the filter and support.

15.7 CALCULATION

15.7.1 TABLE

Total Dissolved Solids

Description		Weight (g)
Weight of the clean porcelain evaporating dish (g)	W1	
Weight of the dish and the residue (g)	W2	
Weight of residue(g)	W	
Volume of the Sample (mL)	V	
Total Dissolved Solids (mg/L)	**TDS**	

Tabulation for Total Dissolved Solids (TDS):

Weight of the clean porcelain evaporating dish (g) W_1 =35.4329

Weight of the dish and the residue (g) W_2 =35.4498

Weight of residue (g) W =0.0169

The volume of the sample (mL) V = 50.0

Total Suspended Solids

Description		Weight (g)
Weight of the clean filter paper (g)	W_1	
Weight of the filter paper and the residue (g)	W_2	
Weight of residue(g)	W	
Volume of the Sample (mL)	V	
Total Suspended Solids (mg/L)	**TSS**	

Tabulation for Total Suspended Solids (TSS)

Weight of the clean filter paper (g) W_1 =1.6329

Weight of the clean filter paper and the residue (g) W_2 =1.6531

Weight of residue (g) W =0.0202

Volume of the sample (mL) V = 100.0

15.7.2 DATA SHEET

DETERMINATION OF TOTAL DISSOLVED SOLIDS
DATA SHEET

Date Tested : August 30, 2010

Tested By : CEM Class, Group A

Project Name : CEM, NITTTR Lab

Sample Number : BH1

Sample Location : Perungudi (Lat 12' 57'' 31.74 & Long 80'14'' 8.82)

Sample Description : Surface water

Description		Weight (g)
Weight of the clean porcelain evaporating dish (g)	W_1	35.4329
Weight of the dish and the residue (g)	W_2	35.4498
Weight of residue(g)	W	0.0169
Volume of the Sample (mL)	V	50. 0
Total Dissolved Solids (mg/L)	**TDS**	**338.0**

Model Calculation:

W_1 = 35. 4329 g

W_2 = 35. 4498 g

V = 50. 0 mL

Weight of residue (g) W = $W_2 - W_1$
= 35. 4498 - 35. 4329
= 0. 0169 g

Weight of residue in mg (To convert W (g) to W (mg), multiply W (g) with 1000)

W (mg) = 0.0169 x 1000
= 16.9mg

Multiply the weight of the dry solids (in mg) by 1,000 mL/L to convert the sample size from mL to L.

Total Dissolved Solids (mg/L)

V = Volume of the sample (mL) (To convert mL to L, multiply by 1000)

=16.9 mg/50 mL = 0.338 mg/mL

= 0.338 mg/mL x 1,000 mL/L = **338 mg/L**

DETERMINATION OF TOTAL SUSPENDED SOLIDS
DATA SHEET

Date Tested : August 30, 2010

Tested By : CEM Class, Group A

Project Name : CEM, NITTTR Lab

Sample Number : BH1

Sample Location : Perungudi (Lat 12' 57'' 31.74 & Long 80'14'' 8.82)

Sample Description : Surface water

Description		Weight (g)
Weight of the clean filter paper (g)	W_1	1.6329
Weight of the filter paper and the residue (g)	W_2	1.6531
Weight of residue(g)	W	0.0202
Volume of the Sample (mL)	V	100. 0
Total Suspended Solids (mg/L)	**TDS**	**202.0**

Model Calculation:

W_1 = 1.6329g

W_2 = 1.6531g

V = 100.0 mL

Weight of residue (g) W = $W_2 - W_1$

= 1.6531 - 1.6329

= 0. 0202 g

Weight of residue in mg (To convert W (g) to W (mg), multiply W (g) with 1000)

W (mg) = 0.0202 x 1000

= 20.2 mg

Multiply the weight of the dry solids (in mg) by 1,000 mL/L to convert the sample size from mL to L.

Total Suspended Solids (mg/L)

V = Volume of the sample (mL) (To convert mL to L, multiply by 1000)

=20.2 mg/100 mL = 0.202 mg/mL

= 0.202 mg/mL x 1,000 mL/L = **202 mg/L**

15.8 INTERPRETATION OF RESULTS

In the given sample, total dissolved solid is to **338 mg/L** and total suspended solid is to **202 mg/L.**

15.9 INFERENCE

Water can be classified by the amount of TDS per litre:

- fresh water < 1500 mg/L TDS
- brackish water 1500 to 5000 mg/L TDS
- saline water > 5000 mg/L TDS

The following charts give some common ranges for TSS results and possible removal efficiencies for various types of treatment.

Sample	Common Ranges, mg/L	
Influent	Weak < 150	400+ Strong
Primary Effluent	Weak <60	150+ Strong
Secondary Effluent	Good 10 -	60+ Bad
Tertiary Effluent	Less than 3	
Activated Sludge		
Mixed Liquor (MLSS)	1,000 - 5,000	
Return or waste sludge	2,000 - 12,000	
Digester Supernatent	3,000 - 10,000	
Sludge	20,000 - 60,000	

15.10 EVALUATION

1. The pore size of the filter paper used for filtration is

    a) 2.0µm or smaller
    b) 2.0µm or bigger
    c) 2.0µm
    d) 20.0µm

2. The type of crucible used for the experiment is made of _____.

a) Porcelain
b) Clay
c) Silver
d) Iron

3. Total Suspended Solids are mostly responsible for

a) Turbidity.
b) colour
c) Odour
d) Taste

4. The chemical substance used in the desiccators is _____.

a) Calcium Chloride
b) Calcium Carbonate
c) Sodium Chloride
d) Sodium Hydroxide

5. Always the Total Suspended Solids value will be

a) Less than Total Dissolved Solids
b) Greater than Total Dissolved Solids
c) Less than Total Solids
d) Greater than Total Solids

6. High total dissolved solids indicates lower level of hardness.

a) True
b) False

7. The concentration of dissolved solids in water can be determined by specific conductance.

a) True
b) False

8. The settleable suspended solids with diameter 0.15 to 0.2mm are generally

a) inorganic
b) Organic
c) algae
d) fungi

9. The dissolved solids that impose BOD are _____.

a) volatile solids
b) non volatile solids
c) inorganic solids
d) total solids

10. As per IS Code the acceptable TDS value is

a) 250 ppm
b) 500 ppm
c) 750 ppm
d) 900 ppm

KEY TO ITEMS:

1) a
2) a
3) a
4) a
5) c
6) False
7) True
8) a
9) a
10) b