

ToppersNotes

IES/GATE
CIVIL ENGINEERING

ENVIRONMENTAL

VOLUME-I

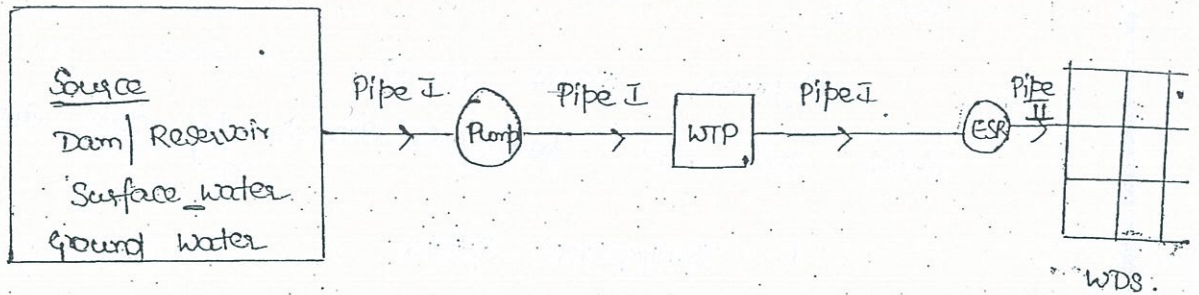
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Toppersnotes

Water supply engineering



WTP - Water Treatment Plant

ESR - Elevated Service Reservoir

WDS - Water Distribution System

Qualities of Raw Water:-

The parameters which help in ascertaining qualities and properties of Raw water are termed as water quality Parameters. They include

1. Physical water Quality Parameters
2. chemical water Quality Parameters and
3. Biological water Quality Parameters.

Toppersnotes

1. Physical water Quality Parameters:-

The parameters which help in ascertaining physical qualities of water are termed as Physical water Quality Parameters.

Physical water quality parameters are those which can be felt (or) sensed by our senses.

1. Suspended solids

2. Turbidity

3. colour

4. Taste and odour

5. Temperature

1. Suspended Solids:-

It is a physical water quality parameter while dissolved solids is a chemical water quality parameter.

Suspended solids in water may come from inorganic particles like clay, silt, sand, glass etc.

It may come from organic particles like plant fibres, algae, plankton etc. (or) it may be induced

in the water due to immiscible liquids

like oil and grease.

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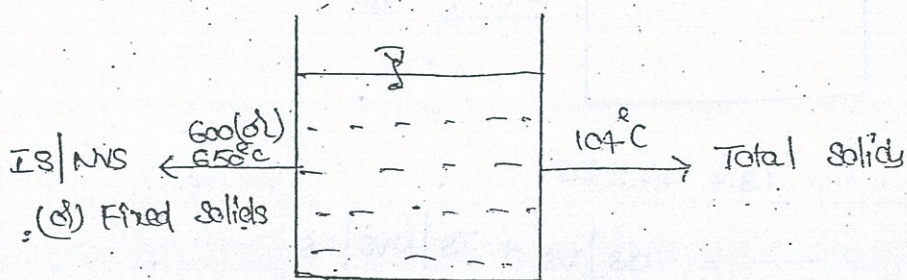
Note:- organic solids are biologically degradable but inorganic solids are not degradable.

Impacts of Suspended Solids:-

1. It has a psychological effect and make the water aesthetically displeasing.
2. If suspended solids are biologically active (organic) they may form disease causing organics.
3. Suspended solids provide adsorption sites for chemical and biological reagents thereby interferes with the further treatment of water.
4. It partially shields the micro-organisms present in water thereby reduces efficiency of disinfection.

Measurement of Suspended Solids:-

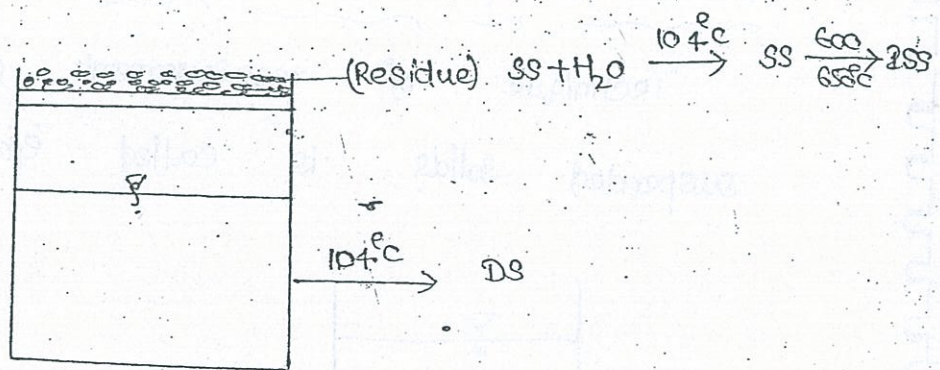
Technique of measurement of weight of suspended solids is called gravimetric method.



Toppersnotes

1. Total Solids can be obtained by evaporating the raw water sample at 104°C .
2. Suspended Solids can be obtained by heating the residue left over the filter (when the raw water sample is filtered) at 104°C .
3. Organic Solids can be obtained (both total & in suspended form) by filtering heating the original water sample at 600 to 650°C and filtered residue to 600 to 650°C respectively.

At this temperature, all the organic solids in water are converted into water vapours and CO_2 leaving behind the inorganic solids (Fixed Solids).



$$TS = SS + DS$$

$$= OS | VS + IS | NVS | FS$$

$$OS = TS - IS$$

$$OSS = SS - 2SS$$

Toppersnotes

DS - Dissolved Solids

SS - Suspended Solids

TS - Total Solids

OS - Organic Solids

OSS - Organic Suspended Solids

NVS - Non-volatile Solids

ISS = Inorganic Suspended Solids

$$DS = TS - SS$$

Note:-

In some cases suspended solids smaller than the size of filter pores get measured as dissolved solids. To avoid this, classification of solids is done as filterable & non-filterable solids.

Filterable Solids \rightarrow Dissolved Solids

Non-Filterable Solids \rightarrow Suspended Solids

Permissible Limits:-

For Total Solids acceptable limit = 500 mg/l

Caution for Rejection = 2000 mg/l

2. Turbidity:-

It is the measure of extent to which light is either absorbed (a) scattered by water sample.

Turbidity is due to the presence of SS in water but it is not the direct

quantitative measure of SS.

More SS \Rightarrow More Turbidity.

Impacts of Turbidity:-

All impacts due to SS are applicable here.

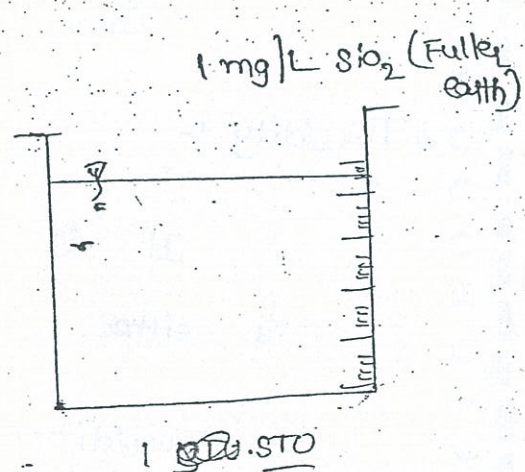
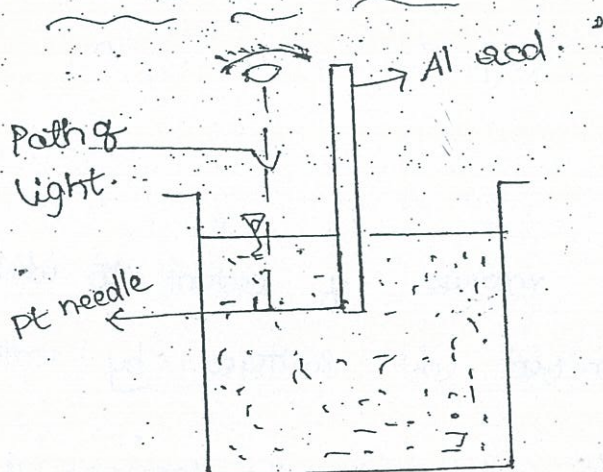
- The turbidity of water interferes with penetration of sunlight in natural water body these by affects photosynthesis which in turn inhibits the growth of aquatic life.

Measurement of Turbidity:-

The first method to determine turbidity

is Turbidity - Rod method.

1. Turbidity Rod Method:-



- It is field method in which Al rod having

2. Pt. needle or

sample whose turbidity is to be calculated.

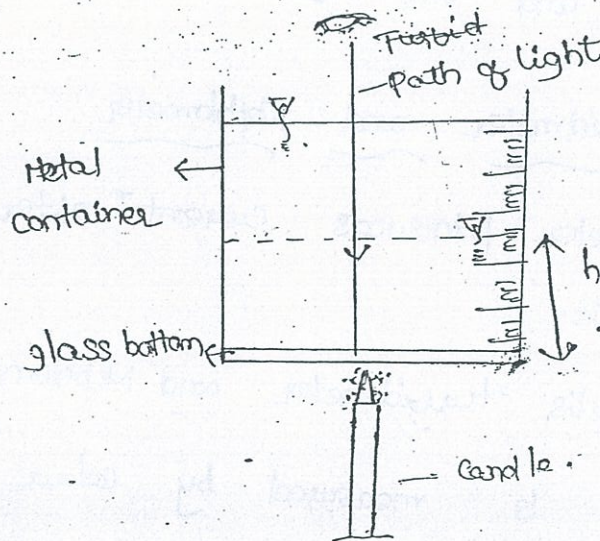
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2. The depth of immersion of rod at which pt. needle just becomes invisible is noted & it gives the turbidity of the water sample in standard unit which is obtained by addition of 1 mg of silica in powdered form as sludge in 1 litre of water (pure). This unit is ppm or mg/l or STU (Silica Turbidity Unit).

Note:- Turbidity greater than 5 units is easily detectable by naked eye.

2. Jackson Turbidimeter:-

J.T.U.:- Jackson Turbidity Unit.



(1). It's laboratory test which can measure the turbidity greater than 85 units. Hence it is generally not used for testing of water supplies but normally used for testing of natural water bodies.

(2). In this test level of water is increased in metallic container having glass bottom placed over ignited flame and the depth of water at which flame ceases to be seen is noted to give turbidity of water sample in standard units.

Note:-

In both the above tests, principle involved in the turbidity measurement is same i.e; longer is the length of path travelled by light, smaller is turbidity and vice-versa.

3. Boylis Turbidimeter and Nephelometer:

photometer produces current after incidence of light over it.

(1). In Boylis turbidimeter and Nephelometer method turbidity is measured by colour matching technique.

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- (ii). In these methods small turbidity (< 1 unit) can also be measured. Hence these methods are readily used for testing of water supplies.
- (iii). In this method colour produced in the test and standard sample due to their subjection to source of light is noted. If colour produced in the test sample is same as that of standard sample, then Turbidity of test sample is same as that of standard sample.
- (iv). To improve the efficiency of test, the intensity of current is noted instead of intensity of colour by photometer behind the samples.
- (v). In Boyl's turbidimeter light intensity is measured in the direction of incidence of light whereas it is measured at right angle to the direction of incidence of light in Nephelometer. Hence the nephelometer is based on scattering principle and Boyl's turbidimeter is based on absorption of light.

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(vi) In Nephelometer turbidity is expressed in a standard unit which is obtained by adding 1mg of Formazine (Hexamethylene tetramine) as base instead of silica oxide in one litre of pure water.

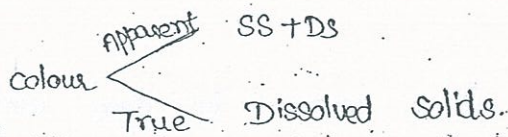
NTU — Nephelometer Turbidity Unit.

There is no relation between NTU and JTU.

Permissible limits:-

Acceptable limit for Turbidity — 1 NTU.

Causes for Rejection is — 10 NTU.



Colour is due to organic matter.

When chlorine and colour are present in water, chlorine is an oxidising agent & colour is due to O.M. So, chlorine oxidises O.M. and the purpose of addition of chlorine is for disinfection. Instead of disinfection, oxidation of O.M. occurs.

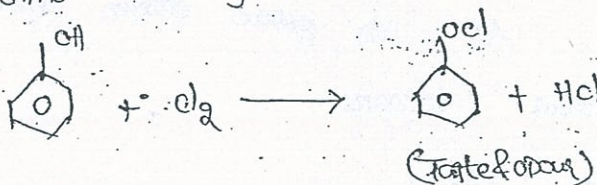
Impacts of colour:-

* Coloured water can't be used for washing & dyeing of clothes.

* Colour causing compound increases the demand of chlorine in water. Hence reduces the effectiveness of chlorination. Chlorine is a strong oxidising agent. Hence carried out the oxidation of O.M., that causes colour in water.

* Certain colour causing organic compound reacts with chlorine to form carcinogenics.

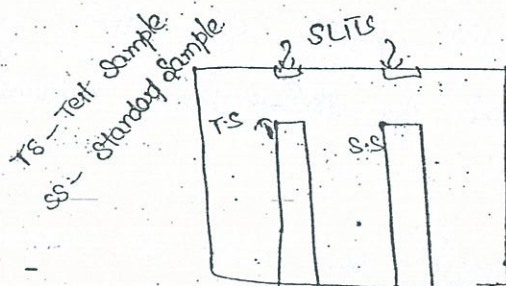
* Certain colour causing organic compounds like phenol reacts with chlorine to give taste and odour in water.



Measurement of colour:-

* Measurement of colour in water is done using colour matching technique with the help ofessler tubes in Tintometer.

Turbidity also analysed by colour matching technique
(Test sample is compared with standard sample)



Intensity of colour of TS is matched with SS.

The intensity of colour is represented in terms of standard unit T.C.U (True colour unit) which is obtained by addition of Pt in the form of chloroplatinate ion in 1 litre of pure water.

If 5 mg of Pt in form chloroplatinate ion in 1 litre of pure water, the intensity of colour is 5 TCU.

This method is used if the colour of water is yellowish in nature.

As ~~at~~ yellow colour chloroplatinate is, yellowish colour increases.

other colour

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Testing of water for colour should be done within 72 hours of collection.

colour may be due to SS, DS, organic & inorganic.

If colour is due to SS, if water is stored for more than 72 hours, SS settle down due to sedimentation and colour changes. Hence testing should be done within 72 hours.

If colour is due to OH, micro-organisms (bacteria) (in 72 hours) change the colour.

Acceptable limits for colour is 5 TCU

Cause for Rejection - 25 TCU.

Taste And odour:-

Source:-

- Organic matter.

- Inorganic particles like salts (Na, K etc)

- Hydrogen Sulphide (H_2S) or Dissolved gases CH_4 , CO_2 , NH_3 etc.
(End products of decomposition of OH).

* Taste & odour in water is (may be) present due to inorganic mineral salts like Na, Ca, K etc.

* It may also be due to the presence of dissolved OH. Algae releases certain type of oils that give bad taste and odour. (b) It may also be due to the presence of dissolved gases like H_2S , CO_2 , CH_4 , NH_3 etc.

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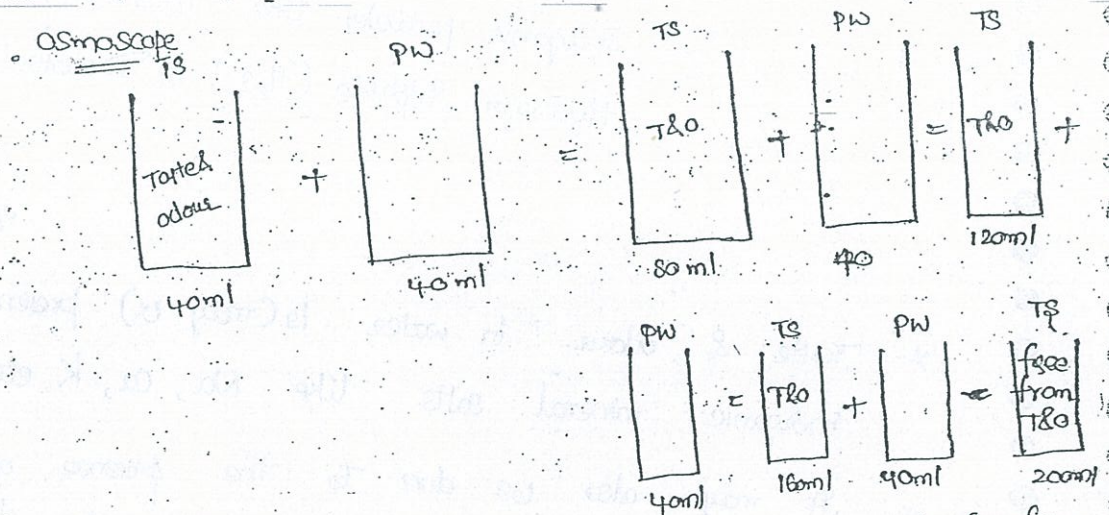
Impact:-

* Taste & odour in water may result in the formation of carcinogenics.

Measurement:-

* Taste & odour in water is determined using osmoscope by diluting the water sample upto an extent, taste and odour is hardly detectable in it, And this intensity of taste & odour is represented in terms of standard unit TON (Threshold odour Number) which represents the dilution ratio at which taste and odour is hardly detectable.

10 sets of noses are used to find Taste & odour as per epvt. of India Manual.



$$\text{Dilution Ratio (D/R)} = \frac{\text{Final volume of sample free from T\&O}}{\text{Initial volume of sample}}$$

$$= \frac{200}{40} = 5.$$

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If at 200 ml volume, T&O is present then we have to reduce initial volume of sample since 200 ml is fixed.

Testing of T&O:-

Testing of T&O must be done at Normal Temperature condition because T&O changes with Temp.

As Temp. \uparrow s micro-organism growth biological activity \uparrow
" " " " chemical reaction speed up & vice versa

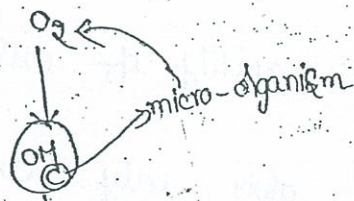
Acceptable Limits : 1 TON.

Cause for Rejection : 3 TON.

TEMPERATURE

* Temp effects both chemical and Biological reactions taking place in water.

* An avg. increase of 10°C in the temperature of water almost doubles the Biological Activity. (Also O_2 decrease by $\frac{1}{2}$)



Biomass (CO_3^{2-} , NO_3^- , SO_4^{2-} , Acids, Alcohols, gases (CO_2 , NH_3 , CH_4 , H_2S , N_2)

Biological Activity:-

* For water supplies, Temp. should be maintained in the range of 10 to 25°C .

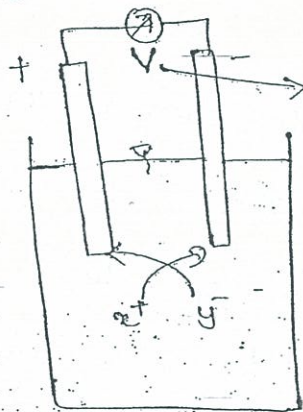
Chemical water quality Parameter:-

1. Dissolved Solids

It cannot be seen, hence it is chemical parameter.

DS can be found completely by gravimetric method

& the approximate method is by using Di-ionic-Tetra



Electrical conductivity.

Di-ionic-Tetra

DS are determined based on electrical conductivity of water. EC is ability of water to pass current through it.

This method gives only conc. DS present only in ionic form.

Hence DS computed is $<$ Actual D.S. present

because it does not give D.S. which are non-ionic.

Electrical conductivity is calibrated in the form DS in TDS.