

# **WASTE WATER ANALYSIS**

*Submitted in partial fulfillment of the requirements of the award of the degree of*

*Master of Technology*

*In*

*Energy and Environmental Engineering*

*By*

**PARITOSH KUMAR  
(18SOCE2020003)**

*Under the guidance of*

**Mr. Md. Gulam Tajdaar**



SCHOOL OF CIVIL ENGINEERING  
GALGOTIAS UNIVERSITY  
GREATER NOIDA  
**MAY, 2020**

## **ACKNOWLEDGEMENT**

I am highly grateful to **Prof. (Dr) Manju Dominic, Dean** of the school of Civil Engineering for giving me her advice and facilities for the successful completion of my project.

It gives me great pleasure to express my deep sense of gratitude and indebtedness to my guide **Mr. Md. Gulam Tajdaar**, Asstt. Professor, School of Civil Engineering for his proper guidance, valuable support and encouragement throughout the project. I am highly obliged to him for providing me with this opportunity to carry out my ideas and work during my project period and helping me to gain the successful completion of my Project.

I am also highly obliged to **Mr. Deepak Kumar Soni** project coordinator and **Mr. Sushil Kumar Singh** project coordinator for providing me with all possible support and their valuable encouragement throughout my project.

My special thanks are going to all of the faculties and staff of the School of Civil Engineering, Galgotias University, for encouraging me constantly to work hard in this project. I pay my respect and love to my parents and all other family members and friends for their help and encouragement throughout this course of project work.

## **CERTIFICATE**

This is to certify that the project work entitled **"WASTE WATER ANALYSIS"** submitted by **18SOCE2020003** to the School of Civil Engineering, Galgotias University, Greater Noida, for the award of the degree of **Master of Technology in Energy and Environmental Engineering** is a bonafide work carried out by him under my supervision and guidance. The present work, in my opinion, has reached the requisite standard, fulfilling the requirements for the said degree.

The results contained in this report have not been submitted, in part or full, to any other university or institute for the award of any degree or diploma.

**Mr. Md. Gulam Tajdaar**  
**Asst. Professor , Guide**

**Prof. Dr. Manju Dominic**  
**Dean, School of Civil Engineering**

**External Examiner**

## **DECLARATION**

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

**Date:**

**PARITOSH KUMAR**

**Place:**

**18SOCE2020003**

# CONTENTS

<b>LITERATURE REVIEW</b>	<b>01</b>
<b>(1) INTRODUCTION</b>	<b>03</b>
1.1 Water	03
1.2 Uses of Water	05
1.3 Definition of Water Pollution	06
1.4 Typical Effluent Treatment Plant	08
1.5 Process involved in Effluent Treatment Plant	09
1.6 Limits of Major Industries	11
• Maximum Permissible Limits for Effluent discharge	11
• Standards for small scale industries located in the union territories	13
• Different industries & their parameter	14
a) Pulp & paper industries	14
1) Discharge into inland water	14
2) Disposal on land	14
b) Leather industries	14
c) Electroplating industries	15
d) Pharmaceutical industry	15
e) Sugar industry	15
f) Thermal power industry	16
g) Iron industry	16
h) Fertilizer industry	16
i) Petroleum oil refinery	17
j) Iron & steel plant	18
k) Petrochemical industry	18
l) Standards for effluent from textile industry	18
m) Edible oil & vantipasti industry	19

<b>(2) SIGNIFICANCE OF DIFFERENT PHYSICOCHEMICAL PARAMETER</b>	<b>20</b>
2.1 Temperature	20
2.2 Ph	20
2.3 Colour	21
2.4 Odour	21
2.5 Turbidity	22
2.6 Suspended solid	22
2.7 Dissolved solid	22
2.8 Dissolved oxygen	23
2.9 Biological oxygen demand	23
2.10 Chemical oxygen demand	24
2.11 Ammonia	24
2.12 Nitrate	25
2.13 Phosphorus	25
2.14 Sulphate	25
2.15 Chromium	26
2.16 Oil & grease	26
<b>3) METHODOLOGY OF ANALYSIS OF DIFFERENT PARAMETER</b>	<b>27</b>
3.1 Chloride	27
3.2 Biological oxygen demand	28
3.3 Chemical oxygen demand	29
3.4 Ph	31
3.5 Total suspended solid	32
3.6 Total dissolved solid	33
3.7 Oil & grease	34
3.8 Ammonia	35
3.9 Conductivity	37
3.10 Phosphate	37

<b>4) SAMPLING, SAMPLE HANDLING &amp; PRESERVATION</b>	<b>39</b>
4.1 Sampling	39
• Spot or grab sample	39
• Composite sample	40
• Integrated sample	40
4.2 Collection of effluent sample	40
4.3 Flow measurement	40
• Bucket method	40
• Surface float method	40
4.4 Sample handling & preservation	41
<b>5) DIFFERENT CONTROL MEASURES FOR WATER POLLUTION</b>	<b>44</b>
5.1 Domestic sewage	44
5.2 Industrial waste water	44
5.3 Agricultural waste water	45
• Non-point source controls	45
• Point source waste water treatment	45
<b>6) INTERFERENCES</b>	<b>46</b>
7) RESULT	47
8) REFERNCE	48

## LIST OF FIGURES /TABLES

<b>S.No.</b>	<b>Tables / Figures</b>	<b>Page No.</b>
1.	Table-1; Shows the composition of Ground water, surface water & sea water	07
2.	Table-2; Water consumption of various purposes.	05
3.	Table-3; Various water Quality Parameter	07
4.	Figure -1.4; Typical effluent treatment plant	08
5.	Table- 1.6; Limits of Major Industries	11 to 13
6.	Table- Standards for small scale industries located in the Union Territories	13
7.	Table;- Different Industries & Their Parameter	14 to 19
8.	Table; 4.4, Sample Handling and Preservation	41 to 43
9.	Interferences	46
10.	Results of the sample	47



# **LITERATURE REVIEW**

## **GENERAL**

Wastewater is the water that has been affected by anthropogenic activities. Wastewater is the used water of domestic, industrial, commercial or agricultural activities, surface runoff or storm water, and any sewer inflow or sewer infiltration. Therefore, wastewater is a byproduct of domestic, industrial, commercial or agricultural activities. The characteristics of wastewater vary depending on the source.

Sewage treatment is the process of removing contaminants from municipal sewage water. The term sewage treatment plant is nowadays often replaced with the term wastewater treatment plant or wastewater treatment station. Physical, chemical, and biological processes are used to remove contaminants and produce treated wastewater (or treated effluent) that is safe enough for release into the environment.

## **TREATMENT METHODS GENERALLY ADOPTED AT AN STP**

Sewage before being disposed of either in river streams or on land has generally to be treated. The degree of treatment has been given depends upon the characteristics of the source of disposal.

Conventional wastewater treatment consists of different processes and operations to remove solids, organic matter and, sometimes, nutrients from wastewater. General terms used to describe different degrees of treatment, in order of increasing treatment level, are preliminary, primary, secondary, and tertiary and/or advanced wastewater treatment. In some countries, disinfection to remove pathogens sometimes follows the last treatment step.

## **PRELIMINARY TREATMENT**

This process merely consists of screening for removing floating materials such as papers, rags, cloths, tree branches, etc. Grit chambers or detritus tank for removing grit and sand. Skimming tanks for removing oil and greases.

## **PRIMARY TREATMENT**

Sometimes, the preliminary, as well as primary treatments are classified together under primary treatment. This process consists of removing large suspended organic material and has a high BOD. The organic solids which are separated in the sedimentation tanks are often stabilized by anaerobic decomposition in a digestion tank or are incinerated. The residue is used for landfills.

## **SECONDARY TREATMENT**

The process involves further treatment of the effluents coming from the primary sedimentation tank. This is generally accomplished through the biological decomposition of organic matter, which can be carried out either under aerobic or anaerobic conditions. In these biological units, bacteria will decompose the fine organic matter, to produce clearer effluent. The treatment reactors, in which the organic matter is destroyed and stabilized by bacteria, are known as **anaerobic biological units** and many consists of **anaerobic lagoons, septic tanks, Imhoff tank**, etc.

## **THE FINAL TREATMENT**

This treatment process is also known as **tertiary treatment** and it consists of removing the organic load left after the secondary treatment and particularly to kill the pathogenic bacteria.

# **1. INTRODUCTION**

## **1.1 WATER**

Water is one of the most important renewable resources on this planet. It is one of the most abundant compounds in nature, covering approximately three fourth of the surface of the earth. 97% of the total water is contained in the oceans and other saline bodies of the water and is not readily usable for most purposes of the remaining 3% a little over 2% is tied up in ice caps and glaciers and along with atmospheric ad soil moisture is inaccessible. Thus for their general livelihood and the support of their varied technical and agriculture activities, humans must depend upon the remaining 0.62% found in freshwater lakes, river and groundwater supplies.

Water is in constant state of motion. Atmospheric water condenses and falls to the earth as rain, snow or some other form of precipitation. One of the earth's surface, water flows in to streams, lakes and eventually finds it's in the way into the oceans. A fraction of this percolates through the soil and in to the aquifers that eventually discharge in to surface water. Through evaporation from water body and plants, water molecules return to the atmosphere to repeat this cycle. About one third of the solar flux absorbed by the earth's surface is used to drive the hydro logical cycle.

Water in nature is most nearly pure in its evaporation state. Because the very act of condensation usually requires a surface, or nuclei, water may acquire impurities at the very moment of condensation. Additional impurities are added as the liquid water travels through the remainder of the hydro logical cycle an comes in to the contact with materials in the air or beneath the surface of the earth. Human activities, contribute further impurities in the form of industrial and domestic wastes, agricultural chemicals and other less obvious contaminants. Ultimately, these impure water will complete the hydro-logical cycle and return to the atmosphere as relatively pure water molecules. However, it is water quality in the intermediate stage which is of greatest concern because it is the quality at this stage that will affect human use of water.

Groundwater and surface water (i.e., river, lake, spring) used up by man are of different characteristics. Groundwater contains dissolved minerals from the soil layers through which it passes. In the process of seepage through the ground, the water becomes free from most of the microorganisms originally present in the surface water. Though the salt content may be excessively high on occasions, it is generally superior as a domestic water source. In general ground water have higher dissolved mineral contents that surface waters. This is because of the

intimate contact between CO<sub>2</sub> bearing water, rock and soils in the ground and the length of time of dissolution. The oceans and sea are products of gigantic acid base titrations during the early stages of formation of the earth. Acids (HCl, H<sub>2</sub>SO<sub>4</sub>) which leaked out from of the interior of the earth, through volcanoes, were titrated with bases liberated by the weathering of primary rocks.

Chemically speaking, sea water is a solution of 0.5 m NaCl and 0.05 MgSO<sub>4</sub>, containing traces of all conceivable matter in the universe. The oceans are the final sink for many substances involved in numerous geochemical processes, as well as the waste dumped as a result of human activities. They receive the runoff from the continents and materials washed from the atmosphere, but are important habitat of the earths biosphere. Ocean waters are more or less mixed with the result that, in contrast to the variable composition of fresh water, the ratios of the major constituents of sea water are almost the same all over the globe. Although the salt content is variable from place to place. The most abundant elements viz., Na, Cl, Mg, constitute 90% of the matter in sea water, K, Ca, and S 3% and the other elements together 7%.

**Table- 1 shows the composition of ground water, surface water & sea water**

Parameters (PPM)	Ground Water (Well Water)	Surface Water (River Water)	Sea Water
Bicarbonate	339	119	140
Calcium	92	36	400
Chloride	9.6	13	19×10 <sup>3</sup>
Iron (2)	0.09	0.02	0.01
Magnesium	34	8.1	1.35×10 <sup>3</sup>
Nitrate	13	0.1	-
Potassium	1.4	1.2	80
Silica	10	1.2	6
Sodium	8.2	6.5	10.5×10 <sup>3</sup>
Sulphate	84	22	2.65×10 <sup>3</sup>
Total Dissolved Solid	434	1.65	-
Total Hardness (CaCO <sub>3</sub> )	369	123	-

## **1.2 USES OF WATER**

Water has a wide utility for all the living organisms. Water is the most vital components of the protoplasm of a living cell. The percentage content of water in protoplasm is 75% in plant cell and 67% in animal cell. The uses of water are following.

- 1) Domestic use-for drinking purposes, bathing, washing of cloths, cleaning of house utensils, food, cooking etc.
- 2) Industrial use
  - a) Cleaning equipment's and other material
  - b) Production of distilled water
  - c) Production of chemicals
  - d) As cooling agent
- 3) Agriculture –irrigation
- 4) Livestock and wild life watering
- 5) Propagation of fish and other aquatic life
- 6) Shellfish culture
- 7) Swimming, boating, and aesthetic enjoyments
- 8) Water power- hydroelectric projects
- 9) Transport, dispersion and assimilation of waste

**Table-2 Water consumption of various purposes**

type of consumption	normal range	Average	%
domestic consumption	65-300	160	35
Industrial & commercial demand	45-450	135	30
public uses including free demand	20-90	45	10
losses and waste	45-150	62	25

### **1.3 DEFINITION OF WATER POLLUTION**

Any change which has the potential to adversely influence the biological and non-biological equilibrium of the environment is known as pollution. The term pollution has attracted wide attention during recent years and it has been defined scientifically as follows.

According to the report of the committee on pollution, national academy of sciences, USA (1966)- pollution is undesirable change in the physical, chemical or biological characteristics of our air, land, and water that may or will harmfully affect human life, living condition and cultural assets, or that may or will waste or deteriorate our raw material resources.

According to a report of the environmental pollution panel of the United State presidents science advisory committee- “pollution is the unfavorable alternation of our surroundings wholly or largely as a byproduct of mans action through direct or indirect effect of changes in energy patterns, radiation levels of chemical and physical constituents and abundance of organism”.

The water pollution may be defined as the adverse change in composition or condition of the water such that it becomes less suitable for the purpose for which it would be suitable in its natural state. The changes include physical, chemical and biological. The substance which is responsible for the deterioration of quality of water is known as pollutant.

Water pollution is the serious problem ever since sewage and industrial effluents are being disposed out into the water bodies. Population growth adds both to pure water requirements and to the generation of sewage and waste products. Industries need a wider variety of chemicals and/or metals which are later discharged into rivers, streams, lakes and oceans. The modern techniques of agriculture involved the use of a wide spectrum of a fertilizer and pesticides which when applied improperly to the soil will find their way into water courses.

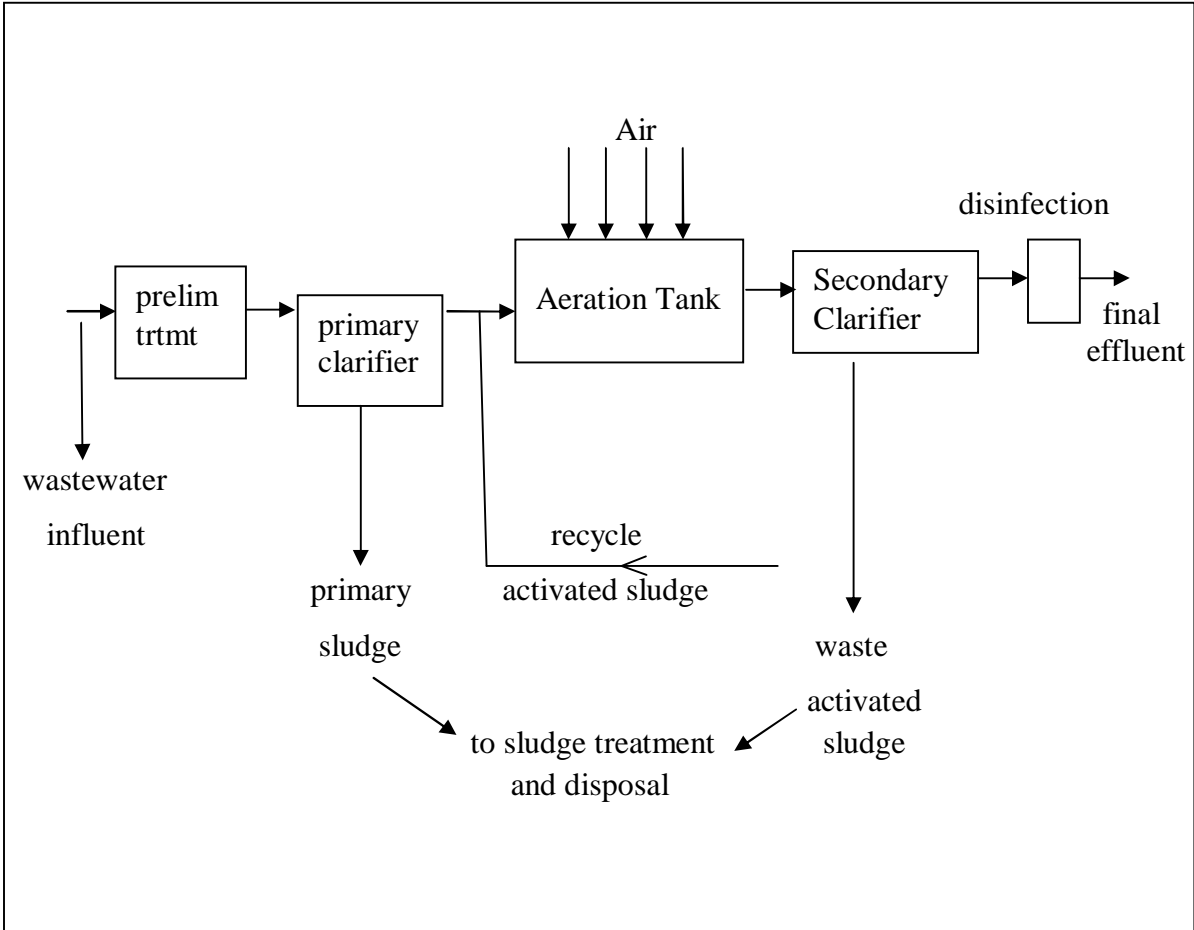
Aquatic pollution causes lethal effects on its inhabitants and it is rapidly increasing. The wastes materials introduced into water and their deleterious effects on the environment is of prime importance. Dumping off industrial wastes into water without treatment has resulted in loss of many commercially important aquatic biota. Where water pollution is very severe, it is generally due to three contaminants- sewage, industrial wastes and pesticides. Soluble materials and various insoluble organic substances often bring about changes from aerobic to anaerobic condition, particularly where the displacement of water is slow and water current is sluggish.

Keeping in view of the above facts, many parameters related to physical, chemical and biological pollution have been assessed to check the quality of water. The concentration of different constituents (parameters)

**Table -3 various water quality parameter**

PHYSICAL WATER-QUALITY PARAMETERS	CHEMICAL WATER-QUALITY PARAMETERS	BIOLOGICAL WATER-QUALITY PARAMETERS
Temperature Colour Odour Turbidity Foam and Froth Conductivity Solids (Suspended, dissolved and, Volatile)	Dissolved Oxygen, Biological Oxygen Demand, (B.O.D) Chemical Oxygen Demand, (C.O.D) pH, Alkalinity, Acidity,  Redox potential, Ammonia, Nitrates, Nitrites Phosphate Sulphate Calcium, Magnesium Hardness Sodium, Potassium Iron, Heavy metals, Detergent, Pesticides	Bacteria, Coliforms,

## 1.4 TYPICAL EFFLUENT TREATMENT PLANT





## **1.5 PROCESSES INVOLVED IN EFFLUENT TREATMENT PLANT**

Any industry has to set up the ETP for the maintaining to different parameter like ph., BOD, COD, TSS, Col our, TDS.

The following processes are involved in the effluent treatment plant.

### **Preliminary treatment**

When the waste water entered in to the treatment plant, the solid waste & scum is removed by the process of screening.

### **Primary clarifier**

After the passing of water through the process of preliminary treatment, the residual liquid is allowed in to the primary clarifier; in the primary clarifier unit the suspended solid is removed by the formation of the sludge in the bottom of the primary clarifier.

The sludge is formed in the primary clarifier unit in the bottom; it is required to the further treatment.

### **Aeration tank**

After the passing of water in the primary clarifier unit, it is allowed in to the aeration tank. In the aeration tank, those particles are try to remove which is in the state of motion. For these mechanical aerators is provided. But now in these days, the diffusers are provided, for the process of aeration. The alum is added into the aeration tank, it forms the floccs by entangling of dirt in self, and these floccs can be removed manually.

Bacteria are also allowed in to the aeration tank. In the aeration tank in the aeration tank bacteria consumed the organic matter, On which it converts in to simpler substances. In this process the sludge is also formed.

### **Secondary clarifier**

After the passing of water through the aeration tank, the water is allowed in to the secondary clarifier, the activated sludge process is done.

It is a continuous flow flocculated growth process in which bacterial flocs are separated from the treated effluent by a clarifier and recycled to the aeration tank to maintain a high degree of process intensity, the microbial cell matter which is formed as a part of the waste degradation process is generally kept in the aeration tank till micro-organism reach their saturation stage of growth when the cells flocculate well to form to settleable solids, these solids settle out in a settler and part of it discarded.

The bulk of solids, return sludge is recycled to the bottom of the aeration tank and the fresh sewage is allowed to it.

### **Disinfection**

After the passes of water through the secondary clarifier, the water is allowed in to the disinfection unit for the removal of microorganism for this purpose the common chemical chlorine is added.

### **Sludge disposal & treatment**

In sludge treatment this is the major problem of its disposal is the major problem the sludge can be spread on soil or landfills, the sludge may be utilized as fertilizer on croplands.

## **1.6 LIMITS OF MAJOR INDUSTRIES**

### **Maximum permissible limits for industrial effluent discharges**

Parameter	Into inland Surface waters Indian Standards: 2490 (1974)	Into public sewers Indian Standards: 3306(1974)	On land for Irrigation Indian Standards: 3307 (1974)
pH	5.5-9.0	5.5-9.0	5.5.-9.0
Biological oxygen demand  (for 5 days at 20°C)	30	350	100
Chemical oxygen demand	250		
Suspended solids	100	600	200
Total dissolved solids  (inorganic)	2100	2100	1000
Temperature (°c)	40	45	-
Oil and grease	10	20	10

Phenolic compounds	1	5	-
Cyanides	0.2	2	0.2
Sulphides	2	-	-
Fluorides	2	15	-
Total residual chlorine	1	-	-
Pesticides	-	-	-
Arsenic	0.2	0.2	0.2
Cadmium	2	1	-
Chromium (hexavalent)	0.1	2.0	-
Copper	3	3	-
Lead	0.1	1.0	-
Mercury	0.01	0.01	-
Nickel	3	3	-
Selenium	0.05	0.05	-
Zinc	5	15	-
Chlorides	1000	1000	600

Boron	2	2	2
Sulphates	1000	1000	1000
Sodium (%)	-	60	60
Ammoniacal nitrogen	50	50	-
Radioactive materials			
Alpha emitters (millicurie/milliliter)	$10^{-7}$	$10^{-7}$	$10^{-8}$
Beta emitters ( $\mu$ Curie/millilitre)	$10^{-6}$	$10^{-6}$	$10^{-7}$

**STANDARDS FOR SMALL SCALE INDUSTRIES LOCATED IN THE UNION TERRITORIES**

PARAMETER	Concentration not in exceed
ph.	5.5-9.0
Suspended solid	250mg/l
BOD	150mg/l
Temperature	Shall not exceed 5* C
Free available chlorine	0.5 mg/l
Oil & grease	10 mg/l
Cr	2.0 mg/l
Phosphate	5.0 mg/l
Sulphide	2 mg/l
Chloride	9000 mg/l
Sulphate	1000 mg /l

## **DIFFERENT INDUSTRIES & THEIR PARAMETER**

### **Pulp & paper industries**

#### **Discharge into inland surface water**

<b>Parameter</b>	<b>Standard</b>
Ph	5.5-9.0
Suspended solid	100 mg/l
BOD	30 mg/l

#### **Disposal on land**

<b>Parameter</b>	<b>Standard</b>
Ph	5.5-9.0
Suspended solid	100 mg/l
BOD	30 mg/l

### **Leather industries**

<b>parameter</b>	<b>inland surface water</b>	<b>public sewer</b>	<b>land for irrigation</b>	<b>marine coastal area</b>
suspended solid	100 mg/l		200 mg/l	100 mg/l
BOD at 27* c	30 mg/l	350 mg/l	100 mg/l	100 mg/l
Ph	6.0-9.0	6.0-9.0	6.0-9.0	6.0-9.0
chlorides	1000 mg/l	1000 mg/l	200 mg/l	-
sulphides	2 mg/l	5mg/l	-	5mg/l
oil & grease	10 mg/l	20mg/l	10 mg/l	20 mg/l

### **Electroplating Industry**

<b>parameter</b>	<b>standard</b>
Ph	0.6-0.9
Temperature	above than 5* c
Oil & grease	10 mg/l
Suspended solid	100 mg/l
hexavalent chromium	2.0 mg/l

### **Pharmaceutical Industry**

<b>Parameter</b>	<b>Standard</b>
Ph	6.0-8.5
Oil & grease	10mg/l
BOD	100 mg/l
total suspended solid	100 mg/l

### **Sugar Industry**

<b>parameter</b>	<b>standard</b>
BOD	100- for on disposal on land
suspended solid	100- for on disposal on land

**Thermal power industry**

<b>parameter</b>	<b>standard</b>
Suspended solid	100 mg/l
Oil & grease	20 mg/l
Copper	1.0 mg/l

**Iron industry**

**Ash pond effluent**

<b>parameter</b>	<b>standard</b>
Ph	6.5-8.5
Suspended solid	100 mg/l
Oil & grease	20 mg/l

**Fertilizer industry**

<b>parameter</b>	<b>standard</b>
Ph	6.5-8.0
ammonical nitrogen	50 mg/l



TKN	100mg/l
suspended solid	100mg/l
Oil & grease	10 mg/l

**Petroleum oil refinery**

<b>Parameter</b>	<b>Standard</b>
Ph	6.5-8.5
COD	125mg/l
BOD	15mg/l
Suspended solid	20 mg/l
oil & grease	5.0 mg/l
Ammonia	15.0mg/l

### **Iorn & steel plant**

<b>Parameter</b>	<b>Standard</b>
ph	6.0-8.0
Suspended solid	100mg/l
Phenol	1.0 mg/l
BOD	30 mg/l

### **Petrochemical Industry**

<b>Parameter</b>	<b>Standard</b>
ph	6.5-8.5
Suspended solid	100mg/l
BOD	50 mg/l
total chromium	2.0 mg/l

### **Standard for effluent from textile industry**

<b>Parameter</b>	<b>Standard</b>
ph	5.5-9.0
Suspended solid	100mg/l

BOD	30mg/l
COD	250 mg/l
Oil & grease	10 mg/l

**Edible oil & vantipasti industry**

<b>Parameter</b>	<b>Standard</b>
Ph	6.5-8.5
suspended solid	150 mg/l
BOD	100 mg/l
COD	200 mg/l
oil & grease	20 mg/l
Temperature	not more than 5* c

## **2. SIGNIFICANCE OF DIFFERENT PHYSICO-CHEMICALS PARAMETERS**

### **2.1 TEMPERATURE**

The parameter of temperature is basically important for its effect on the chemical and biological reactions in the organisms and in water. A rise in temperature of water leads to the speeding up of the chemical reactions in water, reduced the solubility of gases and amplifies the tastes and odours. Water in the temperature range of 7° C has a pleasant taste and is refreshing. At higher temperature with less dissolved gases, the water becomes tasteless and even does not quench the thirst. (Ref-Trivedi and Goel 1986). At the elevated temperature metabolic activity of the organisms increases, requiring more Oxygen but at the same time the solubility decreases, thus accentuating the stress. The disease resistance in the fishes also decreases with the rise in temperature.

Temperature changes affect the reaction rates and solubility levels of chemicals. It is also important in the determination of various other parameters such as pH, conductivity, saturation level of gases, various forms of alkalinity etc.

### **2.2. PH**

pH is the measure of the intensity of acidity or alkalinity and measures the concentration of hydrogen ions in water. It does not measure total acidity or alkalinity.

Most natural waters are generally alkaline due to presence of sufficient quantities of carbonates. pH of water gets drastically changed with time due to the exposure to air, biological and temperature changes. Significant change in pH occurs due to disposal of industrial wastes, acid mine drainage etc... Most chemical and biological reactions occur at a narrow range of pH. Determination of pH is one of the most important objectives in treatment of the waste. In anaerobic treatment, if the pH goes below 5 due to excess accumulation of acids the process is affected adversely.

Fishes are either killed or seriously handicapped if pH drops from 5.0 or rises up to 9. By acidic discharge of tanneries or distilleries the fish foods are destroyed. pH below 6.0 is corrosive to concrete structures i.e. sewers.

### **2.3 COLOUR:**

Pure water is colourless, but water in nature often coloured by foreign substances. Water whose colour is partly due to suspended matter is said to have apparent colour. Colour contributed by dissolved solids, that remain after removal of suspended matter is known as true colour.

Colored water is not aesthetically acceptable to the general public. Highly coloured water is unsuitable for laundering, dyeing, paper making, beverage manufacturing, dairy production and other food processing, textile and plastic production. Thus the colour of water affects its marketability for both domestic and industrial use.

The wastewater of tannery also contains colour due to the use of dyes. The dyes may contain certain toxic metals like chromium, arsenic etc... Tannery wastes when discharged into iron-containing streams may cause deep green or inky blue colorations due to the interaction of tannins with iron (Redlich, 1953)

The colour of distillery wastewater is deep brown. The deep colour may reduce the penetration of sunlight under the water and as a result the photosynthesizing organisms will get less amount of sunlight. This ultimately affects the organisms.

### **2.4 ODOUR :**

Odour in a water course is one of its most important characteristics. It is caused both by chemical agents such as free chlorine, phenols, hydrogen sulfide and microorganisms. It is also caused by chemical agents such as free chlorine, phenols, hydrogen sulfide and ammonia and by biological agents such as algae and microorganisms. The odour is also caused due to the decaying of organic substances and other degradable matters.

The presence of inorganic and organic compounds of nitrogen, sulfur and phosphorus and the putrefaction and other organic materials present in sewage and in trade wastes are the causes for odour in polluted rivers. Many of the industrial effluents containing organic substances, (e.g. phenols, alcohols, esters, aldehydes, ketones and sulfur compounds) possess characteristic odours and are imparted to the receiving water.

The odours and tastes are sometimes rejected on the ground of aesthetic value. Offensive odours can cause poor appetite for food, lowered water consumption. The odour in water is also not suitable in food, pharmaceuticals and beverage industries.

## **2.5 TURBIDITY :-**

Turbidity in water is caused by the substances not present in the form of true solution. True solutions have a particle size of less than  $10^{-9}$  m. (Trivedi and Goel 1986). Any substance having more than this size will produce turbidity. Turbidity of water is actually the expression of optical property (tyndal effect) in which the light is scattered by the particles present in the water.

The wastewaters of all the three industries i.e. distillery, dairy and tannery are highly turned. This turbidity is due to the presence of high value of suspended and volatile solids.

Turbidity makes the water unfit for domestic purposes, food and beverage industries and may other industrial uses. Determination of turbidity is an important objective in removal of the turbidity by coagulation filtration etc. A reduction in turbidity is associated with a reduction in suspended matter and microbial growth. Turbidity in natural waters restricts light penetration for photosynthesis. Highly water is unfit even for irrigation.

## **2.6 SUSPENDED SOLIDS :-**

The raw waste of tannery, distillery and the dairy has high suspended solids. Insoluble matter in suspension is one of the commonest form of pollution. Suspended matter may be inorganic or organic or both in nature. It interferes with the self –purification of streams by reducing the photosynthetic activity of aquatic plants and by smothering benthic organisms. Moreover, abrasive materials present in the suspended matter can coke the mills of fish and thereby cause damage to fisheries. Preposition of suspended matter on stream bed destroys plant and animal life and thus the food supplies for fish are diminished. A report by Patrice indicates that the eggs of fish can become buried by suspended solids. Suspended matters containing organic material will undergo putrefaction during warm weather. As a result, solids buoyed by gas may rise to surface, leading to the formation of floating masses of evil smelling sludge. Suspended solids choke sewers through  $\text{CaCO}_3$  deposition on wall.

## **2.7 DISSOLVED SOLIDS:-**

Dissolved solids denotes mainly the various kinds of minerals present in the water. Chlorides, sulfates nitrates, bicarbonates and phosphates of sodium, potassium, magnesium iron and manganese, and some of the fluorides' are soluble in water High concentration of dissolved solids reduces the palatability of water (ISI, 1983). High concentration of dissolved solids near 3000 mg/l may also produce distress in cattle or livestock (Trivedi and Goel). Plants are also

adversely affected by the higher content of solids in irrigation water which increases the salinity of the soil.

When waters containing excessive salts are discharged into rivers, the course becomes blackish which affect fish life and certain vegetation. Many of the refresh water fish varieties die in salt water and this is entirely due to osmotic changes (Manivasakam). Not only these soluble salts affect biological organisms but they also cause severe effects to pipe lines, pumps and other metallic or concrete structures. Sulphates are converted either into sulfuric acid which aids corrosion or into sulfides which produces odour nuisances. The conversion of sulfates to sulfides is brought about sulfate reducing bacteria and sulfur bacteria (Power and Daginawala).

Certain soluble salts of iron aluminum react with the natural bicarbonate alkalinity to form insoluble hydroxides. When the river or stream depleted or dissolved oxygen due to sewage or industrial contaminants, the water may turn black due to the formation of ferrous sulfide. Iron can react with phenols to form varied coloured compounds and make the stream coloured.

### **2.8 DISSOLVED OXYGEN:-**

Dissolved oxygen is one of the most important parameter in water quality assessment and reflects the physical and biological processes prevailing in the waters. Non- polluted surface waters are normally saturated with oxygen. Low oxygen concentration or totally absence of dissolved oxygen are generally associated with heavy contamination by organic matters other inorganic reluctant such as hydrogen sulfide, ammonia, nitrites, ferrous iron and other oxidizable substances also substances also tend to decrease dissolved oxygen in water.

Low oxygen in water can kill fishes and other organisms present in water. Organisms have specific requirement of oxygen for example, game fish requires at least 5mg/L and coarse fish about 2mg/L of minimum dissolved oxygen in water. Several noxious anaerobes can grow within the oxygen free water and thus creates unhygienic conditions. These are unfit for irrigation purpose.

### **2.9 BIOCHEMICAL OXYGEN DEMAND:-**

The amount of oxygen consumed during microbial utilization of organics is called the Biological Oxygen Demand (BOD). On an average basis the demand for Oxygen is proportional to the amount of organic waste to be degraded aerobically. Hence BOD approximates the amount organic matter present in the solution and the BOD value can be used as a measure of waste

strength. It is highly important to know the amount of organic matter present in the waste treatment system and that the quantity of oxygen required for its stabilization. The BOD test is also useful in stream pollution control management and in evaluating the self – purification capacities of streams which serves as a measure to assess the quality of waste which can be safely assimilated by the stream.

The raw effluent to tannery, distillery and dairy all have high organic load and thus very high BOD. Very high BOD values upsets the quality of river water or other water reservoir into which they are discharged.

### **2.10 CHEMICAL OXYGEN DEMAND**

Chemical Oxygen demand (COD) is also a major parameter for determining the pollutant load in the water. COD is the oxygen required by the organic substances in water to oxidize them by a strong oxidant.

Very high COD containing effluent if discharged into fresh water body, it will lead to oxygen depletion of that water body and the consequence can easily be understood. COD value of distillery tannery and dairy is high enough to upset the quality of water of receiving body.

### **2.11 AMMONIA :-**

Ammonia of mineral origin is rare in natural waters. The most important source of ammonia is the ammonification of organic matter. Occurrence of ammonia in the waters can be accepted as the chemical evidence of organic pollution.

The presence of ammonia in ground water is quite generally a result of natural degradation processes. Ammonia in higher concentration is harmful to fish and other biota. It is also toxic to man to higher concentrations. The toxicity of ammonia increase with ph. because at higher ph. most of the ammonia remains in the gaseous form. (Trivedi and Goel). Ammonia (Ammonia Nitrogen) is present in the effluents of all the three selected industries as they have high degradable organics. The ammonia causes chronic acidosis and tissue changes. If ingested 0.5% ammonia for 17 days. It also retards hemoglobin activity thus suffocates the fish if ammonia is 1 mg/l present in water. Ammonia content of water if between 0.4 to 0.5 mg/l there will be complete disappearance of algae (Aphanigomenon).



### **2.12 NITRATE:-**

Nitrate represents the highest oxidized form of nitrogen. Nitrates are of prime concern because of methemoglobinemia when the concentration of nitrates exceeds 40mg/l. In this disease the skin becomes blue due to decreased efficiency of hemoglobin to combine with oxygen. In cattle the high concentration nitrates is reported to cause mortality in pigs and calves and abortion in brood animals.

Although high concentrations are useful in irrigation but their entry into the water resources increase the growth of nuisance algae and trigger Eutrophication.

### **2.13 PHOSPHORUS:-**

Phosphorus in the natural fresh waters is present mostly in inorganic forms such as  $\text{H}_2\text{PO}_4^-$  and  $\text{HPO}_4^{2-}$ . Phosphorus being an important constituent of biological system may also be present in the organic form.

Although the phosphorus content of the raw effluent of the selected industries are very low, as the phosphorus comes into the effluent due to the use of detergents for cleaning purposes. The phosphorus may come as waste in the processing of dairy products.

The prime concern of phosphorus lies in the ability to increase the growth of nuisance algae and Eutrophication. Phosphorus as such is not harmful to organisms. The quality criteria for phosphorus in waters is only to check nuisance growth of algae and process of eutrophication.

### **2.14 SULPHATES:-**

It is naturally occurring anions in all kinds of water. Discharge of industrial waste and domestic sewage in waters tends to increase its concentration.

The tannery effluent contain a considerable amount of sulphate which comes from the processing of tanning the distillery effluent also contain a high amount of sulphates. The Dairy effluent any sulphate but in less amount.

Sulphate is an important constituent of hardness with calcium and magnesium. Sulphate produces an objectionable taste as 300-400 mg/l concentrations. At concentrations around 1000 mg/l it is laxative (U.S., EPA, 1973). Sulphate with sodium interferes with the normal functioning of the intestine with the normal functioning of the intestine. It has got indirect importance by producing  $\text{H}_2\text{S}$  which helps in corrosion of concrete, thus posing serious problems in the wastewater collection pipes.

### **2.15 CHROMIUM :-**

Chromium is widely used in chrome tanning of leather in tanneries. Thus chromium is the major pollutant discharged by the tanneries, Hexavalent chromium is considered as carcinogenic. It is very harmful even in trace amount.

By large dosage of chromates corrosive effects in the intestinal tract and nephrities may cause. More than 0.5g of  $K_2Cr_2O_7$  is toxic dose for man. It also causes destruction of fishes. Impairment of photosynthetic activities of algae (Macrocytic peripheral) at concentration of 1mg/l has been also reported. It is seen that the photosynthetic activity of this algae reduces up to 10-20% by 5 days of 20-30% reduction by 7-9 day.

### **2.16 OIL AND GREASE:-**

Oil of grease is released in considerable amount in the effluent of Dairy. It causes increase in turbidity of the water. In less amount it does not cause any considerable harm but in irrigation water the large amount may give rise to weeds which competes with the crops in the field and thus decrease they yield. These also give an unpleasant odour to the water and thus affect aesthetic value of the river.

## 4. METHODOLOGY OF ANALYSIS OF DIFFERENT PARAMETERS

### 3.1 CHLORIDE

Chlorides are generally present in natural water. The most important source of chlorides in the water is the discharge of domestic sewage waste generated from paper mills etc. Man & other animals excrete very high quantities of chlorides conc. Serves as a pollution by sewage. Industries are important source of chlorides.

#### **Principle**

Silver nitrate reacts with chloride to form slightly soluble white ppt of Agcl. At the end when all the chlorides get precipitated, free silver ions react with chromate to form silver chromate of reddish brown colour.

#### **Reagents:**

- a) Silver Nitrate (0.02N) : dissolve 3.4 gm of dried  $\text{AgNO}_3$  distilled water to make 1L of solution & keep in a dark bottle
- b) Potassium chromate (5%) : Dissolve 5gm of  $\text{K}_2\text{Cr}_2\text{O}_4$  in 100 ml of distilled water.

#### **Procedure**

1. Take 25ml of sample in a flask. If sample is having higher conc. Of chloride, take a small volume & dilute to 50ml.
2. Add few drops of chromate solution.
3. Titrate it against 0.0141N  $\text{AgNO}_3$  until a persistent red tinge appears.

#### **Observation**

sample type	sample volume	Initial tit-rant reading (ml)	Final titrant reading(ml)	volume of titrant used (ml)
drain sample	25	0	6	6

#### **Calculation:**

$$\text{Cl}(\text{mg/l}) = (A-B) \times N (\text{AgNO}_3) \times 35.5 \times 1000 / \text{volume of sample}$$

Where, A = ml of titrant for sample

B=ml of titrant for blank

$$N_{(\text{AgNO}_3)} = \text{Normality of AgNO}_3 (0.0141\text{N})$$

$$\text{Cl}(\text{mg/l}) = (6-0) \times 0.0141 \times 35.5 \times 1000 / 25 = 120 \text{ mg/l}$$

## Result

Chloride present in the sample =120mg/l

### 3.2 BIOLOGICAL OXYGEN DEMAND (B.O.D.)

B.O.D is taken as indirect measure of water quality. It is in fact a measure of the amount of Oxygen required by microbes while stabilizing decompose organic matter.

#### **Method :** Titration

- a) Reagents: Sodium Thiosulphate (Hypo) Solution: 0.025N (N/40) solution: Dissolve 6.205g of  $\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{SH}_2\text{O}$  in previously distilled water and make up the volume to 1L. Add a pellet of NaOH as stabilizer. Keep the solution in a dark colored glass stopper bottle.
- b) Manganous sulphate solution: Dissolved 100g of  $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$  in 200ml of previously boiled distilled water and filter the solution
- c) Alkaline Azide solution : Dissolved 100g of  $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$  in 200ml of previously boiled distilled water and filter the solution.
- d) Starch indicator solution: dissolve 1g of starch in 100 mL of warm (80cc-90cc) distilled water and add a few drops of formaldehyde solution or toluene as preservatives.

**Procedure:** a) dilution water was prepared in a container by bubbling compressed air in distilled water for 2 hours.

b) One ml each of phosphate buffer, magnesium sulphate, and calcium chloride and ferric chloride solutions for each litre of dilution water was added and mixed thoroughly.

c) the ph. of the sample was maintained around 7.0 by using 1N NaOH or  $\text{H}_2\text{SO}_4$ .

d) Several dilution of the sample were prepared. 3 BOD bottles were prepared for each dilution of the sample.

e) One set of the bottle were kept in BOD incubator at  $20^\circ\text{C}$  for 5 days and the DO content of the another set were determined immediately.

f) The do of the sample bottle kept for incubation, were determined after the completion of 5 days.

g) Similarly for blank 6 BOD bottles of dilution water were taken and same process was taken.

### **Calculation**

BOD (5 days at 20° c) mg/l=  $\{(D_1 - D_2) - (C_1 - C_2) F\} / P$

Where,  $D_1$  = initial dissolved oxygen content of the diluted sample

$D_2$  = D.O content of the diluted sample after incubation

$C_1$ =initial D.O content of the seeded dilution water

$C_2$  =D.O content of the seeded dilution water after incubation

F=ration of the seed in the sample to that in the control

P=decimal fraction of the seed used

### **3.3 CHEMICAL OXYGEN DEMAND (C.O.D.)**

In C.O.D. organics are used chemically and C.O.D. values are always higher than the B.O.D. values.

Chemical Oxygen demand is the measure of oxygen consumed during the oxidation of oxidizable organic matter by strong oxidizing agent.

( $K_2Cr_2O_7$ ) in the presence of  $H_2SO_4$ .

Method: Titration

#### **Reagents:**

- a) Sulphuric acid
- b) Mercuric sulphate ( $HgSO_4$ ) Solid
- c) ( $AgSO_4$ ) silver sulphate solid
- d) Ferroin indicator
- e) Ferrous ammonium sulphate (0.1N) dissolve 39.2g of  $Fe (NH_4)_2(SO)_2 \cdot 6H_2O$  in water adding 20mL conc.  $H_2SO_4$  to make 1L.
- f) Standard potassium dichromate ( $K_2Cr_2O_7$ ) solution: Dissolve 12.259g of dried A.R. grade  $K_2Cr_2O_7$  in distilled water to make it 1L. Solution.

#### **Procedure:**

- a) Took 20mL of sample in a 250-500 mL C.O.D. flask.
- b) Added 10mL,  $K_2Cr_2O_7$  solution.
- c) Added a pinch of  $HgSO_4$  and  $Ag_2SO_4$
- d) Added slowly 30mL conc.  $H_2SO_3$ , mixed it well.
- e) Connected the flask in reflux (Heat reflux) and set the timer for a minimum of 2 hours. Coiled them and then add 80mL distilled water in solution.

- f) Then transferred the solution in conical flask and then kept it for cooling. After cooling, poured 2-3 drops Ferro in indicator and titrated it against ferrous ammounium sulphate solution. Sharp colour changes from blue green to wine red indicated the end point or completion of the titration.
- g) Refluxed blank sample in the same manner using distilled water instead of sample.

**Observation table**

sample type	sample volume	Initial titrant reading (ml)	final titrant reading (ml)	Volume of titrant used (ml)
blank	20	0	25.05	25.05
drain sample	20	0	11.37	11.37

**Calculation**

COD (mg/l) =

$$\frac{(A-B) \times N \times 8000}{\text{Volume of smaple}}$$

- A= burette reading
- B= Reading of blank
- N= normality of ferrous ammonium sulphate (0.1N)

$$\text{COD (mg/l)} = (25.05 - 11.37) \times 0.1 \times 8000/20$$

$$= 547.2 \text{ mg/l}$$

## Result

COD Present in the sample = 547.2mg/l

### 3.4 PH

PH value is the logarithm of reciprocal of hydrogen ion activity in moles per litre. It is used to express the intensity of acidic or alkaline condition of a solution. It is used to express the intensity of acidic or alkaline condition of a solution. The overall PH value range of natural water is generally between 6 and 8. Temperature change, dissolved gas such as CO<sub>2</sub>, H<sub>2</sub>S and ammonia affect PH value of water. Hence PH value should be determined at the time of collection of sample.

- Method : Electrometric
- Instrument : PH scale
- **Reagents**
  - a) Potassium Hydrogen – phthalate Buffer (PH=4.0): 10.2g potassium hydrogen- phthalate+ distilled water up to 100mL mark.
  - b) Phosphate buffer (PH=7.0): 3.4g KH<sub>2</sub>PO<sub>4</sub>+4.4gNa<sub>2</sub>HPO<sub>4</sub>·2H<sub>2</sub>O+ distilled water up to 100 mL mark.
  - c) Born Buffer (PH=9.0): 3.18g NA<sub>2</sub>B<sub>4</sub>O<sub>7</sub>·10H<sub>2</sub>O+ Distilled water upto 100mL mark.

### **Procedure:**

- a) PH meter was standardized with the buffer solution of PH 4,7 & 9 Electrometer response was checked by measuring PH of another standard buffer solution having different PH value.
- b) Electrodes were immersed in the sample and PH of the sample was recorded.

### Observation

Sample	Ph value
S1	5.31
S2	8.56
S3	7.53
S4	7.5

### 3.5 TOTAL SUSPENDED SOLID (T.S.S.)

#### Principle :

Total suspended solids are separated from the dissolved ones by means of a good crucible. The sample is drawn through the crucible with the help of vacuum. Suspended solids are retained on the filter paper.

#### Procedure:

- At first weighed the filter paper and noted its weight ( $W_1$ )
- Then took 50mL sample and poured through the crucible with the help of vacuum (after shaking well the taken sample)
- Thus, after subtracting the initial weight ( $W_1$ ) to final weight ( $W_2$ ). We got the total suspended solids value.

#### Observation

sample type	sample volume	Initial weight of filter paper	final weight of filter paper
drain sample	50ml	0.05026g	0.08907g



**Calculation:**

Total suspended solid =  $(W_2 - W_1) \times 10^6 / \text{volume of sample}$

Where,  $W_2$  = weight of filter after drying

$W_1$  = initial weight of filter

Total suspended solid (mg/l) =  $(0.08907 - 0.05026) \times 10^6 / 50 = 776.2 \text{ mg/l}$

**Result :**

Total suspended solid present in the sample = 776.2 mg/l

**3.6 TOTAL DISSOLVED SOLID (T.D.S.)****Principal :**

Total dissolved solids are determined as the residue left after evaporation of the filtered sample. Total dissolved solids is the difference between the Total solids and Total suspended solids.

**Procedure :**

- a) filter the sample through paper in pre weighed beaker
- b) dry the sample at 105°C & after that dry at 180° c until complete drying of sample
- c) cool in a desiccators to make moisture free & weigh
- d) the difference between the final weigh of beaker with residue & initial weight of empty beaker give the amount of dissolved solids.

**Observation**

sample type	Sample volume	Initial weight of empty beaker	Final weight of beaker with residue
drain sample	50ml	51.2251g	51.3400g

**Calculation :**

T.D.S. =  $(W_2 - W_1) \times 10^6 / \text{volume of sample}$

Where,  $W_2$  = final weight of beaker with residue (g)

$W_1$  = initial weight of empty beaker (g)

Total dissolved solid =  $(51.3400 - 51.2251) \times 10^6 / 50 = 2298 \text{ mg/l}$

**Result**

Total dissolved solid present in the sample = 2298 mg/l

**3.7 OIL & GREASE**

Oil & grease when present in water forms a layer on water surface. This only surface markedly reduce the rate of oxygen uptake by water thereby affecting aquatic life.

**Principle**

Oil & grease present in water can be extracted in petroleum ether, which is immiscible in water & can be separated by a separatory funnel. This residue, after avaporation of this petroleum ether will yield the oil & grease.

**Reagent**

- Seperatory funnel
- Water bath, filter paper
- Petroleum ether,  $H_2SO_4$ , ethyl alcohol

**Procedure**

1. Take sample in a seperatory funnel.
2. Add 10 ml  $H_2SO_4$  & 25-50ml petroleum ether.
3. Shake well, & if suspension prevails, add small amount of ethyl alcohol. Keep for some time to separate the two distinct layers, the upper one of petroleum either & lower one of sample.
4. Discard lower layer of the sample through separator funnel, through filter paper soaked in petroleum either in a pre-weighed glass beaker.

5. Some more petroleum ether is passed through filter paper so that no oil & grease remain stuck to the paper.
6. The beaker with contents is kept in an oven so as to evaporate the petroleum ether.
7. Take the final weight of the beaker. Difference between the final & initial weight will represent the oil & grease present in the water sample.

### **Observation**

sample	sample volume	Initial weight of empty beaker	Final weight of beaker with oil
drain sample	1180	52.7223 g	52.7237 g

### **Calculation**

oil & grease (mg/L) =  $(W_f - W_i) \times 10^6 / \text{vol. of sample}$

where,  $W_f$  = final weight of beaker with oil content (g)

$W_i$  = initial weight of empty beaker

Oil & grease (mg/l) =  $(52.7237 - 52.7223) \times 10^6 / 1180 = 1.1864 \text{ mg/l}$

### **Result**

Oil & grease present in the sample = 1.1864 mg/l

## **3.8 AMMONIA**

Ammonia is a colourless, gaseous compound with a sharp distinctive odor. It is highly soluble in water where it exists in a molecular form associated with water and ionized form as  $\text{NH}_4^+$ .

Ammonia can be determined in waste water by distillation method. Firstly, distill the sample when all ammonia is absorbed in indicating boric acid containing flask & then titrate it against 0.02N  $\text{H}_2\text{SO}_4$ .

### **Apparatus required**

1. Distillation assembly
2. Borate buffer solution dissolves 5g sodium tetraborate  $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$  in approximately 500ml distilled water. Add to this solution 88ml 0.1 N NaOH and then diluted to 1 litre.
3. Sodium hydroxide (6N) - dissolve 240g NaOH in 1 distilled water.
4. Sulphuric acid  $\text{H}_2\text{SO}_4$  (0.02N) - dilute 98ml or conc  $\text{H}_2\text{SO}_4$  to 1 litre with distilled water & dilute it to 100 times.

- Mixed indicator- dissolved 0.2g metju; red om100; 95% ethanol, and dissolve 0.1 g methylene blue in 500ml 95% ethanol. Mix both the solutions. This solution is stable for 1 month.

### **Procedure**

- Firstly we take the 30ml sample.
- The we check the ph, if the ph. id not the 9 then we maintain the ph value of 9 by adding of NaOH/H<sub>2</sub>SO<sub>4</sub>.
- Add 50-60 ml distilled water.
- Add 15 ml borate butter solution.
- Take 50ml boric acid in to the conical flask.
- Just we keep the solution in the distillation flask. On the one side we keep the sample and on another side we put the 50ml boric acid.
- Collect distillate in 50 ml indicating boric acid taken in 250 ml conical flask.
- Now titrate the distillate with standard 0.02N H<sub>2</sub>SO<sub>4</sub> titrant until color turns to pale bluish purple.
- Carrying out a blank with the same process.

### **observations**

Sample	Sample volume	Initial tit rant reading	final tit rant reading	volume of tit-rant used(ml)
Effluent	30	0	5.9	5.9

### **Calculation**

$NH_3, N \text{ (mg/l)} = (a-b) \times c \times 14 \times 1000 / \text{volume of sample}$

Where, a = volume of H<sub>2</sub>SO<sub>4</sub> (0.02N) for sample titration

b=volume of H<sub>2</sub>SO<sub>4</sub> (0.02N) for blank titration

c=normality of H<sub>2</sub>SO<sub>4</sub>(0.02N)

Ammonia (mg/l) = (5.9-0.0) x 0.02x14x1000/30=55 mg/l

### **Result**

Ammonia present in the sample=55mg/l

### **3.9 CONDUCTIVITY**

A simple conductivity meter with dip type cell was used for this used to measure the conductivity, the instrument and cell were calibrated using 0.005 MKCL solution.

### **OBSERVATION**

sample	Reading(ms)
S1	12.95
S2	3.44
S3	1.16
S4	1.09

### **3.10 PHOSPHATE**

Phosphorus being an important constituent of biological systems, may also be present in the organic forms. The major sources of the phosphorous are domestic sewage, detergents, agricultural effluents with fertilizers & industrial waste water. The higher concentration of indicative of pollution.

The phosphorus in water reacts with ammonium molybdenum & form complex heteropoly acid, which gets reduced to a complex of blue colour in the presence of  $\text{SnCl}_2$ .

#### **Apparatus & reagent**

**Spectrophotometer for use at 690 nm**

**Acid washed glass wares**

**Ammonium molybdate solution**

a) dissolve 25g of ammonium molybdte in 175ml of distilled water

b) Add 280 ml of conc.  $\text{H}_2\text{SO}_4$  to 400ml of distilled water & cool. Now, mix the two solutions (a) & (b) & dilute to 1L.

### **Stannous chloride solution**

Dissolved 25g  $\text{SnCl}_2$  in 100ml glycerol by heating on a water bath for rapid dissolution.

### **Standard phosphate solution**

Dissolved 4.388g of dried anhydrous potassium hydrogen phosphate ( $\text{K}_2\text{HPO}_4$ ) in distilled water & make up the vol. upto 1L. Dilute this solution to 100 times. This is standard phosphate solution.

### **procedure**

- 1.) Take 50 ml of filtered clear sample in nessler tubes. If the sample contains colour & colloidal impurities, they can be removed by adding a spoonful of activated charcoal & then filtering the sample.
- 2.) Add 2 ml of ammonium molybdate followed by 2-3 drops of stannous chloride.
- 3.) A blue colour will appear take reading at 690 nm on a spectrophotometer using distilled water as blank with the same amount of chemical.
- 4.) Find out the concentration with the help of standard curve.

### **Preparation of standard curve**

- 1) make various dilutions at the interval of 0.1 mgp/l from the standard phosphate solution
- 2) Take 50ml of each dilution & add 2 ml ammonium molybdate solution followed by 5 drops of  $\text{SnCl}_2$  solution
- 3) Take the reading at 690 nm & plot a graph between absorbent & concentration

### **Calculation**

Compare the reading of absorbent of sample with calibration curve and note down the concentration as mg/l  $\text{PO}_4$ , if any dilution is there, multiply it with the observed concentration and note down the final concentration as  $\text{PO}_4\text{-Pmg/l}$

## **4. SAMPLING, SAMPLE HANDLING & PRESERVATION**

Composite samples of waste water from different sampling points were collected for characterization and treat ability studies. The waste water were sampled and analyzed as per the standard Methods, American Public Health Association, APHA- 1985.

### **4.1 SAMPLING**

The significance of the chemical analysis depends to a large extent on the sampling program me. These conditions are met by collection of sample through a process of random selection. These ensure that the composition of the sample is identical to that of the water body from which it is collected and the sample share the same physic- chemical characteristics with the sampled water at the time and site of sampling.

The relevant factors for any sampling program me are

- (a) Frequency of sampling collection.
- (b) Total number of samples.
- (c) Size of each sample.
- (d) Sites of sample collection
- (e) Method of sample collection
- (f) Data to be collected with each sample.
- (g) Transportation and care of samples prior to analysis.

For analysis of natural and waste water, three principal types of sampling procedures are employed:-

#### **1) Spot or grab samples**

Spot or grab samples are discrete portions of water samples taken at a given time. This type of sample is valid only when it is certain that the water quality is not changing in a short time and effluent discharges, if any are fairly regular.

It is advisable to collect and analyze the grab samples separately at various timings, if the water quality is known to change with time in such cases the schedule of timings shall be dependent on the frequency of discharge or change in water quality.

## 2) Composite sample

Composite samples are essentially weighted series of grab samples the volume of each being proportional to the rate of flow of the water stream at the time and site of sample collection. Sample may be composite sample are useful for determining the average condition which when correlated with flow can be used for computing the material balance of a stream of water body over a period of time.

## 3) Integrated sample

In some cases the samples may be collected from a member of nearby localities and may be pooled together to avoid minor variation. This can be done for various samples across the width or a river or the surface and bottom samples of a shallow pond. In deep lakes, however, separate grab samples at various depths shall be required.

### **4.2 COLLECTION OF EFFLUENT SAMPLE:-**

Collection of waste-water is an important part of waste water characteristics and treatment of efficiency. In such cases it is often necessary to acquire hold of a map of all pipelines and systems providing details of size direction and volume of waste water along with all the details of pipelines.

### **4.3 FLOW MEASUREMENT :-**

A Number of methods for measuring flow in streams and wastewater carrying pipes are available.

#### 1) Bucket method

This method is applicable when the waste water is falling from a pipe of sewer. A bucket can be used to fill water from this pipe and the time taken in filling and noted by using a stop watch.

Flow (in liters/min) =

(Liters in bucket x 60) /time in second

#### 2) Surface float method

This is a simple approach. A float (any piece of wood, plastic etc.) is travel (t), a known distance (d) is observed and the average velocity is obtained by

$$V = \frac{d}{1.2t}$$

The factor 1.2 accounts for the fact that surface velocities are normally about 1.2 times higher. If the cross-sectional area (A) is measured, the discharge Q is given by:-

$$Q = VA$$

This method is useful only in shallow and small streams.



#### **4.4 SAMPLE HANDLING AND PRESERVATION:--**

The sample is taken either in polythene bottle or glass bottles of about one litre capacity. Each bottles (glass/polythene) for sample collection should be thoroughly cleaned by rinsing with 8m HNO<sub>3</sub> followed by repeated washing with deionized distilled water. They should be rinses thrice with the sample of water before collection. Each bottle should be well labeled with water proof ink, and recorded the relevant details for each sample just after sampling.

<b>PARAMETER</b>	<b>MINIMUM SAMPLE SIZE ML</b>	<b>CONTATNER TYPE</b>	<b>PRESERVATION</b>	<b>OPTIMUM HOLDING TIME</b>
Ph	100	POLYTHENE/GLASS (P/G)	Not required	Test on site
Temperature	1000	P/G		Determine on Site
D.O.	300	GLASS		Determine/fix on site
ACIDITY	100	P/G	Refrigerate-4°C	24 hrs.
Alkalinity	100	P/G	"	24 hrs.
BOD	1000	P/G	"	6 hrs.
COD	50	P/G	H <sub>2</sub> SO <sub>4</sub> toph2	7 days

CHLORINE	500	P/G		Analyse
(Residual)			Not required	immediately
CHLORIDE	50	P/G		7 days
			Refrigerate-4°C	
COLOUR	50	P/G		24 hours.
			Refrigerate-4°C	
NITROGEN	500	P/G	H <sub>2</sub> SO <sub>4</sub> <2	24 hours.
AMMONIA			And refrigerate	
NITRATE	500	P/G	4°C	24 hours
NITRITE			NaOH to ph12	
CYNIDE	500	P/G	Refrigerte-4°C	24 hours
			Refrigerate-4°C	
HARDNESS	100	P/G	Refrigerate-4°C	7 days
SULPHATE	100	P/G		7 days
SULPHIDE	100	P/G		Analyse
				immediately

PHOSPHATE	50	P/G	Refrigerate-4°C	24 hours.
OIL AND GREASE	100	G	Add HCL to ph<2	24 hrs.
SOLIDS (Total /Dissolved)	100	P/G	Refrigerate-4°C	7 days.
Metals  (Cr, As, Pb, Zn,  Hg)	500	P/G	Add 5 ml cone.  HNO <sub>3</sub> <1  and refrigerate  4°C	6 months

Note :- P/G =Polythene/ Glass.

Source: “STANDARD Methods for the examination of water and waste water”.

-APHA (22<sup>nd</sup> edition)

## **5. DIFFERENT CONTROL MEASURES FOR WATER POLLUTION**

Decisions on the type and degree of treatment and control of wastes, and the disposal and use of adequately treated waste water, must be based on a consideration all the technical factors of each drainage basin, in order to prevent any further contamination or harm to the environment.

### **5.1 DOMESTIC SEWAGE**

Domestic sewage is typically 99.9 percent water with 0.1 percent pollutants. Although found in low concentrations, these pollutants pose risk on a large scale. In urban areas in developed countries, domestic sewage is typically treated by centralized sewage treatment plants. Well-designed and operated system (i.e., secondary treatment or better) can remove 90 percent or more of these pollutants. Some plants have additional systems to remove nutrients and pathogens. Most municipal plants are not specifically designed to treat toxic pollutants found in industrial waste water.

Cities with sanitary sewer overflows or combined sewer overflows employ one or more engineering approaches to reduce discharges of untreated sewage, including Utilizing a green infrastructure approach to improve storm water management capacity throughout the system, and reduce the hydraulic overloading of the treatment plant. Repair and replacement of leaking and malfunctioning equipments. Increasing overall hydraulic capacity of the sewage collection system.

A household or business not served by a municipal treatment plant may have an individual septic tank, which treats the waste water on site and discharges into the soil. Alternatively, domestic waste water may be sent to a nearby privately owned treatment system (e.g. in a rural community).

### **5.2 INDUSTRIAL WASTE WATER**

Some industrial facilities generate ordinary domestic sewage that can be treated by municipal facilities. Industries that generate waste water with high concentrations of conventional pollution (e.g.oil and grease), toxic pollutants (e.g. heavy metals, volatile organic compounds) or other non-conventional pollutants such as ammonia, need specialized treatment systems. Some of these facilities can install a pre-treatment system to remove the toxic components, an then send the

partially treated waste water to the municipal system. Industries generating large volumes of waste water typically operate their own complete on-site treatment systems. Some industries have been successful at redesigning their manufacturing processes to reduce or eliminate pollutants, through a process called pollution prevention.

Heated water generated by power plants or manufacturing plants may be controlled with.

1. Cooling ponds, man-made bodies of water designed for cooling by evaporation, convection, and radiation.
2. Cooling towers, which transfer waste heat to the atmosphere through evaporation and/or heat transfer.
3. Co generation, a process where waste heat is recycled for domestic and /or industrial heating purposes.

### **5.3 AGRICULTURAL WASTE WATER**

#### **1) Non- point source controls**

Sediment (loose soil) washed off fields is the largest source of agricultural pollution in the United States. Farmers may utilize erosion controls to reduce runoff flows and retain soil on their fields. Common techniques include contour plowing, crop mulching, crop rotation, planting perennial crops and installing riparian buffers.

Nutrients (nitrogen and phosphorus) are typically applied to farmland as commercial fertilizer, animal manure, or spraying of municipal or industrial waste water (effluent) or sludge. Nutrients may also enter runoff from crop residues, irrigation water, wildlife, and atmospheric deposition. Farmers can develop and implement nutrient management plans to reduce excess application of nutrients and reduce the potential for nutrient pollution.

To minimize pesticide impacts, farmers may use integrated pest Management (IPM) techniques (which can include biological pest control) to maintain control over pests, reduce, reliance on chemical pesticides, and protect water quality.

#### **2) Point source waste water treatment**

Animal slurries are usually treated by containment in anaerobic lagoons before disposal by spray or trickle application to grassland. Constructed wetlands are sometimes used to facilitate treatment of animal wastes. Some animal slurries are treated by mixing with straw and composted at high temperature to produce a bacteriologically sterile and friable manure for soil improvement.

## 6. INTERFERENCES

Parameter	Interference	Removal
Total hardness	heavy metal like Cu, C, pb etc.	Sodium sulphide
Suspended solids	Too much residue on filter will entrap water	Prolonged drying
Total Dissolved solids	Highly mineralized water Ca, Mg Cl	Prolonged drying, desiccation & rapidly weighting
Ammonia	Volatile amines	distillation
Phosphate	Cr. Sulphide	Ascorbic acid+KmnO4
Chloride	organic compounds	Acidify with H2SO4
COD	Cl, Br	AgSO4,HgSO4

## 7. RESULT

This is the result of some of the sample

Parameter	ph	TSS	COD	BOD	TDS
S1	7.91	524mg/l	444mg/l	190mg/l	126mg/l
S2	7.38	269mg/l	342mg/l	212mg/l	166mg/l
S3	7.91	524mg/l	444mg/l	190mg/l	122mg/l
S4	7.35	625mg/l	504mg/l	359mg/l	128mg/l
S5	7.02	342mg/l	473mg/l	190mg/l	144mg/l
S6	7.35	21mg/l	58mg/l	10mg/l	42mg/l
S7	6.95	392mg/l	667mg/l	234mg/l	98mg/l
S8	7.65	372mg/l	660mg/l	224mg/l	110mg/l
S9	7.19	593mg/l	688mg/l	270mg/l	159mg/l
S10	7.67	216mg/l	271mg/l	123mg/l	98mg/l

Accordingly, to the above results, prescribed tolerance limit has been taken under Environmental protection Act.

- The acceptance limit for ph accordingly to EPA is 6.5-8.5
- The acceptance limit for TSS accordingly to EPA is 600 mg/l
- The acceptance limit for COD accordingly to EPA is 250 mg/l
- The acceptance limit for BOD accordingly to EPA is 350 mg/l (for public sewers)
- The acceptance limit for TDS is 500 mg/l

## **8. REFERENCES**

- 1) Pollution control acts, rules and notification issued these under Schedule – 1" standards for emissions or discharge of environment pollutants from various Industries." pollution control series PCLS/02/2010 (Sixth edition)
- 2) Standard method for the examination of water & waste water 22<sup>nd</sup> edition (APHA)
- 3) A.KDE;' Environment chemistry "2010 7<sup>th</sup> Edition new age international (P) Limited".