

Characterization of Sewage and Design of Sewage Treatment Plant

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ABSTRACT: A study on domestic waste water characterization has been performed followed by the design of sewage treatment plant. The present study involves the analysis of pH value, total solids, total suspended solids, hardness, acidity, alkalinity, chloride, chlorine, BOD, DO and heavy metals such as Iron, Copper, Zinc, Magnesium, Nickel, Chromium, Lead, Calcium, Aluminum, Silicon, Potassium. A sewage treatment plant is quite necessary to receive the domestic and commercial waste and removes the materials which pose harm for general public. Its objective is to produce an environmentally-safe fluid waste stream (or treated effluent) and a solid waste (or treated sludge) suitable for disposal or reuse (usually as farm fertilizer). The samplings of the domestic waste from hostels have been done in different times of the day to have an average data of the measured parameters. The average values of pH, Turbidity, Acidity, Chloride, Residual Chlorine, Hardness, Total Solid, BOD, DO, Alkalinity, Total Iron Content, Zinc Content, Potassium, Copper, Magnesium, Nickel, Chromium, Lead, Calcium, Aluminum and Silicon are found out. A sewage treatment plant has been designed with the treatment units, a bar screen of dimension 1.7m, an aeration tank of dimension 4.5 x 4.5 x 3.7 m³, a collection pit of diameter 4m and depth 5 m.

I. INTRODUCTION

Pollution in its broadest sense includes all changes that curtail natural utility and exert deleterious effect on life. The crisis triggered by the rapidly growing population and industrialization with the resultant degradation of the environment causes a grave threat to the quality of life. Degradation of water quality is the unfavorable alteration of the physical, chemical and biological properties of water that prevents domestic, commercial, industrial, agricultural, recreational and other beneficial uses of water.

Sewage and sewage effluents are the major sources of water pollution. Sewage is mainly composed of human fecal material, domestic wastes including wash-water and industrial wastes. The growing environmental pollution needs for decontaminating waste water result in the study of characterization of waste water, especially domestic sewage. In the past, domestic waste water treatment was mainly confined to organic carbon removal. Recently, increasing pollution in the waste water leads to developing and implementing new treatment techniques to control nitrogen and other priority pollutants.

Sewage Treatment Plant is a facility designed to receive the waste from domestic, commercial and industrial sources and to remove materials that damage water quality and compromise public health and safety when discharged into water receiving systems. It includes physical, chemical, and biological processes to remove various contaminants depending on its constituents. Using advanced technology it is now possible to re-use sewage effluent for drinking water.

II. TREATMENT PROCESS

2.1 INTRODUCTION:

Sewage treatment is the process of removing contaminants from wastewater, primarily from household sewage. It includes physical, chemical, and biological processes to remove these contaminants and produce environmentally safer

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treated wastewater (or treated effluent). A by-product of sewage treatment is usually a semi-solid waste or slurry, called sewage sludge that has to undergo further treatment before being suitable for disposal or land application. Sewage treatment may also be referred to as wastewater treatment, although the latter is a broader term which can also be applied to purely industrial wastewater. For most cities, the sewer system will also carry a proportion of industrial effluent to the sewage treatment plant which has usually received pretreatment at the factories themselves to reduce the pollutant load. If the sewer system is a combined sewer then it will also carry urban runoff (stormwater) to the sewage treatment plant. Sewage water can travel towards treatment plants via piping and in a flow aided by gravity and pumps. The first part of filtration of sewage typically includes a bar screen to filter solids and large objects which are then collected in dumpsters and disposed of in landfills. Fat and grease will also be removed before the primary treatment of sewage.

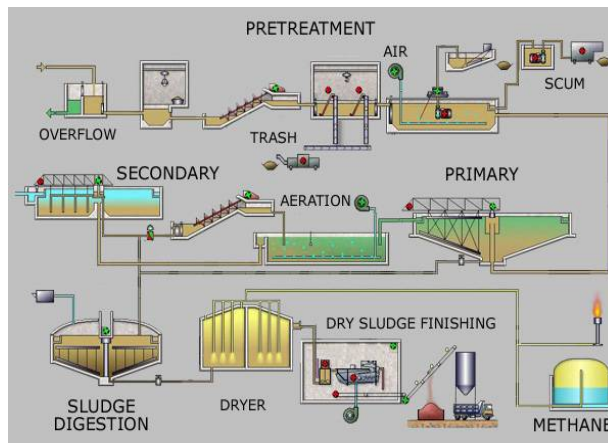


Figure: 1 Pretreatment

2.1.1 PRETREATMENT:

Pretreatment removes all materials that can be easily collected from the raw sewage before they damage or clog the pumps and sewage lines of primary treatment clarifiers. Objects commonly removed during pretreatment include trash, tree limbs, leaves, branches, and other large objects.

- Grit removal
- Flow equalization
- Fat and grease removal



Figure: 2 Primary treatment tanks

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2.2.2 PRIMARY TREATMENT

In the primary sedimentation stage, sewage flows through large tanks, commonly called "pre-settling basins", "primary sedimentation tanks" or "primary clarifiers". The tanks are used to settle sludge while grease and oils rise to the surface and are skimmed off. Primary settling tanks are usually equipped with mechanically driven scrapers that continually drive the collected sludge towards a hopper in the base of the tank where it is pumped to sludge treatment facilities. 9–11 Grease and oil from the floating material can sometimes be recovered for saponification (soap making).

2.2.3 SECONDARY TREATMENT

Main article: Secondary treatment

Secondary treatment is designed to substantially degrade the biological content of the sewage which are derived from human waste, food waste, soaps and detergent. The majority of municipal plants treat the settled sewage liquor using aerobic biological processes. To be effective, the biota requires both oxygen and food to live. The bacteria and protozoa consume biodegradable soluble organic contaminants (e.g. sugars, fats, organic short-chain carbon molecules, etc.) and bind much of the less soluble fractions into floc.

Secondary treatment systems are classified as fixed-film or suspended-growth systems.

- Fixed-film or attached growth systems include trickling filters, constructed wetlands, bio-towers, and rotating biological contactors, where the biomass grows on media and the sewage passes over its surface. 11–13 the fixed-film principle has further developed into Moving Bed Bio film Reactors (MBBR) and Integrated Fixed-Film Activated Sludge (IFAS) processes. An MBBR system typically requires a smaller footprint than suspended-growth systems.



Figure: 3 Secondary clarifier at a rural treatment plant.

Some secondary treatment methods include a secondary clarifier to settle out and separate biological floc or filter material grown in the secondary treatment bioreactor.

2.2.4 TERTIARY TREATMENT

The purpose of tertiary treatment is to provide a final treatment stage to further improve the effluent quality before it is discharged to the receiving environment (sea, river, lake, wet lands, ground, etc.). More than one tertiary treatment process may be used at any treatment plant. If disinfection is practiced, it is always the final process. It is also called "effluent polishing."

Filtration

Sand filtration removes much of the residual suspended matter. [7]:22–23 Filtration over activated carbon, also called carbon adsorption, removes residual toxins [19]

Lagoons or ponds

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Figure: 4 Lagoons or ponds

Lagoons or ponds provide settlement and further biological improvement through storage in large man-made ponds or lagoons. These lagoons are highly aerobic and colonization by native macrophytes, especially reeds, is often encouraged. Small filter-feeding invertebrates such as *Daphnia* and species of *Rotifera* greatly assist in treatment by removing fine particulates.

Biological nutrient removal

Biological nutrient removal (BNR) is regarded by some as a type of secondary treatment process,[1] and by others as a tertiary (or "advanced") treatment process.

Wastewater may contain high levels of the nutrients nitrogen and phosphorus. Excessive release to the environment can lead to a buildup of nutrients, called eutrophication, which can in turn encourage the overgrowth of weeds, algae, and cyan bacteria (blue-green algae). This may cause an algal bloom, a rapid growth in the population of algae. The algae numbers are unsustainable and eventually most of them die. The decomposition of the algae by bacteria uses up so much of the oxygen in the water that most or all of the animals die, which creates more organic matter for the bacteria to decompose. In addition to causing de oxygenation, some algal species produce toxins that contaminate drinking water supplies. Different treatment processes are required to remove nitrogen and phosphorus.

Nitrogen removal

Nitrogen is removed through the biological oxidation of nitrogen from ammonia to nitrate (nitrification), followed by DE nitrification, the reduction of nitrate to nitrogen gas. Nitrogen gas is released to the atmosphere and thus removed from the water.

Nitrification itself is a two-step aerobic process, each step facilitated by a different type of bacteria. The oxidation of ammonia (NH_3) to nitrite (NO_2^-) is most often facilitated by *Nitrosomonas* spp. ("nitroso" referring to the formation of a nitroso functional group). Nitrite oxidation to nitrate (NO_3^-), though traditionally believed to be facilitated by *Nitro bacter* spp. (nitro referring the formation of a nitro functional group), is now known to be facilitated in the environment almost exclusively by *Nitrospira* spp.

Phosphorus removal

Every adult human excretes between 200 and 1000 grams of phosphorus annually. Studies of United States sewage in the late 1960s estimated mean per capita contributions of 500 grams in urine and feces, 1000 grams in synthetic detergents, and lesser variable amounts used as corrosion and scale control chemicals in water supplies. Source control via alternative detergent formulations has subsequently reduced the largest contribution, but the content of urine and feces will remain unchanged. Phosphorus removal is important as it is a limiting nutrient for algae growth in many fresh water systems. (For a description of the negative effects of algae, see Nutrient removal). It is also particularly important for water reuse systems where high phosphorus concentrations may lead to fouling of downstream equipment such as reverse osmosis.

Disinfection

Further information: Advanced oxidation process

The purpose of disinfection in the treatment of waste water is to substantially reduce the number of microorganisms in the water to be discharged back into the environment for the later use of drinking, bathing, irrigation, etc. The effectiveness of disinfection depends on the quality of the water being treated (e.g., cloudiness, pH, etc.), the type of disinfection being used, the disinfectant dosage (concentration and time), and other environmental variables. Cloudy

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water will be treated less successfully, since solid matter can shield organisms, especially from ultraviolet light or if contact times are low. Generally, short contact times, low doses and high flows all militate against effective disinfection. Common methods of disinfection include ozone, chlorine, ultraviolet light, or sodium hypochlorite.¹⁶ Chloramine, which is used for drinking water, is not used in the treatment of waste water because of its persistence. After multiple steps of disinfection, the treated water is ready to be released back into the water cycle by means of the nearest body of water or agriculture. Afterwards, the water can be transferred to reserves for everyday human uses.

2.2.5. FOURTH TREATMENT STAGE

Further information: Environmental impact of pharmaceuticals and personal care products Micro pollutants such as pharmaceuticals, ingredients of household chemicals, chemicals used in small businesses or industries, environmental persistent pharmaceutical pollutant (EPPP) or pesticides may not be eliminated in the conventional treatment process (primary, secondary and tertiary treatment) and therefore lead to water pollution. Although concentrations of those substances and their decomposition products are quite low, there is still a chance to harm aquatic organisms. For pharmaceuticals, the following substances have been identified as "toxicologically relevant": substances with endocrine disrupting effects, genotoxic substances and substances that enhance the development of bacterial resistances. They mainly belong to the group of environmental persistent pharmaceutical pollutants. Techniques for elimination of micro pollutants via a fourth treatment stage during sewage treatment are being tested in Germany, Switzerland [citation needed] and the Netherlands. However, since those techniques are still costly, they are not yet applied on a regular basis. Such process steps mainly consist of activated carbon filters that adsorb the micro pollutants. Ozone can also be applied as an oxidative method.

Odor Control

Odors emitted by sewage treatment are typically an indication of an anaerobic or "septic" condition. Early stages of processing will tend to produce foul-smelling gases, with hydrogen sulfide being most common in generating complaints. Large process plants in urban areas will often treat the odors with carbon reactors, a contact media with bio-slimes, small doses of chlorine, or circulating fluids to biologically capture and metabolize the noxious gases. Other methods of odor control exist, including addition of iron salts, hydrogen peroxide, calcium nitrate, etc. to manage hydrogen sulfide levels.

High-density solids pumps are suitable for reducing odors by conveying sludge through hermetic closed pipe work.

2.4 SLUDGE TREATMENT AND DISPOSAL

Main article: Sewage sludge treatment

The sludge's accumulated in a wastewater treatment process must be treated and disposed of in a safe and effective manner. The purpose of digestion is to reduce the amount of organic matter and the number of disease-causing microorganisms present in the solids. The most common treatment options include anaerobic digestion, aerobic digestion, and composting. Incineration is also used, albeit to a **much lesser degree.**^{19–21}

Sludge treatment depends on the amount of solids generated and other site-specific conditions. Composting is most often applied to small-scale plants with aerobic digestion for mid-sized operations, and anaerobic digestion for the larger-scale operations.

The sludge is sometimes passed through a so-called pre-thickener which de-waters the sludge. Types of pre-thickeners include centrifugal sludge thickeners rotary drum sludge thickeners and belt filter presses. Dewatered sludge may be incinerated or transported offsite for disposal in a landfill or use as an agricultural soil amendment.

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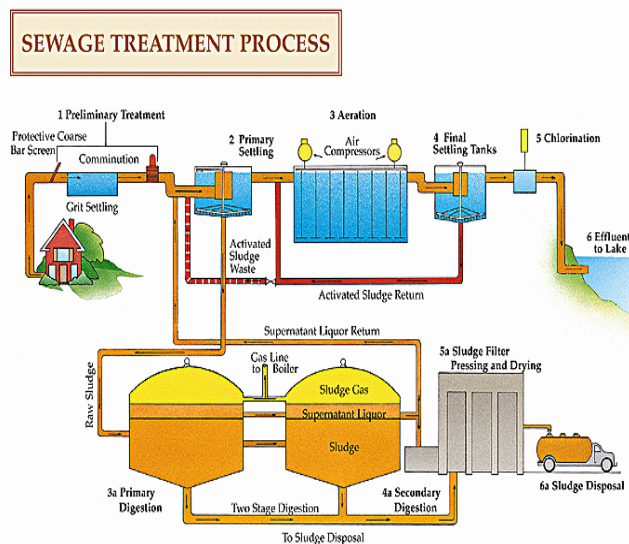


Figure: 5 sewage treatment process

III. MATERIALS AND METHODS

3.1. METHODOLOGY FOR MEASUREMENT OF pH VALUE (ELECTROMERIC METHODS)

The negative logarithm of concentration of hydrogen ion gives the pH of a sample. PH varies from 6-8 in waste water sample, due to hydrolysis of salts of bases and acids. Carbon dioxide, Hydrogen Sulphide and Ammonia which are dissolved affect pH value of water. pH value may be more than 9 in alkaline springs and the pH may be 4 or even less than 4 for acidic ones. Industrial wastes do affect the pH as it depends on buffer capacity of water. pH value of water sample in lab changes because of lossor absorption of gases, reactions with sediments, chemical reaction taking place within the sample bottle. Therefore pH value should preferably be determined at the time of collection of sample. pH can be determined electrometrically or calorimetrically. The electrometric method is more accurate but requires special apparatus. The calorimetric method is simple and requires less expensive apparatus, and is sufficiently accurate for general work.

PRINCIPLE

The pH value is found by measurement of the electromotive force generated in a cell. It is made up of an indicator electrode which is reactive to hydrogen ions such as a glass electrode. When it is immersed in the test solution the contact between reference electrode (usually mercury/calomelelectrode), and the test solution the electromotive force is measured. A Ph meter, that is, a high impedance voltmeter is marked in terms of pH. Varieties of electrodes have been suggested for the determination of pH. The hydrogen gas electrode is the primary standard. Glass electrode in coordination with calomel electrode is generally used with reference Potential provided by saturated calomel electrode. The glass electrode system is based on the theory that a change, of 1 pH unit produces anelectrical change of 59.1 mV at 25°C. The membrane of the glass forms a partition between two liquids of differing hydrogen ion concentration thusa potential is produced between the two sides of the membrane which is proportional to the difference in pH between the liquids.

The apparatus used are:

- pH meter - With glass and reference electrode (saturated calomel),preferably with temperature compensation.
- Thermometer - With least Count of 0.5°C.

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3.2 METHODOLOGY FOR MEASUREMENT OF ALKALINITY

The sample liquid for analysis should be either free from turbidity or should be allowed to settle before analyzing it.

The apparatus used are:

- pH Meter
- Burette - 50-ml capacity.
- Magnetic Stirrer Assembly

The reagents used are:

- Distilled Water - pH must be greater than 6.0. In case the pH falls below 6.0, it shall be boiled for 15 minutes and cooled to room temperature.
- Sulphuric Acid - 5.6 ml of concentrated sulphuric acid is diluted with one liter with distilled water.
- Standard Solution of Sulphuric Acid - 0.02 N.
- Phenolphthalein Indicator - 0.5 g of phenolphthalein in 100 ml is mixed, 1: 1 (v/v) alcohol water mixture is taken.
- Mixed indicator Solution - Dissolve 0.02 g methyl red and 0.01 g bromocresol green in 100 ml, 35 %, ethyl or isopropyl alcohol.

3.3 METHODOLOGY FOR THE DETERMINATION OF TURBIDITY:

PRINCIPLE:

The intensity of light scattered by the sample under defined conditions is compared with the intensity of light scattered by a standard reference suspension under the same conditions, forms the basis of determination of turbidity.

Higher the intensity of scattered lights higher the value of turbidity. Formazin polymer is generally used as turbidity standard because it is more reproducible than other types of standards used previously. The turbidity of a particular concentration of Formazin suspension is defined as 40 Jackson turbidity units. The same suspension of Formazin has a turbidity of approximately 40 units when measured on Jackson candle turbid meter. Thus turbidity units based on the Formazin preparation closely approximate those derived from Jackson candle turbid meter but it may not always be identical to them.

The apparatus used are:

- Sample Tubes - The sample tubes should be of clear and colorless glass.
- Turbidimeter

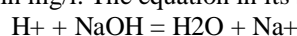
The reagents used are:

- Turbidity-Free Water
- Hexamethylene Tetramine Solution
- Hydrazine Sulphate Solution
- Turbidity Standard Suspension I (Formazin)
- Turbidity Standard Suspension II

3.4 METHODOLOGY FOR THE DETERMINATION OF ACIDITY:

PRINCIPLE:

Acidity of water is the numerically expressible capacity to react with a strong base to a designated pH. It may be defined as equivalent concentration of hydrogen ions in mg/l. The equation in its simplest form is as follows:



The apparatus used are:

- pH Meter
- Burette - 50-ml capacity.
- Magnetic Stirring Device
- The Reagents used are:
- Distilled Water

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- Potassium Acid Phthalate
- Sodium Hydroxide Solution - 15 N.

Sodium hydroxide solution - 1 N 67 ml of 15 N NaOH solutions is diluted to one liter with distilled water.

Sodium hydroxide solution - 0.02 N 20 ml of 1 N NaOH solution is diluted to one liter and is standardized using standard potassium acid phthalate

Phenolphthalein Indicator - 0.5 g of phenolphthalein is dissolved in 100 ml: 1 (v/v) alcohol water mixture and 0.02 N NaOH solution is added drop by drop till slight pink colour is observed.

Methyl Orange Indicator – 0.5 g of methyl orange is dissolved in distilled water and made up to 100 ml in a volumetric flask.

3.5 METHODOLOGY FOR MEASUREMENT OF CHLORIDE PRINCIPLE:

Soluble and slightly dissociated mercuric chloride is formed when Chloride is titrated with mercuric nitrate. Diphenyl Carbazone within the pH range of 2.3 to 2.8 signals the end point by the formation of a purple complex with extra mercuric ions.

The apparatus used are:

- Erlenmeyer flask - 250 ml capacity.
- Micro burette - 5 ml with 0.01 ml graduation intervals.

The reagents used are:

- Standard sodium chloride solution
- Nitric acid - 0.1 N
- Sodium hydroxide - 0.1 N
- Reagents for chloride concentrations below 700 mg/l
- Indicator-acidifier reagent - Nitric acid concentration of this reagent decides the success of the determination and it can be varied as indicated in (a) or (b) to befit the alkalinity range of the sample.

Reagent (a) contains sufficient nitric acid to counteract a total alkalinity of 150 mg as CaCO₃/l to the proper pH in a 100 ml sample. (a) 250 mg s-diphenylcarbazone, 4-O ml. concentration nitric acid and 30 mg xylene cyanol FF in 100 ml 95 percent ethyl alcohol or isopropyl alcohol. The sample is stored in a dark bottle in a refrigerator. This reagent is not stable indefinitely. Deterioration causes a slow end point and high results.

Standard mercuric nitrate titrant - 2.3 g mercuric nitrate [Hg (NO₃)₂ or 2.5 g Hg (NO₃).12H₂O] is dissolved in 100 ml distilled water containing 0.25 ml concentrated nitric acid. It is diluted to just less than 1 liter. Replicates are used containing 5.00 ml standard sodium chloride solution and 10 mg sodium bicarbonate (NaHCO₃) diluted to 100 ml with distilled water. It is adjusted to 0.0141 N and a final standardization of 1.00 ml = 500 µgCl⁻ is made. It is stored away from light in a dark bottle.

3.6 METHODOLOGY FOR THE DETERMINATION OF RESIDUAL CHLORINE:

It is measured as the chlorine left in the water after the required contact period which will ensure complete killing of bacteria and oxidation of the organic matter usually a free chlorine residue is considered to be sufficient.

The reagents used are

- O- Toluidine - 4 drops

3.7 METHODOLOGY FOR THE DETERMINATION OF TOTAL SOLIDS:

PRINCIPLE:

The sample is evaporated in a weighed dish on a steam-bath and is dried to a constant mass in an oven either at 103-105°C or 179-181°C. Total residue is calculated from increase in mass. Note - In general, by evaporating and drying water samples at 179-181°C values are obtained which conform more closely to those obtained by summation of individually determined mineral salts.

The apparatus used are:

- Evaporating Dish
- Steam-Bath

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- Drying Oven
- Desiccator
- Analytical Balance

3.8 METHODOLOGY FOR MEASUREMENT OF DO:

The apparatus used are:

- Incubation bottles
- DO meter
- Air incubator

3.9 METHODOLOGY FOR MEASUREMENT OF BOD:

PRINCIPLE:

The biochemical oxygen demand (BOD) test is based mainly on the classification of biological activity of a substance. A procedure measures the dissolved oxygen consumed by micro-organisms while capable of taking and oxidizing the organic matter under aerobic conditions. The standard test condition lets in incubating the sample in an air tight bottle, in dark at a required temperature for specific time.

The apparatus used are:

i) Incubation Bottles: The bottle has capacity of 300 ml. It has narrow neck with even mouth and has ground glass stoppers. New bottles are cleaned with 5 N hydrochloric acid or sulphuric acid and rinsed with distilled water. In normal use, bottles once used for Winkler's procedure should only be rinsed with tap water followed by distilled water. During incubation water is added to the flared mouth of the bottle time to time, to ensure proper sealing.

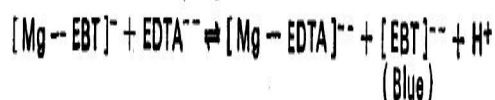
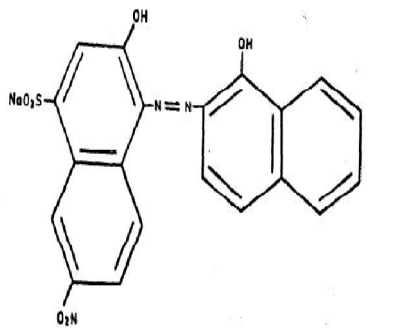
3.10 METHODOLOGY FOR THE DETERMINATION OF HARDNESS:

Principle:

This method is contingent upon the power of ethylene di aminetetra acetic acid (C₁₀H₁₄O₈N₂)



or its disodium salt to form stable complexes with calcium and magnesium ions. When the dye eriochrome black T (EBT) is added to a solution containing calcium and magnesium ions at pH 10.0 a wine red complex is formed. This solution is titrated with standard solution of disodium salt of EDTA, which extracts calcium and magnesium from the dye complex and the dye is changed back to its original blue colour. Eriochrome black T is used to indicate the end-point for the titration of calcium and magnesium together.



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The reagents used are:

- i. Buffer solution (NH₄Cl + NH₄OH)
- ii. Standard calcium solution
- iii. Eriochrome black 1 indicator solution
- iv. Inhibitors
- v. Hydroxylamine hydrochloride solution
- vi. Potassium ferrocyanide crystals
- vii. Sodium sulphide inhibitor
- viii. Sodium cyanide solution
- ix. Standard EDTA solution

3.11 METHODOLOGY FOR THE DETERMINATION OF CARBONATES AND BICARBONATES :(TITRIMETRIC METHOD)

PRINCIPLE:

Potentiometric method is used to do the titration. Phenolphthalein is used as an indicator. The total OH⁻, CO₃²⁻, and HCO₃⁻ content is first found out by titration with standard acid using methyl orange/bromo cresol green indicator. Equal portion of the sample is titrated against the same acid using phenolphthalein/meta cresol purple indicator.

The apparatus used are:

- i. Electrometric Titrator
- ii. Titration Vessel
- iii. Magnetic Stirrer
- iv. Pipettes, Volumetric
- v. Flasks, Volumetric
- vi. Burettes, Borosilicate Glass
- vii. Polyolefin Bottles

IV. RESULTS AND DISCUSSIONS

4.1 TABULATIONS:

Quarter Type	Number of rooms
A	19
B	22
C	30
D	65
E	40
F	108
G	117
FE type Flats	18
Bachelor Flats	24
Transit Flats	18
Director's	1

Table 1: Water consumption by residential quarters.

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Name of the Hall	Capacity of tank (Litres)				Total water supplied (Litres)	Strength
	1000	1500	2000	3000		
SS Bhatanagar HOR	-	27	-	-	37000	130
M Visveswaraya HOR	-	32	-	-	45500	393
GD Birla HOR	-	38	-	-	58500	529
DhirubhaiAmbani HOR	-	40	-	-	59500	514
MS Swaminathan HOR	-	38	-	-	55500	289
HomiBhaba HOR	-		10	10	45500	522
CV Raman HOR	-	14	-	-	20500	245
KiranMajumdar HOR	-	45	-	-	75000	460
Vikram Sarabhai HOR	-	17	-	-	36000	665

Table 2: Water consumption of various residential halls.

SOURCE	CONCENTRATION IN PPM
Bath room waste water	3.6
Kitchen waste water	4.5
Tap water	2.3
Distilled water	1

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1. Determination of chloride content

SOURCE	CONCENTRATION IN PPM	STANDARD
Bath room waste water	57.9	30 -100
Kitchen waste water	113	
Tap water	3.5	

2. Determination of PH of the sample

SOURCE	PH	STANDARD
Kitchen waste	7.89	7.8
Bath room waste	7.36	
Tap water	8.01	

3. Determination of residual chlorine

SL NO	SOURCE	CONC. IN PPM	STANDARD
1	Kitchen waste	2	1-2 ppm
2	Bath room waste	2	
3	Tap water	1	

2 Determination of turbidity of sample

SL NO	SOURCE	VALUE IN NTU
1	Bath room waste	14
2	Kitchen waste	116
3	Tap water	10

3 Table for determination of alkalinity

Here utilization of sulphuric acid is used is zero. Thus it indicates presence of bicarbonate.

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SOURCE	CONC. IN PPM	STANDARD CONC.
Kitchen waste	75	50 - 200
Bathroom waste	80	
Tap water	15	

Table:3 Determination of metals by atomic absorption spectrometry

1. Total iron content

SL NO	SOURCE	CONC. IN MG/L
1	Kitchen waste	2.863
2	Bathroom waste	0.024
3	Tap water	0

2. Zinc content

SL NO	SOURCE	CONC. IN MG/L
1	Kitchen waste	0.115
2	Bathroom waste	0.086
3	Tap water	1.549

3. Copper content

SL NO	SOURCE	CONC. IN MG/L
1	Kitchen waste	0.019
2	Bathroom waste	0.0
3	Tap water	0.007

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IV. POTASSIUM CONTENT

SL NO	SOURCE	CONC. IN MG/L
1	Kitchen waste	11.334
2	Bathroom waste	9.285
3	Tap water	2.491

4.2 TABULATION FOR PHYSICAL AND CHEMICAL HARACTERISTICS IN DIFFERENT TIME

Time →	8 a.m.	12 p.m.	1-2 p.m.	5-6 p.m.	PERMISSIBLE VALUE
Property ↓					
Turbidity (NTU)	32	45	50	38	5
pH	8.76	8.01	8.22	8.4	6.5 - 8.5
Acidity (mg/l)	1.8	2.6	3	1.3	
Alaklinity (mg/l)	42	45	158	78	600
Chloride (mg/l)	11	17	20	15	1000
Residual Chlorine (mg/l)	2	2	2	2	1
Hardness (mg/l)	23	38	40	30	200
Total Solids (mg/l)	200	240	420	600	2000
BOD (mg/l)	1.3	1.21	1.23	1.03	10
DO (mg/l)	7.1	7.01	7.02	6.9	2000

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4.3 TABULATION FOR DETERMINATION OF DIFFERENT MINERAL CONTENT AT DIFFERENT TIME

Time \Rightarrow	8 a.m.	12 p.m.	1-2 p.m.	5-6 p.m.	PERMISSIBLE VALUE
Metals \Downarrow					
Iron (mg/l)	0.077	0.213	0.532	0.052	0.3
Zinc (mg/l)	0.008	0.119	0.124	0.131	15
Copper (mg/l)	0.019	0.012	0.035	0.029	1.5
Magnesium (mg/l)	0.41	1.918	2.581	3.411	30
Nickel (mg/l)	0.01	0.011	0.044	0	0.02
Chromium (mg/l)	0.113	0.212	0.242	0.114	0.05
Lead (mg/l)	0.101	0.091	0.261	0.024	0.01
Calcium (mg/l)	5.41	12.1	19.76	11.23	200
Aluminum (mg/l)	0.07	0.05	0	0.01	0.2
Silicon (mg/l)	3.91	11	10.602	5.21	7-10
Potassium (mg/l)	1.121	1.31	2.41	3.75	-

V. CONCLUSION

- The average ranges of physical, chemical and biological characteristics of waste water quality are experimented and found out.
- The pH ranges from 7.8 to 8.01. The Turbidity ranged from 10 to 120 NTU.
- The value of Turbidity was found to be within the permissible limit.
- The Chloride and Alkalinity were in the range of 3.5 to 120 mg/l and 15 to 80 mg/l respectively.
- The Total Iron content was in the range of 0 to 3 mg/l.
- The Zinc content was in the limits of 0.1 to 2 mg/l.
- Copper content ranged from 0 to 0.2 mg/l.
- Potassium was present in the limits of 2 to 12 mg/l.
- The parameters studied resemble the waste water quality.

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Total amount of waste water treated = 0.423 mld.

- Dimension of the collection pit is calculated to be 4 m in diameter and 5 m depth of the cylindrical tank.
- A bar screen of width 1.7 m is provided.
- Dimension of the aeration tank is 4.5 x 4.5 x 3.7 m³
- Dimensions of Sludge Drying Bed are 4.5 m x 4.5 m x 1 m of two numbers.

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