

***Assessment of Effluent Water Quality
with reference to pH, EC, COD, BOD, TDS and TSS***

Submitted by

G N S SAI CHARAN

S L N SAI SANDEEP

N SRI ABHINAYA

**B-TECH, CHEMICAL ENGINEERING
B.V. RAJU INSTITUTE OF TECHNOLOGY
NARSAPUR , MEDAK DISTRICT**



BVRIT ESTD 1997
Padmasri Dr BV Raju Institute of Technology



Work Place



**ENVIRONMENT PROTECTION TRAINING & RESEARCH INSTITUTE
91/4, GACHIBOWLI, HYDERABAD 500032**

JULY 2015

CERTIFICATE

This is to certify that *Ms. N SRI ABHINAYA, Mr. G N S SAI CHARAN and Mr.S L N SAI SANDEEP* worked on a pilot project entitled *Assessment of Effluent Water Quality with reference to pH, EC, COD, BOD,TDS and TSS* during June 29th to July 31st under supervision of Dr. M. Suneela, Environmental Protection Training and Research Institute (EPTRI), to be submitted to Department of Chemical Engineering, B.V. RAJU INSTITUTE OF TECHNOLOGY, Narsapur.

Mr. Satish Kumar
Co-Supervisor

Dr. M. Suneela
Supervisor

DECLARATION

*I, **G N S SAI CHARAN** declare that the project entitled “Assessment of Effluent Water Quality with reference to pH, EC, COD, BOD,TDS and TSS” submitted to “Environment Protection Training and Research Institute” is a result of original work done by me . It is further declared that the project work or any part of this has not been published earlier elsewhere in any manner*

G N S SAI CHARAN

DECLARATION

*I, **S L N SAI SANDEEP** declare that the project entitled “Assessment of Effluent Water Quality with reference to pH, EC, COD, BOD,TDS and TSS” submitted to “Environment Protection Training and Research Institute” is a result of original work done by me . It is further declared that the project work or any part of this has not been published earlier elsewhere in any manner*

S L N SAI SANDEEP

DECLARATION

*I, **N SRI ABHINAYA** declare that the project entitled “Assessment of Effluent Water Quality with reference to pH, EC, COD, BOD, TDS and TSS” submitted to “Environment Protection Training and Research Institute” is a result of original work done by me . It is further declared that the project work or any part of this has not been published earlier elsewhere in any manner*

N SRI ABHINAYA

ASSESSMENT OF EFFLUENT WATER QUALITY WITH REFERENCE TO PH, EC, COD, BOD, TDS AND TSS

1.0 Aim

To analyze pH, EC, COD, BOD, TDS, TSS and color in effluent samples

1.1 Objective

The objective of the proposed work includes the study of physico-chemical parameters of the effluent water quality of the collected samples.

1.2 Introduction

The first step in assessment of the effluent water quality is collection and preservation of samples. The objective of sampling is to collect representative sample. Representative sample means a sample in which relative proportions or concentrations of all pertinent components will be the same as in the material being sampled. Moreover, the same sample will be handled in such a way that no significant changes in composition occur before the tests are made. The sample volume shall be optimal small enough that it can be transported and large enough for analytical purposes

The record of the collected sample shall be as follows:

- Sample identification number
- Date and Hour
- Sample type

The physico-chemical parameters which we are dealing in this particular project are:

1. pH
2. Electrical Conductivity (EC)
3. Chemical Oxygen Demand (COD)
4. Biological Oxygen Demand (BOD)
5. Total Dissolved Solids (TDS)
6. Total Suspended Solids (TSS)
7. Colour

2.0 Standard Operating Procedures

2.1. Standard operating procedure for pH (Electrometric Method):

2.1.1 Scope and Applications:

This method is applicable for all drinking, surface, and all industrial waste waters.

2.1.2 Summary of the method:

Generally pH is defined as the negative logarithm of the hydrogen ion concentration. The pH is measured electrometrically by using a glass membrane electrode and reference electrode.

The basic principle of the electrometric pH measurement is determination of the activity of the hydrogen ions by potentiometer measurement using a standard hydrogen electrode and a reference electrode.

2.1.3 Apparatus:

pH meter consisting of a glass electrode, a reference electrode and a temperature compensating device.

2.1.4 Procedure:

Standardize the pH meter against pH 4, 7 and 9 buffer solutions. Take 100 ml of sample in a beaker. Immerse the glass electrode in the sample taken in the beaker. Record the pH of the sample. Rinse the pH electrode thoroughly with every sample before making the measurement.

2.1.5 Quality Control:

Calibrate the electrode of pH meter with buffers of pH 4.0, 9.2 before measuring the samples. pH should be measured at temperature of $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ degree Celsius.

3.1 Standard operating procedure for Electrical conductivity (Electrometric Method):

3.1.1 Scope and Application:

This method is applicable for all drinking, surface and also applicable for all industrial waste waters

3.1.2 Summary of the method:

The conductivity is measured potentiometrically using a conductivity meter. Conductivity is the measure of the ability of an aqueous solution to carry an electric current.

3.1.3 Apparatus:

Conductivity meter with electrode conductivity meter consisting of glass electrode Thermometer.

3.1.4 Procedure:

Standardize the conductivity meter against standard KCL (0.01M) solution. Adjust the temperature of a final portion to about 25 degree Celsius of EC meter. Take 100 ml sample in a beaker. Immerse the cell in the sample taken in beaker and read the conductivity of the sample.

3.1.5 Precautions:

Temperature effects the measurement of the electrical conductivity. Wash the cell thoroughly with distilled water before and after taking the measurements for each sample.

3.1.6 Quality Control:

Calibrate the electrode of electrical conductivity meter with KCL-1.41 $\mu\text{mohs/cm}$ before measuring the samples. Electrical Conductivity should be measured at 25 degree Celsius only. Use only glass beakers for taking the samples.

4.1 Standard operating procedure of Chemical Oxygen Demand (Open Reflux Method):

4.1.1 Scope and Application:

This method is suitable for a wide range of wastes where a large sample size is preferred. This method determines COD values of $> 50\text{mg O}_2/\text{L}$.

4.1.2 Summary of the method:

A sample is refluxed in strongly acid solution with a known excess of $\text{K}_2\text{Cr}_2\text{O}_7$. After digestion, the remaining unreduced $\text{K}_2\text{Cr}_2\text{O}_7$ is titrated with ferrous ammonium sulfate to determine the amount of $\text{K}_2\text{Cr}_2\text{O}_7$ consumed and the oxidisable organic matter is calculated in terms of oxygen equivalent.

4.1.3 Apparatus:

Reflux Apparatus

4.1.4 Reagents:

Standard potassium dichromate solution (0.025 N): Dissolve 12.25kg $K_2Cr_2O_7$ primary standard grade, previously dried at 103 degree Celsius for 2 **hours, in one litre of distilled water.**

4.1.5 Sulphuric acid reagent:

5.5g of Ag_2SO_4 (Technical grade) dissolved in 1Kg of H_2SO_4 .
Let stand for one or two days to dissolve Ag_2SO_4 .

4.1.6 Preparation of Standard ferrous ammonium sulfate (0.25N/0.25M):

Dissolve 98g of $Fe(NH)_2(SO_4)_2 \cdot 6H_2O$ in distilled water. Add slowly 20ml of concentrated H_2SO_4 , cool, and dilute to 1000ml with distilled water. Standardize this solution against standard $K_2Cr_2O_7$ solution.

5.1 Standardization of FAS with known normality of $K_2Cr_2O_7$:

10 ml of standard 0.25N of $K_2Cr_2O_7$ in 100 ml conical flask. Add 30 ml of concentrated H_2SO_4 and cool. Titrate with FAS, by using 0.15-0.2 ml ferroin indicator.

$$\text{Normality of FAS} = \frac{\text{Volume of } K_2Cr_2O_7 \times \text{Normality of } K_2Cr_2O_7}{\text{Volume of FAS used in titration (mL)}}$$

Potassium Hydrogen Phthalate (KHP) Standards: Dissolve 0.425g of KHP, previously dried at 120°C for 2 hours, in one litre distilled water.

KHP has a theoretical COD of 1.176mg O_2 /mg and this solution has a theoretical COD of 500 μg of O_2 /mL or 500ppm.

5.1.1 Ferroin Indicator:

Dissolve 1.485g of 1-10 phenanthroline monohydrate and 0.695g of $FeSO_4 \cdot 7H_2O$ in distilled water and dilute to 100mL.

5.1.2 Procedure:

A suitable volume of 20 ml of sample is pipette out in to refluxing flask. Add 0.40g of $HgSO_4$, several glass beads, and very slowly add 30ml of sulfuric acid reagent, with mixing to dissolve $HgSO_4$, cool the solution, add 10ml of $K_2Cr_2O_7$ (0.25N) solution and mix. Attach flask to condenser and turn on cooling water. Reflux the above mixture for 2 hours. Cool and wash down the condenser with 80ml distilled water. Cool to the room temperature and titrate the excess $K_2Cr_2O_7$ with FAS, using 2 to 4 drops of ferroin indicator. The first sharp colour changes from blue-green to reddish brown. Take this as the end point.

5.1.3 Calculation:

$$\text{COD as mgO}_2/\text{L} = \frac{(A-B) \times M \times 8000}{\text{mL of sample}}$$

where

A = mL of FAS used for Blank

B = mL of FAS used for sample

M = Molality of FAS

5.1.4 Quality Control:

Calibrate the analytical balance internally by using externally calibrated weights. Use analytical grade chemicals & double distilled water for the preparation of the standards and the reagents. Use calibrated pipettes and burettes.

6.1 Standard operating procedure of Biological Oxygen Demand (Titrometric Method):

6.1.1 Scope and Application:

This method is suitable for a wide range of waste waters, effluents and polluted water.

6.1.2 Summary of the Method:

The method consists of filling with sample to overflowing, an air tight bottle of the specified size and incubating it to specified temperature for 3 days at 27°C. Dissolved oxygen is measured initially after incubation and BOD is computed from the difference between initial and final DO.

The test measures the oxygen utilized during a specified incubation period for the biochemical degradation of organic material. The sample pH should be 6.5-7.5. If pH is between 6.0-8.0 adjust the sample temperature to $20 \pm 3^\circ\text{C}$. Then adjust the pH to 7.0-7.2 using a solution of H_2SO_4 or NaOH .

6.1.3 Reagents:

Standard Potassium Dichromate Solution: Dissolve 0.3065g of $\text{K}_2\text{Cr}_2\text{O}_7$, primary standard grade previously dried at 103°C for 24 hours, in 250 ml of distilled water.

Standard Sodium thiosulphate titrant (0.025N): Dissolve 6.205g of $\text{K}_2\text{Cr}_2\text{O}_7$ in one litre of distilled water

Phosphate buffer solution: Dissolve 8.5g KH_2PO_4 , 4.75g of K_2HPO_4 , 33.4g of $\text{Na}_2\text{HPO}_4 \cdot 7\text{H}_2\text{O}$ and 1.7g of NH_4Cl in one litre. pH should be 7.2 without further adjustment.

Magnesium Sulphate Solution: Dissolve 22.5g of $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ in distilled water & dilute to 1L.

Calcium Chloride solution: Dissolve 27.5g of CaCl_2 in one litre of distilled water.

Ferric Chloride solution: Dissolve 0.2582g of FeCl_2 in one litre of distilled water.

Glucose-Glutamic Acid solution: Dry reagent grade glucose and reagent grade glutamic acid at 103°C for one hour. Add 0.150g glucose and 0.150g of glutamic acid in one litre distilled water. Concentrated HCl.

Starch indicator: 0.2g of Analytical grade soluble starch and 0.2g of salicylic acid, as a preservative in 100mL hot distilled water.

Manganese Sulphate solution: Dissolve 480g of $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$ in distilled water, filter and make up to one litre.

Alkali-iodide-azide reagent: Dissolve 500g of NaOH and 135g of NaCl in distilled water and dilute it to one litre. Add 10g of NaN_3 dissolved in 40 ml distilled water **Concentrated H_2SO_4 .**

Standardisation of Hypo with known normality of $\text{K}_2\text{Cr}_2\text{O}_7$: 10mL of standard 0.025N $\text{K}_2\text{Cr}_2\text{O}_7$ in 250mL iodometric flask, add 90mL distilled water, 2g of NaHCO_3 and 3g of KI with mixing to dissolve NaHCO_3 and KI. Add 6mL of concentrated HCL to the above solution. Mix well, cap the iodometric flask, and keep the flask in dark for 10 minutes. Titrate the solution with Hypo titrant. Initially the solution is brown in colour and changes to pale yellow. At this point add few drops of starch. Continue the titration until the end point, where blue colour changes to pale green.

$$\text{Normality of Hypo} = \frac{\text{Volume of } \text{K}_2\text{Cr}_2\text{O}_7 \times \text{Normality of } \text{K}_2\text{Cr}_2\text{O}_7}{\text{Volume of Hypo used in titration}}$$

6.1.4 Procedure:

Preparation of dilution water: Place desired volume of aerated water in suitable container, add 1mL each of phosphate buffer; MgSO_4 , CaCl_2 and FeCl_3 solutions / L of aerated water.

Composition of dilution water: Suitable dilution water should satisfy the following requirements.

Correct pH limits

Proper salinity

Reasonable buffer capacity, the presence of necessary mineral nutrients and the absence of bactericidal and bacteriostatic substances such as toxic metals and free chlorine.

The suitability of dilution water may be checked against a standard glucose glutamic acid solution.

Dilution of sample: The BOD of sample generally depends on the particular dilution used. It is therefore advisable to make several dilutions and to base the value on the dilution showing about 50% depletion of dissolved oxygen.

Temperature: Apart from all, temperature is an important factor in the determination of BOD.

Determination of DO: Use one set of sample dilutions and dilution water in the BOD incubator at 27°C for 3 days. After 3 days, determine the final DO.

6.1.5 Procedure for initial DO:

Collect the sample in 300mL BOD bottle. Add 2mL of manganese sulphate solution, followed by the addition of 2 mL of alkali-iodide-azide solution. The tip of the pipette should be below the surface of the liquid. Allow the precipitate to settle completely leaving a clear supernatant liquid. Carefully remove the stopper and add 2mL concentrated H₂SO₄ by the sides of the bottle. Stir the bottle and mix thoroughly until dissolution is completed. Measure 200mL of the solution from the bottle into 500mL conical flask. Titrate immediately with 0.025N Sodium thiosulphate solution using starch as indicator.

6.1.6 Calculations:

$$\text{BOD 3 days at 27}^\circ\text{C mg/L} = \frac{[(D1-D2) - (S1-S2) \times F - (B1-B2)]}{P}$$

P

Where;

D1 = DO of diluted sample immediately after preparation in mg/L

D2 = DO of diluted sample after 5 days incubation at 20°C in mg/L

P = Decimal volumetric fraction of sample

S1 = DO of seed control before incubation in mg/L

S2 = Do of sample after incubation in mg/L

F = Ratio of seed in diluted sample to seed in seed control (%seed in diluted sample 1% of seed in seed control)

B1 = Initial DO of blank

B2 = Fianl DO of blank

6.1.7 Quality Control:

Calibrate the analytical balance internally by using externally calibrated weights. Use analytical grade chemicals & double distilled water for the preparation of standards & reagents. Use calibrated pipettes and burettes.

7.1 Standard operating procedure of Total Dissolved Solids (Gravimetric Method):

7.1.1 Scope and Applications:

This method is suitable for drinking and surface waters, domestic and industrial wastes.

7.1.2 Summary of the Method:

A well- mixed sample is filtered through a standard filter and the filtrate is evaporated to dryness in a weighed dish and dried to constant weight at 180°C. The increase in the weight represents the TDS.

7.1.3 Apparatus:

Evaporating dishes of 100 to 200mL capacity made of porcelain 90mm diameter.

Filtration assembly

Drying oven for operation at 180±2°C

Water bath

Graduated cylinders

Desiccators

Analytical Balance

7.1.4 Procedure:

Stir the sample well and take a measured volume of 100mL onto a filter paper and collect the filtrate sample by using the filtration assembly. Transfer the filtrate sample into a porcelain dish and it should be further kept in water bath at 100°C until the total sample evaporates. Wash with three successive 10mL volumes of water. After the evaporation of the samples the porcelain dishes should be subjected to heating in hot air oven at about 180°C for 1 hour. After removing the dishes from the hot air oven, they should be immediately transferred to the desiccators for cooling. After the dishes are completely cooled down take the final weights of the dishes.

7.1.5 Calculation:

$$\text{TDS (mg/L)} = \frac{(A - B) \times 1000 \times 1000}{\text{Volume of the sample}}$$

Where;

A = Weight of the dried residue dish (mg)

B = Weight of the dish (mg)

7.1.6 Quality Control:

Calibrate the analytical balance by using external calibrated weights

Calibrate hot air oven at 180°C by using digital thermometer that is calibrated externally.

Desiccators should be airtight.

Use porcelain dishes only.

8.1 Standard operating procedure of Total Suspended Solids (Gravimetric Method):

8.1.1 Scope and Applications:

Solids measured in water may contain organic solids as well as inorganic solids in suspended form. These are mainly contributed by surface water, ground water, domestic water and industrial waste water.

8.1.2 Summary of the Method:

A well mixed sample is filtered through a pre-weighed standard whatman filter paper and the residue retained on the filter is dried to a constant weight at 105°C. The increase in weight represents the TSS.

8.1.3 Apparatus:

Glass fiber filter paper disks without organic binder.

Filtration Assembly

Drying hot air oven for operation at 105°C

Desiccators

Watch Glass

Graduated Cylinders

Spatula

8.1.4 Procedure:

Dry the standard filter paper at 105°C and desiccate. Record the initial weight of the filter paper. Take 100 mL sample for Ground water/Surface water, and 50 mL for Industrial waste water samples. Filter the sample and dry the paper at 105°C for at least 1 hour and desiccate. Take the final weight.

8.1.5 Calculations:

$$\text{Total Suspended Solids (mg/L)} = \frac{(A-B) \times 1000 \times 1000}{\text{Volume of the sample (mL)}}$$

Where;

A = Weight of the filtered and dried residue in mg

B = Weight of the filtered paper in mg

8.1.6 Quality Control:

Calibrate the analytical balance by using external calibrate weights.

Calibrate hot air oven at 105°C by using digital thermometer, which is calibrated externally.

Desiccators should be airtight.

9.1 Standard operating procedure for determination of Colour (Visual comparison Method):

9.1.1 Scope and Application:

Colour is determined by visual comparison of the sample with known concentration of colored solution. The Platinum cobalt method is applicable to natural waters, portable waters, and waste waters both domestic and industrial waste having colored imported by naturally occurring materials.

9.1.2 Summary of the Method:

Color is visually compared with platinum cobalt standards. The unit of colour is that which is produced by one-miligram platinum per litre in the form of Chloro palatinate.

9.1.3 Apparatus:

pH meter

Nessler's tubes matched 50ml tall form.

Filter assembly and filter 0.45 µm pore diameter cellulose membrane filter of 22 or 47 mm.

9.1.4 Reagents:

Double distilled water is generally used for the precipitation of standard solution. Standard potassium chloro palatinate : (500 units Colour) . Dissolve 1.246g K_2PtCl_6 (equivalent to 0.5g metallic platinum) and 1.00g $CoCl_2 \cdot 6H_2O$ of (equivalent to 0.25g metallic Co) in distilled water with 100mL concentrated HCl and dilute to 1000mL. Sodium Hydroxide (NaOH) solution.

Working Standards: Prepare series of working standards from 5 to 100 units by diluting appropriate volumes (5, 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 Cobalt units).

9.1.5 Procedure:

Fill the sample in matched nessler tube to the 50mL mark. Compare the colour with standards and report to the nearest volume. Dilute the sample if the colour exceeds 100 units. If the turbidity is present report as "apparent colour ". Measure and reports sample pH.

9.1.6 Calculation:

Colour units = $A \times 50/B$

Where;

A = Estimated colour of sample or diluted sample.

B = mL sample taken for dilution.

9.1.7 Quality Control:

Calibrate the analytical balance internally by using externally calibrated weights. Use analytical grade chemicals & double distilled water for the preparation of the standards and reagents.

By using the above Standard operating procedures the analysis has been done for all the parameters.

The Sampling locations and the results of the analysis are tabulated below.

The above stated standard operating procedures are extracted from APHA 21st edition.

1.0 Effluents quality (As per part-A of General standards for discharge of environmental pollutants Part -A: effluents (GSR 801) (E))

10.1.1 The effluents sampling locations in the study area were selected considering their proximity to the project sites. 20 effluents samples were collected and analysed, the effluents quality results were compared with *General standards for discharge of environmental pollutants, Part -A: effluents (GSR 801) (E)*. The effluents sampling locations are mining areas.

Table: 1

| Sl.No. | Date of sampling | Sample Code |
|---------------|-------------------------|--------------------|
| 1. | 02-07-2015 | EW-1 |
| 2. | 04-07-2015 | EW-2 |
| 3. | 02-07-2015 | EW-3 |
| 4. | 08-07-2015 | EW-4 |
| 5. | 09-07-2015 | EW-5 |
| 6. | 09-07-2015 | EW-6 |
| 7. | 02-07-2015 | EW-7 |
| 8. | 04-07-2015 | EW-8 |
| 9. | 08-07-2015 | EW-9 |
| 10. | 06-07-2015 | EW-10 |
| 11. | 06-07-2015 | EW-11 |
| 12. | 10-07-2015 | EW-12 |
| 13. | 12-072015 | EW-13 |
| 14. | 10-07-2015 | EW-14 |
| 15. | 12-07-2015 | EW-15 |
| 16. | 22-07-2015 | EW-16 |
| 17. | 24-07-2015 | EW-17 |
| 18. | 22-07-2015 | EW-18 |
| 19. | 19-07-2015 | EW-19 |
| 20. | 24-07-2015 | EW-20 |

*

Table:1.2- Physico-Chemical characteristics of Effluent samples collected within the study area

| S.No | Test Parameter(s) | Unit | Test Method | Standards | | | Results | | | |
|------|--------------------------------------------|-------------|-------------|----------------------------------|---------------|---------------------|---------|------|------|------|
| | | | | Part -A: effluents (GSR 801) (E) | | | EW-1 | EW-2 | EW-3 | EW-4 |
| | | | | Inland Surface water | Public sewers | Land for irrigation | | | | |
| 1 | pH | -- | 4500-H+B | 5.5 to 9.0 | 5.5 to 9.0 | 5.5 to 9.0 | 6.80 | 7.4 | 7.5 | 7.7 |
| 2 | Electrical Conductivity | | | - | - | - | 1070 | 975 | 1300 | 1260 |
| 3 | Biochemical Oxygen Demand (3 days at 27°C) | mg/L | IS:3025 | 30 | 350 | 100 | 12 | 8 | 8 | 22 |
| 4 | Chemical Oxygen Demand | mg/L | 5220. D | 250 | -- | -- | 39 | 29 | 29 | 59 |
| 5 | Total Suspended Solids | mg/L | 2540. D | 100 | 600 | 200 | 55 | 7.8 | 6.4 | 7.8 |
| 6 | Total Dissolved Solids | mg/L | | - | - | - | 690 | 600 | 800 | 760 |
| 7 | Colour | Pt-co-Scale | 2120. B | * | -- | * | 10 | 5 | 15 | 5 |

| S. No | Test Parameter(s) | Unit | Test Method | Standards | | | Results | | | |
|-------|--------------------------------------------|-------------|-------------|----------------------------------|---------------|---------------------|---------|------|------|------|
| | | | | Part -A: effluents (GSR 801) (E) | | | EW-5 | EW-6 | EW-7 | EW-8 |
| | | | | Inland Surface water | Public sewers | Land for irrigation | | | | |
| 1 | pH | -- | 4500-H+B | 5.5 to 9.0 | 5.5 to 9.0 | 5.5 to 9.0 | 6 | 7.3 | 7.4 | 8 |
| 2 | Electrical Conductivity | | | - | - | - | 24800 | 1180 | 499 | 722 |
| 3 | Biochemical Oxygen Demand (3 days at 27°C) | mg/L | IS:3025 | 30 | 350 | 100 | 126 | 10 | 5 | 8 |
| 4 | Chemical Oxygen Demand | mg/L | 5220. D | 250 | -- | -- | 353 | 39 | 20 | 39 |
| 5 | Total Suspended Solids | mg/L | 2540. D | 100 | 600 | 200 | 196 | 9.1 | 9.4 | 7.2 |
| 6 | Total Dissolved Solids | mg/L | | - | - | - | 15600 | 740 | 300 | 440 |
| 7 | Colour | Pt-co-Scale | 2120. B | * | -- | * | 25 | 10 | 5 | 5 |

| S.No | Test Parameter(s) | Unit | Test Method | Standards | | | Results | | | |
|------|--------------------------------------------|-------------|-------------|----------------------------------|---------------|---------------------|---------|-------|-------|-------|
| | | | | Part -A: effluents (GSR 801) (E) | | | EW-9 | EW-10 | EW-11 | EW-12 |
| | | | | Inland Surface water | Public sewers | Land for irrigation | | | | |
| 1 | pH | -- | 4500-H+B | 5.5 to 9.0 | 5.5 to 9.0 | 5.5 to 9.0 | 7.7 | 7.7 | 7 | 7.8 |
| 2 | Electrical Conductivity | | | | | | 1260 | 1780 | 896 | 912 |
| 3 | Biochemical Oxygen Demand (3 days at 27°C) | mg/L | IS:3025 | 30 | 350 | 100 | 8 | 4 | 8 | 10 |
| 4 | Chemical Oxygen Demand | mg/L | 5220. D | 250 | -- | -- | 29.4 | 19.6 | 29.4 | 39.2 |
| 5 | Total Suspended Solids | mg/L | 2540. D | 100 | 600 | 200 | 22.4 | 40.4 | 47.8 | 5.8 |
| 6 | Total Dissolved Solids | mg/L | | - | - | - | 764 | 1100 | 560 | 580 |
| 7 | Colour | Pt-co-Scale | 2120. B | * | -- | * | 5 | 5 | 15 | 10 |

| S.No | Test Parameter(s) | Unit | Test Method | Standards | | | Results | | | |
|------|--------------------------------------------|-------------|-------------|----------------------------------|---------------|---------------------|---------|-------|-------|-------|
| | | | | Part -A: effluents (GSR 801) (E) | | | EW-13 | EW-14 | EW-15 | EW-16 |
| | | | | Inland Surface water | Public sewers | Land for irrigation | | | | |
| 1 | pH | -- | 4500-H+B | 5.5 to 9.0 | 5.5 to 9.0 | 5.5 to 9.0 | 4.5 | 7 | 7.3 | 7.2 |
| 2 | Electrical Conductivity | | | | | | 2240 | 1040 | 1480 | 1310 |
| 3 | Biochemical Oxygen Demand (3 days at 27°C) | mg/L | IS:3025 | 30 | 350 | 100 | 8 | 5 | 4 | 8 |
| 4 | Chemical Oxygen Demand | mg/L | 5220. D | 250 | -- | -- | 29.4 | 19.6 | 19.6 | 29.4 |
| 5 | Total Suspended Solids | mg/L | 2540. D | 100 | 600 | 200 | 35.8 | 10.4 | 13.8 | 10.8 |
| 6 | Total Dissolved Solids | mg/L | | - | - | - | 1400 | 640 | 920 | 806 |
| 7 | Colour | Pt-co-Scale | 2120. B | * | -- | * | 5 | 5 | 5 | 10 |

| S. No | Test Parameter(s) | Unit | Test Method | Standards | | | Results | | | |
|-------|--------------------------------------------|-------------|-------------|----------------------------------|---------------|---------------------|---------|-------|-------|-------|
| | | | | Part -A: effluents (GSR 801) (E) | | | EW-17 | EW-18 | EW-19 | EW-20 |
| | | | | Inland Surface water | Public sewers | Land for irrigation | | | | |
| 1 | pH | -- | 4500-H+B | 5.5 to 9.0 | 5.5 to 9.0 | 5.5 to 9.0 | 7.3 | 7.2 | 7.3 | 7.5 |
| 2 | Electrical Conductivity | | | | | | 1180 | 1020 | 1400 | 880 |
| 3 | Biochemical Oxygen Demand (3 days at 27°C) | mg/L | IS:3025 | 30 | 350 | 100 | 5 | 10 | 8 | 6 |
| 4 | Chemical Oxygen Demand | mg/L | 5220. D | 250 | -- | -- | 19.6 | 39.2 | 39.2 | 29.4 |
| 5 | Total Suspended Solids | mg/L | 2540. D | 100 | 600 | 200 | 18.4 | 12.2 | 5.6 | 6.8 |
| 6 | Total Dissolved Solids | mg/L | | - | - | - | 736 | 640 | 860 | 540 |
| 7 | Colour | Pt-co-Scale | 2120. B | * | -- | * | 25 | 5 | 30 | 5 |

1.2 Effluents Quality:

The effluent analysis results are compared with the tolerance limits for general standards for discharge of environmental pollutants, Part –A: effluents (GSR 801 (E), presented in the Table:1.2. The results are compared with Inland Surface Waters Category, Public Sewers, Land for irrigation category.

From the results it can be seen that, at all the locations the pH values were within the standard limits (i.e between 5.5 to 9.0), except at the sample collected at (EW-13), where as the pH value is below the limit (4.5).

From the results it can be observed that the values of the Chemical Oxygen Demand (COD) at all the locations are within the standard limit of 250 mg/L, except at the sample collected at EW-5, where the value is 353 mg/L. From the results it can also be observed that the values of the Biochemical oxygen demand (BOD) at all the locations are within the standard limits (30 mg/L), except sample collected at EW-5, where the value is 126mg/L.

From the results it can be seen that the effluents collected in Study area were meeting the requirements in accordance with *the tolerance limits for General standards for discharge of environmental pollutants, Part –A: effluents (GSR 801 (E), Inland Surface Waters Category*, except for the sample collected *form* EW-5 and EW-13.

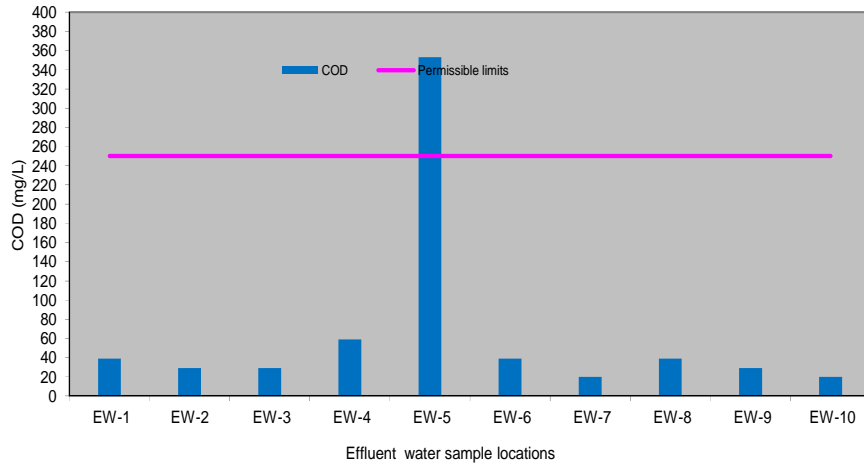


Fig1.1 Graphical presentation of COD Concentrations

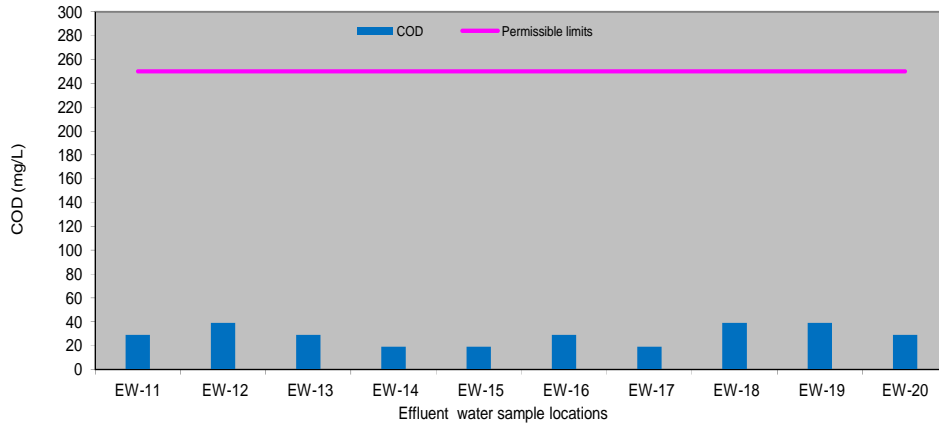


Fig1.2 Graphical presentation of COD Concentrations

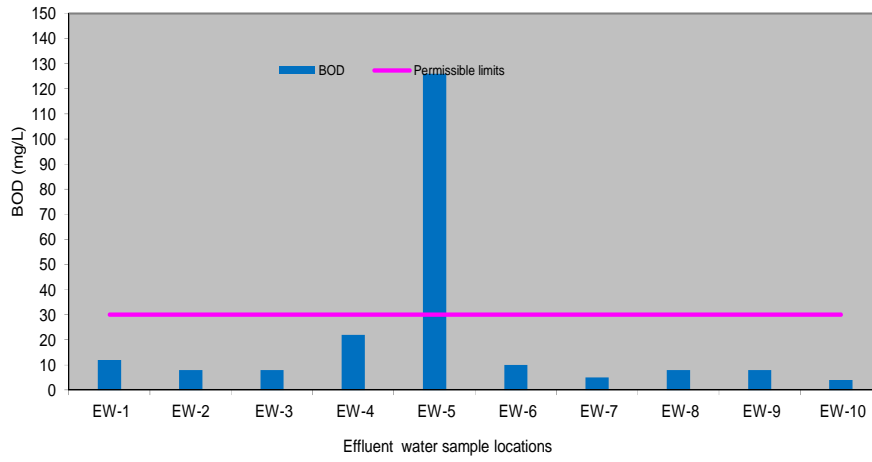


Fig1.3 Graphical presentation of BOD Concentrations

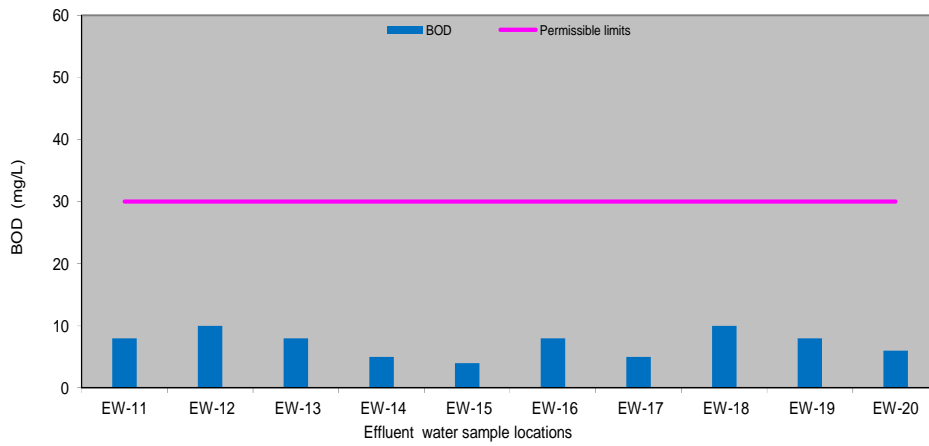


Fig1.4 Graphical presentation of BOD Concentrations