# ACTION PLAN FOR INDUSTRIAL CLUSTER IN CRITICALLY POLLUTED AREA

## Monitoring, Sampling, Analysis of Stack, Ambient Air Quality, Surface Water, Ground Water, Waste Water

# तारापुर Tarapur

**Maharashtra Pollution Control Board**

Kalptaru Point, Sion East, Mumbai - 400022

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# INDEX

## Acknowledgement

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We would also like to extend our thanks to the concerned staff of Regional Hospitals, who has provided us the health data, which is the most important component of this revised concept of CEPI.

By undertaking this project and completing in schedule time, we consider ourselves very lucky since we have helped the mankind by giving the data on pollution load and further action by the Board, to bring down the pollution level.

We also thank our associates for working on this project for making the write up, making graphs and feeding the data on computer.

This acknowledgement will be incomplete if we do not thank our laboratory analysts and others who made this project a success by timely analysing the samples.

We also thank our sampling team members for conducting the sampling in this vast area.

## Abbreviations:

**APHA** American Public Health Association

**BDL** Below Detection Limit

**BOD** Biochemical Oxygen Demand

**CEPI** Comprehensive Environmental Pollution Index

**CETP** Common Effluent Treatment Plant

**COD** Chemical Oxygen Demand

**CPA** Critically Polluted Areas

**DO** Dissolved Oxygen

**ETP** Effluent Treatment Plant

**MIBK** Methyl Isobutyl Ketone

**MPCB** Maharashtra Pollution Control Board

**NAAQS** National Ambient Air Quality Standards

**$NO_x$** Oxides of Nitrogen

**ND** Not Detected

**PAH** Poly Aromatic Hydrocarbons

**PCB** Poly Chlorinated Biphenyls

**PCT** Poly Chlorinated Terphenyls

**$PM_{10}$** Particulate Matter (size less than 10 µm)

**$PM_{2.5}$** Particulate Matter (size less than 2.5 µm)

**$SO_2$** Sulphur Dioxide

**STAP** Short Term Action Plan

**WHO** World Health Organization

# 1. Introduction:

Rapid modernization and industrialization worldwide has not only uprooted to the economic development, but has increased pollution of land, air and water. This has also destroyed our habitat and environment too. Pollutants discharged from the industries have widespread implications and one of the unpleasant effects on water bodies and air. .Long term exposure to the polluted air and water causes chronic health problems, making the issue industrial pollution into severe one. So, scientists are exploring the quantum of pollution load as well as to device certain strategies and technologies so that our sustainable development would not be jeopardized otherwise our long cherished dream of establishing eco-socialism on this watery planet could not come true.

In view of this, Central Pollution Control Board (CPCB) has evolved the concept of Comprehensive Environmental Pollution Index (CEPI) during 2009-10 as a tool for comprehensive environmental assessment of prominent industrial clusters and formulation of remedial Action Plans for the identified critically polluted areas. Later-on proposals were received from the SPCBs, State Governments, and Industrial Associations and concerned Stake-holders for revisiting the criteria of assessment under CEPI concept. After careful examination and consideration of the suggestions of concerned stake-holders, it was decided to prepare the revised concept of CEPI by eliminating the subjective factors but retaining the factors which can be measured precisely. Hence, revised concept came into existence, which is termed as Revised CEPI Version 2016.

The present report is also based on the revised CEPI version 2016. The results of the application of the Comprehensive Environmental Pollution Index (CEPI) to selected industrial clusters or areas are presented in this report. The main objective of the study is to identify polluted industrial clusters or areas in order to take concerted action and to centrally monitor them at the national level to improve the current status of their environmental components such as air and water quality data, ecological damage, and visual environmental conditions. A total of 88 industrial areas or clusters have been selected by the Central Pollution Control Board (CPCB) in consultation with the Ministry of Environment & Forests Government of India for the study. The index captures the various dimensions of environment including air, water and land. Comprehensive Environmental Pollution Index (CEPI), which is a rational number to characterize the environmental quality at a given location following the algorithm of source, pathway and receptor have been developed.

The present CEPI study includes Tarapur industrial area of Maharashtra state. It is one of the best industrial area situated near Mumbai, Thane and adjacent to Gujarat state on Mumbai - Ahmedabad Express Highway. The industrial part of this place has a number of factories manufacturing dyes, paints and industrial / agricultural chemicals. Heavy metal factories manufacturing a wide variety of equipment are also based in this region. A few nationally prominent industrial establishments have their manufacturing plants in Tarapur. This city accommodates bulk drug manufacturing units, speciality chemical manufacturing units, steel plants and some textile plants. Government of Maharashtra has established Industrial Estate at Boisar, Tarapur in the year 1972. This estate is known as MIDC Tarapur. This is one of the largest chemical industrial estates in the State of Maharashtra.

# 2. Scope of Work

The Scope of Work consisted of the following:

Monitoring, Sampling, Analysis for Stack, Ambient Air Quality, Surface Water, Waste Water, and Ground Water Quality for identified five Critically Polluted areas (CPAs) in Maharashtra i.e. **Chandrapur, Dombivali, Aurangabad, Navi Mumbai,** and **Tarapur** and 3 Severely Polluted areas (SPAs) in Maharashtra i.e. **Chembur, Pimpri-Chinchwad and Nashik** as per standard methods.

- At each of the 5 CPAs and 3 SPAs, 24 hourly ambient air quality monitoring to be carried out.
- Representative samples for surface water quality, waste water quality and ground water quality to be collected from prominent surface and ground water bodies located in and around the clusters/areas.
- Submission of complete monitoring, sampling and analysis reports including the summary of the parameters exceeding the prescribed standards/norms for all the 5 CPAs and 3 SPAs.
- Submission of 3 copies of final report with photographs at prominent locations and the CD (soft copy) on completion of the project for every critically polluted and severely polluted area separately.

**Monitoring, Sampling, Analysis for Stack, Ambient Air Quality, Surface Water, Waste Water and Ground Water Quality for Tarapur:**

- The sampling was carried out in 3 days at various locations i.e. from 06$^{th}$ June to 08$^{th}$ June, 2017.
- In Tarapur, a total of 7 Stack Monitoring Samples, 6 Ambient Air Quality Monitoring Samples, 7 Waste Water Samples and 6 Ground Water Samples were collected and analyzed.
- Health data of last 05years (2011-2016) was collected from the hospitals nearby industrial clusters under study.

## 2.1 Stack Emission Parameters

The Stack Emissions were analyzed with the following parameters:

1) Acid Mist
2) Ammonia
3) Carbon Monoxide
4) Chlorine
5) Fluoride(gaseous)
6) Fluoride (particulate)
7) Hydrogen Chloride
8) Hydrogen Sulphide
9) Oxides of Nitrogen
10) Oxygen
11) Polyaromatic Hydrocarbons (Particulate)
12) Suspended Particulate Matter

13) Sulphur Dioxide

14) Benzene

15) Toluene

16) Xylene

17) Volatile Organic Compounds (VOCs)

## 2.2 Ambient Air Quality Parameters

The Ambient Air Quality was analyzed with the following parameters:

1) Sulphur Dioxide ($SO_2$)

2) Nitrogen Dioxide ($NO_2$)

3) Particulate Matter (PM10)

4) Particulate Matter (PM2.5)

5) Ozone ($O_3$)

6) Lead (Pb)

7) Carbon Monoxide (CO)

8) Ammonia ($NH_3$)

9) Benzene ($C_6H_6$)

10) Benzo (a) Pyrene (BaP) (Particulate Phase Only)

11) Arsenic (As)

12) Nickel (Ni)

## 2.3 Water/Waste Water Parameters

The Water/Waste Water was analyzed with the following parameters:

a. Prominent Surface Water bodies such as outfalls of CETPs, ETPs, treated effluent drainage, river, canal, ponds, lakes and other such water supply resources flowing through the area or flowing adjoining the CPA.

b. Ground Water Quality data of prominent ground water resources such as observation wells of Central Ground Water Board, drinking water wells, hand pumps, bore wells, hand pumps, bore wells and other such water supply resources located in the industrial cluster/area under consideration or in the peripheral areas.

**Basic water quality parameters for surface water and ground water both are as follows:**

**i. Simple Parameters:**

1) Sanitary Survey

2) General Appearance

3) Colour

4) Smell

5) Transparency

6) Ecological(Presence of animals like fish, insects) (Applicable to only surface water)

**ii. Regular Monitoring Parameters:**

7) pH

8) Oil & Grease

9) Suspended Solids

10) Dissolved Oxygen (% saturation) (Not applicable for ground waters)

11) Chemical Oxygen Demand

12) Biochemical Oxygen Demand

13) Electrical Conductivity

14) Nitrite-Nitrogen

15) Nitrate-Nitrogen

16) $(NO_2 + NO_3)$-Nitrogen

17) Free Ammonia

18) Total Residual Chlorine

19) Cyanide

20) Fluoride

21) Sulphide

22) Dissolved Phosphate

23) Sodium Absorption Ratio (SAR)

24) Total Coliforms (MPN/100 ml)

25) Faecal Coliforms (MPN/100 ml)

**iii. Special Parameters:**

26) Total Phosphorous

27) Total Kjeldahl Nitrogen(TKN)

28) Total Ammonia ($NH_4$ +$NH_3$)-Nitrogen

29) Phenols

30) Surface Active Agents

31) Organo Chlorine Pesticides

32) Polynuclear aromatic hydrocarbons (PAH)

33) Polychlorinated Biphenyls (PCB)and Polychlorinated Terphenyls (PCT)

34) Zinc

35) Nickel

36) Copper

37) Hexavalent Chromium

38) Chromium (Total)

39) Arsenic (Total)

40) Lead

41) Cadmium

42) Mercury

43) Manganese

44) Iron

45) Vanadium

46) Selenium

47) Boron

**iv. Bioassay (Zebra Fish) Test:** For specified samples only.

### 2.4 Methodology followed in Sampling and Analysis

Industries, places and locations that have been chosen for the sampling are representative of the city/area. Sampling has been done at the potential polluted areas so as to arrive at the CEPI. This will further help the authorities to monitor the areas in order to improve the current status of their environmental components such as air and water quality data, ecological damage and visual environmental conditions. Methodology for sampling, preservation and analysis have been done according to the references incorporated. Methodology of various types of parameters is presented under following annexure:

1. Stack Emission Sampling and Analysis Methodology – **Annexure I**
2. Ambient Air Sampling and Analysis Methodology **- Annexure II**
3. Water/Wastewater Sampling and Analysis Methodology - **Annexure III**

## 3. Result of Analysis

Results of Analysis are tabulated below for Stack Emission Monitoring, Ambient Air Quality Monitoring, Waste Water Analysis and Water Analysis. These are followed by their respective graphical representation.

***Kindly note:**

- NA specifies the sample is not analysed for the specific parameter.
- ND specifies that even though the sample was analysed for the parameter, it was not detected.
- BDL specifies that the result obtained is below detection limit.

**Please Note:** ***Industrial clusters observed with below detection limit parameters are NOT included into the graphs.***

### 3.1 Stack Emission Monitoring:

Stack Emission Monitoring Results are compared against The Environment (Protection) Rules, 1986 General Emission Standard - Part D. The limits are represented on the graphical representation. Graph of Volatile Organic Carbon (VOCs) could not be prepared as their concentration was found either very less or not detected.

| Sr. | Name of Industry | Included in |
|---|---|---|
| 1. | UPL, Plot No. E-51 | Table No. I |
| 2. | Calyx Chemical Ltd. | Table No. I |
| 3. | Siyaram Silk Mills Ltd. | Table No. I |
| 4. | M/s Angadpal industries Pvt. Ltd. | Table No. I |

| | | |
|---|---|---|
| 5. | Gini Silk Mills Ltd | Table No. II |
| 6. | Mandhana Industrial Ltd. (Shirting Unit) | Table No. II |
| 7. | Mandhana Industrial Ltd. (Dyeing Unit- II) | Table No. II |

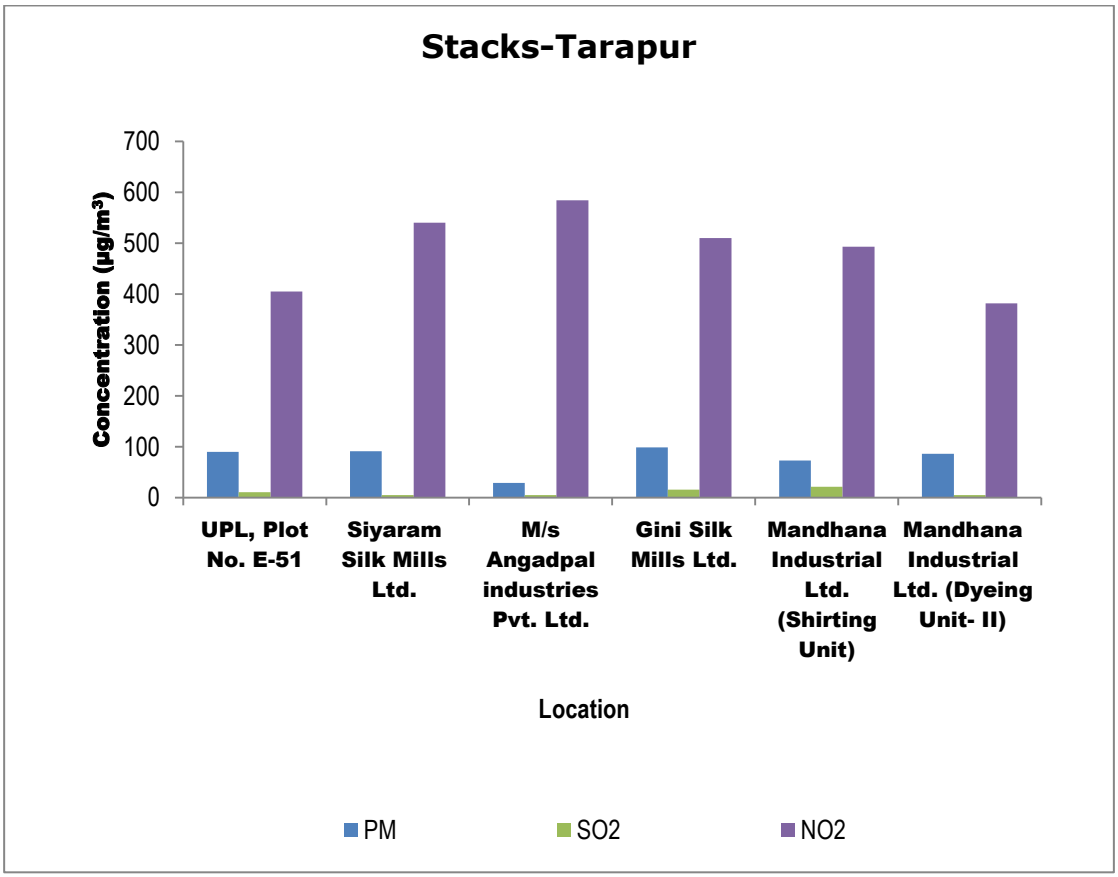
**Table No. I:**

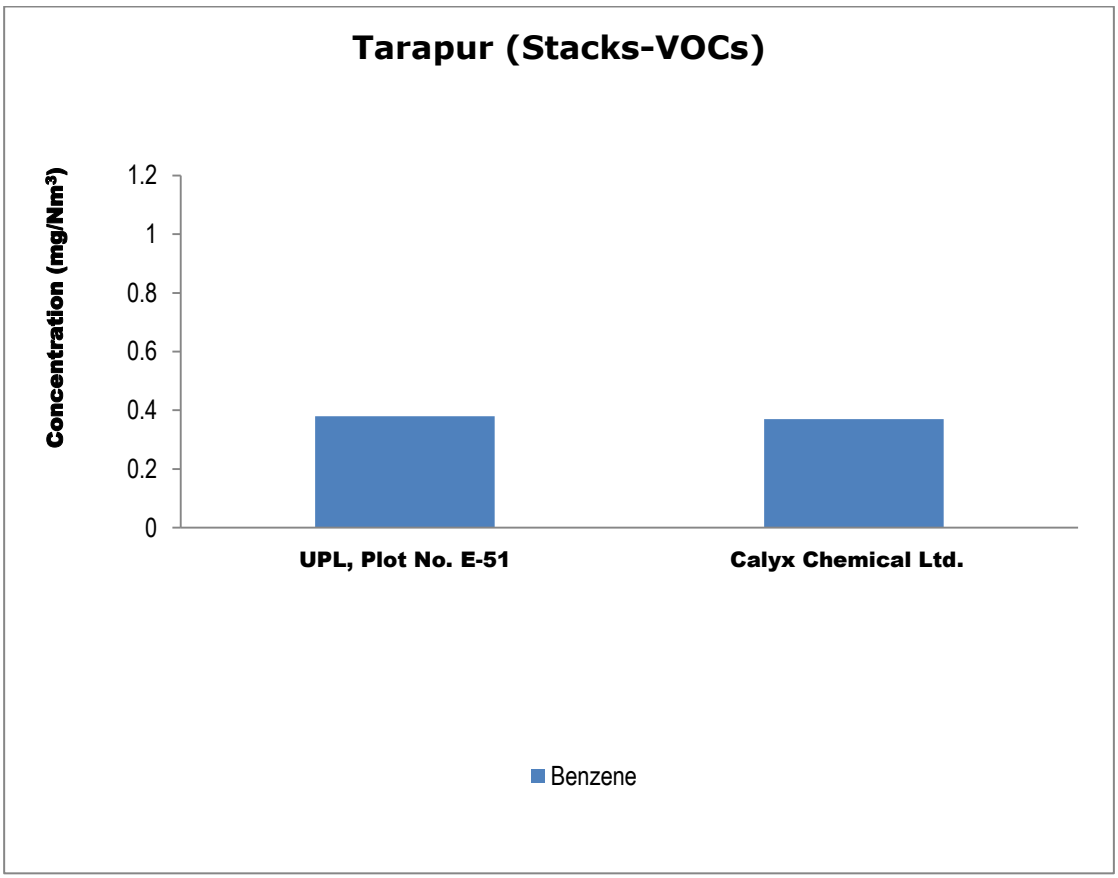
| **Name of Industry** | | | **UPL, Plot No. E-51** | **Calyx Chemical Ltd.** | **Siyaram Silk Mills Ltd.** | **M/s Angadpal industries Pvt. Ltd.** |
|---|---|---|---|---|---|---|
| **Date of Sampling** | | | **07.06.17** | **07.06.17** | **06.06.17** | **05.06.17** |
| **Stack ID** | | | Boiler | Boiler | Boiler | Boiler |
| **Sr.** | **Parameters** | **Unit** | **Result** | | | |
| 1 | Particulate Matter | $mg/Nm^3$ | 90 | - | 91 | 29 |
| | **Std. Limit** | **$mg/Nm^3$** | **150** | **150** | **150** | **150** |
| 2 | Sulphur Dioxide ($SO_2$) | $mg/Nm^3$ | 10.6 | - | 5.33 | 5.33 |
| | | kg/d | 5.54 | - | 1.39 | 2.9 |
| | **Std. Limit** | **$mg/Nm^3$** | **-** | **-** | **-** | **-** |
| 3 | Nitrogen Dioxide ($NO_2$) | $mg/Nm^3$ | 405 | - | 540 | 584 |
| 4. | Volatile Organic Carbons (VOCs) | | | | | |
| | Methyl Isobutyl Ketone | $mg/Nm^3$ | ND | ND | ND | ND |
| | Benzene | $mg/Nm^3$ | 0.38 | 0.37 | ND | ND |
| | Toulene | $mg/Nm^3$ | 1.1 | 0.23 | ND | ND |
| | Xylene | $mg/Nm^3$ | ND | ND | ND | ND |
| | Ethyl Benzene | $mg/Nm^3$ | ND | ND | ND | ND |
| | Ethyl Acetate | $mg/Nm^3$ | ND | ND | ND | ND |

**Table No. II:**

| **Name of Industry** | | | **Gini Silk Mills Ltd** | **Mandhana Industrial Ltd. (Shirting Unit)** | **Mandhana Industrial Ltd. (Dyeing Unit- II)** |
|---|---|---|---|---|---|
| **Date of Sampling** | | | **06.06.17** | **07.06.17** | **05.06.17** |
| **Stack ID** | | | Boiler | Boiler | Boiler |
| **Sr.** | **Parameters** | **Unit** | **Result** | | |
| 1 | Particulate Matter | $mg/Nm^3$ | 99 | 73 | 86 |
| | **Std. Limit** | **$mg/Nm^3$** | **150** | **150** | **150** |
| 2 | Sulphur Dioxide ($SO_2$) | $mg/Nm^3$ | 16 | 21.3 | 5.33 |
| | | kg/d | 23.9 | 23.3 | 5.89 |
| | **Std. Limit** | **$mg/Nm^3$** | **-** | **-** | **-** |
| 3 | Nitrogen Dioxide ($NO_2$) | $mg/Nm^3$ | 510 | 493 | 382 |
| 5. | Volatile Organic Carbons (VOCs) | | | | |
| | Methyl Isobutyl Ketone | $mg/Nm^3$ | ND | ND | ND |
| | Benzene | $mg/Nm^3$ | ND | ND | ND |
| | Toulene | $mg/Nm^3$ | ND | ND | ND |
| | Xylene | $mg/Nm^3$ | ND | ND | ND |
| | Ethyl Benzene | $mg/Nm^3$ | ND | ND | ND |
| | Ethyl Acetate | $mg/Nm^3$ | ND | ND | ND |

**Graphs: Stack Monitoring Results:**



## 3.2 Ambient Air Quality:

In order to arrive at conclusions, the Ambient Air Quality Monitoring Results are compared against National Ambient Air Quality Standards, 2009 (Annexure IV). The limits are represented on the graphical representation.

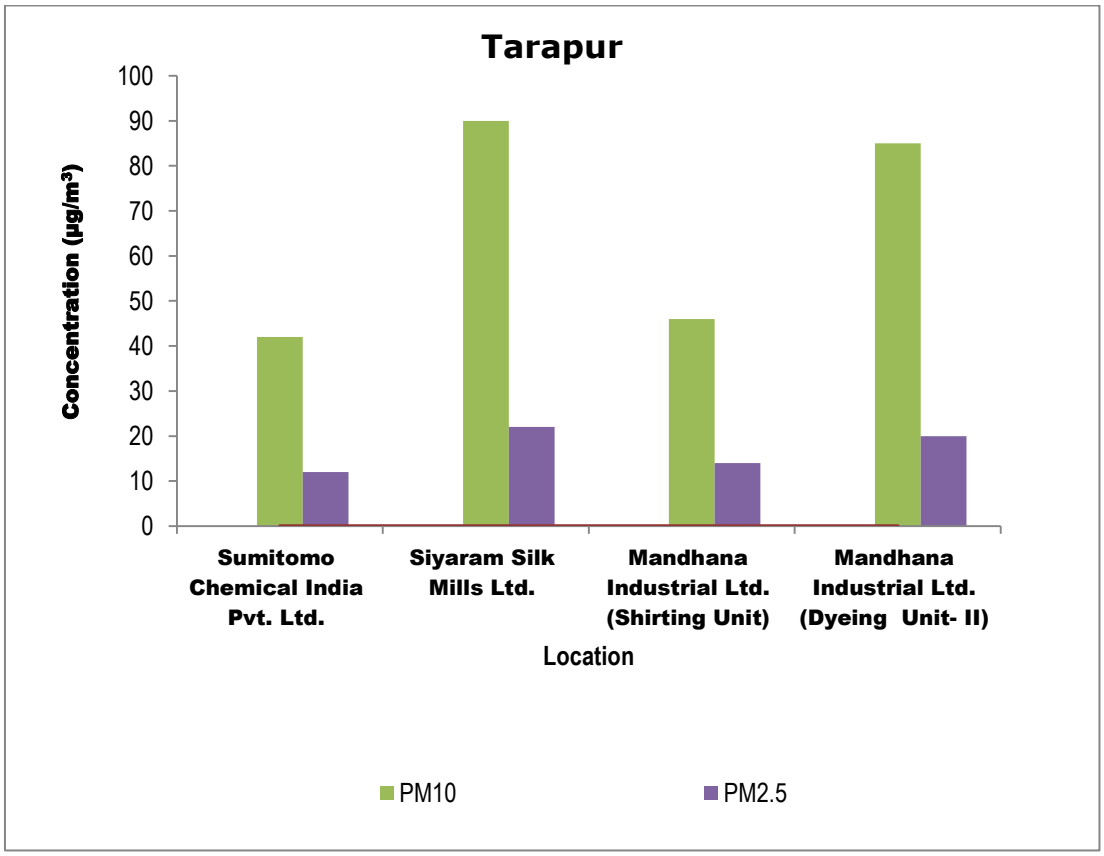
| Sr. | Locations | Included in |
|---|---|---|
| 1. | Sumitomo Chemical India Pvt. Ltd. | Table No. I |
| 2. | Siyaram Silk Mills Ltd. | Table No. I |
| 3. | Mandhana Industrial Ltd. (Shirting Unit) | Table No. I |
| 4. | Mandhana Industrial Ltd. (Dyeing Unit- II) | Table No. I |

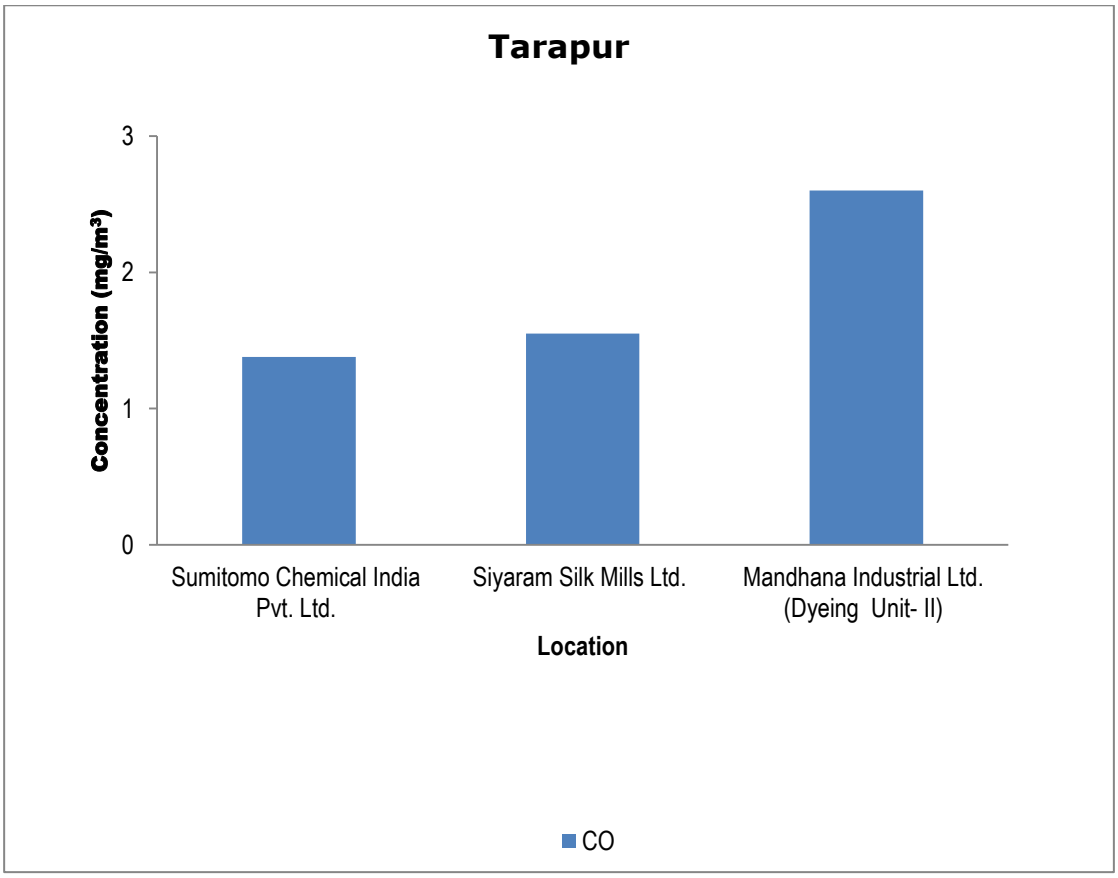
**Table No. I:**

| **Location** | | | | **Sumitomo Chemical India Pvt. Ltd.** | **Siyaram Silk Mills Ltd.** | **Mandhana Industrial Ltd. (Shirting Unit)** | **Mandhana Industrial Ltd. (Dyeing Unit- II)** |
|---|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | **07.06.17** | **07.06.17** | **06.06.17** | **06.06.17** |
| **Sr.** | **Parameters** | **Unit** | **Std. Limit (NAAQS, 2009)** | **Results** | | | |
| 1. | Sulphur Dioxide ($SO_2$) | $\mu g/m^3$ | **80** | BDL | BDL | BDL | BDL |
| 2. | Nitrogen Dioxide ($NO_2$) | $\mu g/m^3$ | **80** | BDL | BDL | BDL | BDL |
| 3. | Particulate Matter (size <10 µm)or PM10 | $\mu g/m^3$ | **100** | 42 | 90 | 46 | 85 |
| 4. | Particulate Matter (size <2.5µm)or PM2.5 | $\mu g/m^3$ | **60** | 12 | 22 | 14 | 20 |

| **Location** | | | | **Sumitomo Chemical India Pvt. Ltd.** | **Siyaram Silk Mills Ltd.** | **Mandhana Industrial Ltd. (Shirting Unit)** | **Mandhana Industrial Ltd. (Dyeing Unit-II)** |
|---|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | **07.06.17** | **07.06.17** | **06.06.17** | **06.06.17** |
| 5. | Ozone ($O_3$) | $\mu g/m^3$ | **180** | BDL | BDL | BDL | BDL |
| 6. | Lead (Pb) | $\mu g/m^3$ | **1** | BDL | BDL | BDL | BDL |
| 7. | Carbon Monoxide (CO) | $mg/m^3$ | **04** | 1.38 | 1.55 | BDL | 2.6 |
| 8. | Ammonia ($NH_3$) | $\mu g/m^3$ | **400** | BDL | BDL | BDL | BDL |
| 9. | Benzene ($C_6H_6$) | $\mu g/m^3$ | **5** | BDL | BDL | BDL | BDL |
| 10. | Benzo (a) Pyrene (BaP) – particulate phase only | $ng/m^3$ | **1** | BDL | BDL | BDL | BDL |
| 11. | Arsenic (as As) | $ng/m^3$ | **6** | BDL | BDL | BDL | BDL |
| 12. | Nickel (as Ni) | $ng/m^3$ | **20** | BDL | BDL | BDL | BDL |

## Graphs: Ambient Air Monitoring Results:



## 3.3 Water/Waste Water:

Water analysis Results are compared against CPCB document on criteria for Comprehensive Environmental Assessment of Industrial Clusters-Water Quality Parameters Requirement and Classification (Annexure VIII), CPCB Water Quality Criteria (Annexure VII) and Drinking Water Specification, IS 10500:2012 (Annexure VI), Wastewater Analysis Results are compared with General Standards for Discharge of Environmental Pollutants Part A: Effluents, The Environment (Protection) Rules, 1986, Schedule VI (Annexure V)

### 3.3.1.1 Waste Water Analysis Results:

| Sr. | Locations | Included in |
|---|---|---|
| 1. | UPL Plot No. E-51 | Table I |
| 2. | Calyx Chemical Ltd. | Table I |
| 3. | Siyaram Silk Mills Ltd. | Table I |
| 4. | Navapur Discharge | Table II |
| 5. | CETP outlet | Table II |
| 6. | CETP inlet | Table II |

**Table I:**

| **Location** | | | | **UPL Plot No. E-51** | **Calyx Chemical Ltd.** | **Siyaram Silk Mills Ltd.** |
|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | **07.06.17** | **07.06.17** | **07.06.17** |
| **Sr.** | **Parameters** | | **Std. Limit** | **Results** | | |
| 1. | Colour | Hazen | | 1 | 1 | 10 |
| 2. | Smell | - | | Agreeable | Agreeable | Agreeable |
| 3. | Transparency | m | | 7.37 | 6.32 | 7.41 |
| 4. | pH | - | **5.5 -9.0** | BDL | BDL | BDL |
| 5. | Oil & Grease | mg/L | **10.0** | 21 | 13 | 86 |
| 6. | Suspended Solids | mg/L | **100.0** | 38 | 55 | 65 |

| **Location** | | | | **UPL Plot No. E-51** | **Calyx Chemical Ltd.** | **Siyaram Silk Mills Ltd.** |
|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | **07.06.17** | **07.06.17** | **07.06.17** |
| **Sr.** | **Parameters** | | **Std. Limit** | **Results** | | |
| 7. | Dissolved Oxygen (%Saturation) | % | | 99 | 60 | 20 |
| 8. | Chemical Oxygen Demand | mg/L | **250.0** | 34 | 21 | 7 |
| 9. | Biochemical Oxygen Demand (3 days,27$^{o}$C) | mg/L | **30.0** | 839 | 1940 | 2070 |
| 10. | Electrical Conductivity (at 25$^{o}$C ) | µmhos/cm | | BDL | 0.016 | <0.01 |
| 11. | Nitrite Nitrogen (as N) | mg/L | | 5.5 | 43.4 | 20.1 |
| 12. | Nitrate Nitrogen (as N) | mg/L | **10.0** | 5.5 | 43.4 | 20.1 |
| 13. | ($NO_2$ + $NO_3$)-Nitrogen | mg/L | **5.0** | BDL | BDL | BDL |
| 14. | Free Ammonia (as $NH_3$-N) | mg/L | **5.0** | BDL | BDL | BDL |
| 15. | Total Residual Chlorine | mg/L | **1.0** | BDL | BDL | BDL |
| 16. | Cyanide (as CN) | mg/L | **0.2** | 0.7 | 0.4 | 0.32 |
| 17. | Fluoride (as F) | mg/L | **2.0** | BDL | BDL | BDL |
| 18. | Sulphide (as $S^{2-}$) | mg/L | **2.0** | BDL | BDL | BDL |
| 19. | Dissolved Phosphate (as P) | mg/L | **5.0** | 2.59 | 2.71 | 9.32 |
| 20. | Sodium Absorption Ratio | - | | 280 | 1600 | BDL |

| **Location** | | | | **UPL Plot No. E-51** | **Calyx Chemical Ltd.** | **Siyaram Silk Mills Ltd.** |
|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | **07.06.17** | **07.06.17** | **07.06.17** |
| **Sr.** | **Parameters** | | **Std. Limit** | **Results** | | |
| 21. | Total Coliforms | MPN index/ 100 mL | **100.0** | 170 | 1600 | BDL |
| 22. | Faecal Coliforms | MPN index/ 100 mL | **1000.0** | BDL | BDL | BDL |
| 23. | Total Phosphorous (as P) | mg/L | **1.0** | 4.34 | 13.3 | 4.26 |
| 24. | Total Kjeldahl Nitrogen | mg/L | **100.0** | BDL | 7.6 | 0.32 |
| 25. | Total Ammonia ($NH_4$+$NH_3$)-Nitrogen | mg/L | **5.0** | BDL | BDL | BDL |
| 26. | Phenols (as $C_6H_5OH$) | mg/L | **3.0** | BDL | BDL | BDL |
| 27. | Surface Active Agents (as MBAS) | mg/L | **3.0** | | | |
| 28. | Organo Chlorine Pesticides | µg/L | **0.1** | | | |
| | Alachlor | µg/L | **2.0** | BDL | BDL | BDL |
| | Atrazine | µg/L | **0.2** | BDL | BDL | BDL |
| | Aldrin | µg/L | **0.1** | BDL | BDL | BDL |
| | Dieldrin | µg/L | **2.0** | BDL | BDL | BDL |
| | Alpha HCH | µg/L | **0.01** | BDL | BDL | BDL |
| | Beta HCH | µg/L | **2.0** | BDL | BDL | BDL |
| | Butachlor | µg/L | **3.0** | BDL | BDL | BDL |

| **Location** | | | | **UPL Plot No. E-51** | **Calyx Chemical Ltd.** | **Siyaram Silk Mills Ltd.** |
|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | **07.06.17** | **07.06.17** | **07.06.17** |
| **Sr.** | **Parameters** | | **Std. Limit** | **Results** | | |
| | Chlorpyrifos | | | BDL | BDL | BDL |
| | Delta HCH | µg/L | **0.2** | BDL | BDL | BDL |
| | p,p DDT | µg/L | **0.05** | BDL | BDL | BDL |
| | o,p DDT | µg/L | **100.0** | BDL | BDL | BDL |
| | p,p DDE | µg/L | **250.0** | BDL | BDL | BDL |
| | o,p DDE | µg/L | **30.0** | BDL | BDL | BDL |
| | p,p DDD | µg/L | | BDL | BDL | BDL |
| | o,p DDD | µg/L | | BDL | BDL | BDL |
| | Alpha Endosulfan | µg/L | **10.0** | BDL | BDL | BDL |
| | Beta Endosulfan | µg/L | | BDL | BDL | BDL |
| | Endosulfan Sulphate | µg/L | **5.0** | BDL | BDL | BDL |
| | Y HCH (Lindane) | µg/L | **1.0** | BDL | BDL | BDL |
| 29. | Poly Aromatic hydrocarbons (as PAH) | µg/L | **0.2** | BDL | BDL | BDL |
| 30. | Polychlorinated Biphenyls (PCB) | µg/L | **2.0** | BDL | BDL | BDL |
| 31. | Zinc (as Zn) | mg/L | **5.0** | 0.09 | 0.199 | BDL |
| 32. | Nickel (as Ni) | mg/L | **3.0** | BDL | BDL | BDL |
| 33. | Copper (as Cu) | mg/L | | BDL | BDL | BDL |

| **Location** | | | | **UPL Plot No. E-51** | **Calyx Chemical Ltd.** | **Siyaram Silk Mills Ltd.** |
|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | **07.06.17** | **07.06.17** | **07.06.17** |
| **Sr.** | **Parameters** | | **Std. Limit** | **Results** | | |
| 34. | Hexavalent Chromium (as $Cr^{6+}$) | mg/L | **0.1** | BDL | BDL | BDL |
| 35. | Total Chromium (as Cr) | mg/L | **2.0** | BDL | BDL | BDL |
| 36. | Total Arsenic (as As) | mg/L | **0.2** | BDL | BDL | BDL |
| 37. | Lead (as Pb) | mg/L | **0.1** | 0.044 | BDL | 0.014 |
| 38. | Cadmium (as Cd) | mg/L | **2.0** | BDL | BDL | BDL |
| 39. | Mercury (as Hg) | mg/L | **0.01** | BDL | BDL | BDL |
| 40. | Manganese (as Mn) | mg/L | **2.0** | 0.057 | 0.089 | 0.085 |
| 41. | Iron (as Fe) | mg/L | **3.0** | 4.53 | 0.667 | 0.757 |
| 42. | Vanadium (as V) | mg/L | **0.2** | BDL | BDL | BDL |
| 43. | Selenium (as Se) | mg/L | **0.05** | BDL | BDL | BDL |
| 44. | Boron (as B) | mg/L | | BDL | BDL | BDL |
| 45. | Bioassay Test on fish | % survival | **90% survival after 96h in 100%effluent** | 100 | 100 | 80 |

**Table II:**

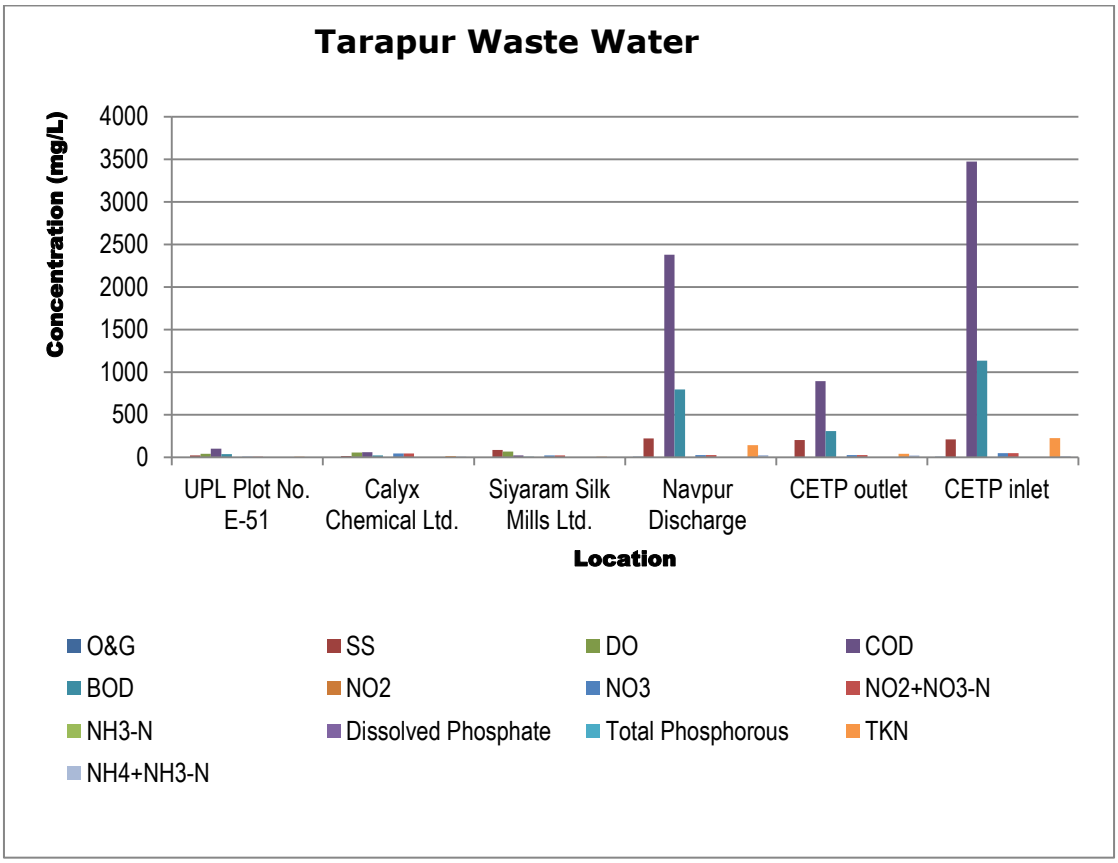
| **Location** | | | | **Navapur Discharge (CETP Discharge)** | **CETP Tarapur MIDC** | **CETP Tarapur MIDC** |
|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | **07.06.17** | **07.06.17** | **07.06.17** |
| **Sr.** | **Parameters** | **Unit** | **Std. Limit** | **Results** | | |
| 1. | Colour | Hazen | | 100 | 100 | 100 |
| 2. | Smell | - | | Agreeable | Agreeable | Agreeable |
| 3. | pH | - | **5.5 -9.0** | | | |
| 4. | Oil & Grease | mg/L | **10.0** | 7.33 | 7.42 | 7.11 |
| 5. | Suspended Solids | mg/L | **100.0** | 4.2 | 1.2 | 5 |
| 6. | Dissolved Oxygen (%Saturation) | % | | | | |
| 7. | Chemical Oxygen Demand | mg/L | **250.0** | 2380 | 892 | 3472 |
| 8. | Biochemical Oxygen Demand (3 days,27°C) | mg/L | **30.0** | 795 | 308 | 1133 |
| 9. | Electrical Conductivity ( at 25°C ) | µmhos/cm | | 26400 | 3010 | 10000 |
| 10. | Nitrite Nitrogen (as N) | mg/L | | 0.017 | 0.026 | 0.044 |
| 11. | Nitrate Nitrogen (as N) | mg/L | **10.0** | 22.8 | 23.2 | 46.3 |
| 12. | $(NO_2 + NO_3)$-Nitrogen | mg/L | **5.0** | 22.8 | 23.2 | 46.3 |
| 13. | Free Ammonia (as $NH_3$-N) | mg/L | **5.0** | BDL | BDL | BDL |
| 14. | Total Residual Chlorine | mg/L | **1.0** | BDL | BDL | BDL |
| 15. | Cyanide (as CN) | mg/L | **0.2** | BDL | BDL | BDL |
| 16. | Fluoride (as F) | mg/L | **2.0** | 0.76 | 1.14 | 1.4 |
| 17. | Sulphide (as $S^{2-}$) | mg/L | **2.0** | BDL | BDL | BDL |

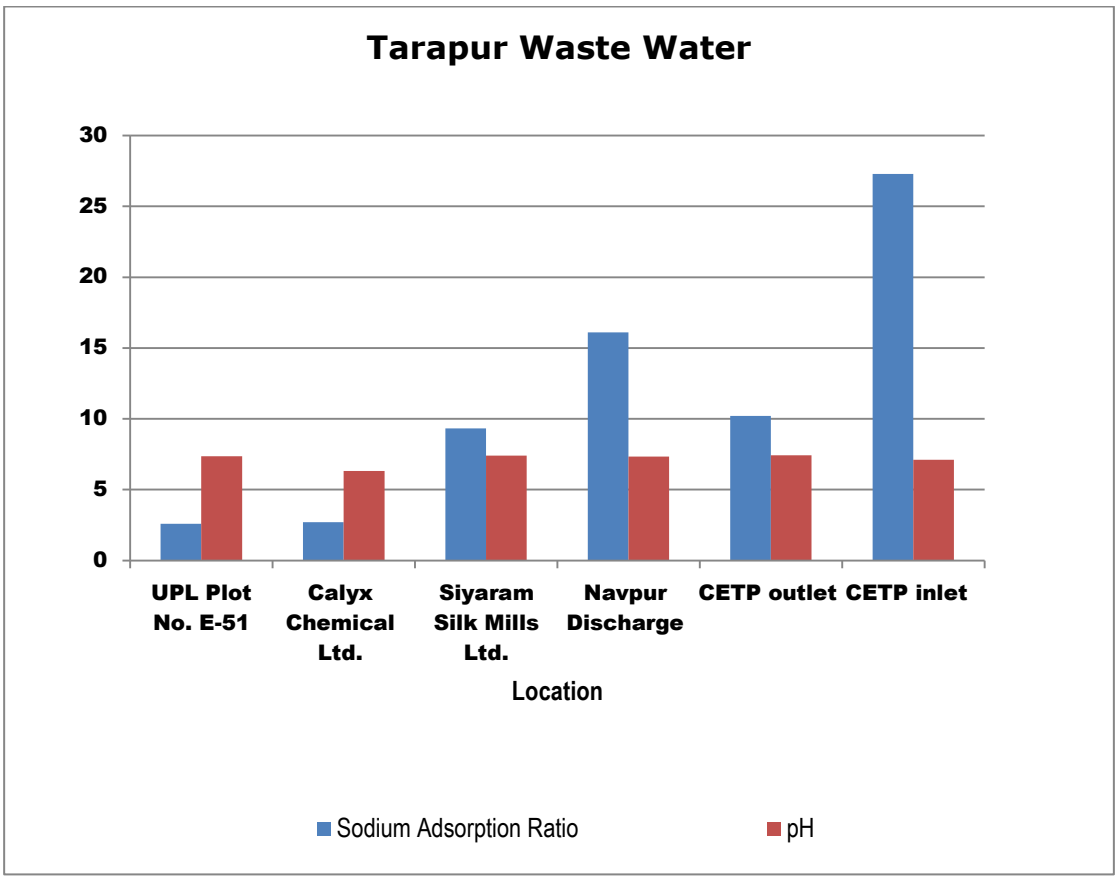
| **Location** | | | | **Navapur Discharge (CETP Discharge)** | **CETP Tarapur MIDC** | **CETP Tarapur MIDC** |
|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | **07.06.17** | **07.06.17** | **07.06.17** |
| **Sr.** | **Parameters** | **Unit** | **Std. Limit** | **Results** | | |
| 18. | Dissolved Phosphate (as P) | mg/L | **5.0** | BDL | 0.12 | 0.23 |
| 19. | Sodium Absorption Ratio | - | | 16.1 | 10.2 | 27.3 |
| 20. | Total Coliforms | MPN index/ 100 mL | **100.0** | 24 | 280 | 280 |
| 21. | Faecal Coliforms | MPN index/ 100 mL | **1000.0** | 11 | 39 | 14 |
| 22. | Total Phosphorous (as P) | mg/L | **1.0** | 0.19 | 0.22 | 0.62 |
| 23. | Total Kjeldahl Nitrogen | mg/L | **100.0** | 140 | 40.6 | 224 |
| 24. | Total Ammonia ($NH_4$+$NH_3$)-Nitrogen | mg/L | **5.0** | 24.5 | 22.4 | 10.1 |
| 25. | Phenols (as $C_6H_5OH$) | mg/L | **3.0** | BDL | BDL | BDL |
| 26. | Surface Active Agents (as MBAS) | mg/L | **3.0** | BDL | BDL | BDL |
| 27. | Organo Chlorine Pesticides | µg/L | **0.1** | | | |
| | Alachlor | µg/L | **2.0** | BDL | BDL | BDL |
| | Atrazine | µg/L | **0.2** | BDL | BDL | BDL |
| | Aldrin | µg/L | **0.1** | BDL | BDL | BDL |
| | Dieldrin | µg/L | **2.0** | BDL | BDL | BDL |
| | Alpha HCH | µg/L | **0.01** | BDL | BDL | BDL |
| | Beta HCH | µg/L | **2.0** | BDL | BDL | BDL |

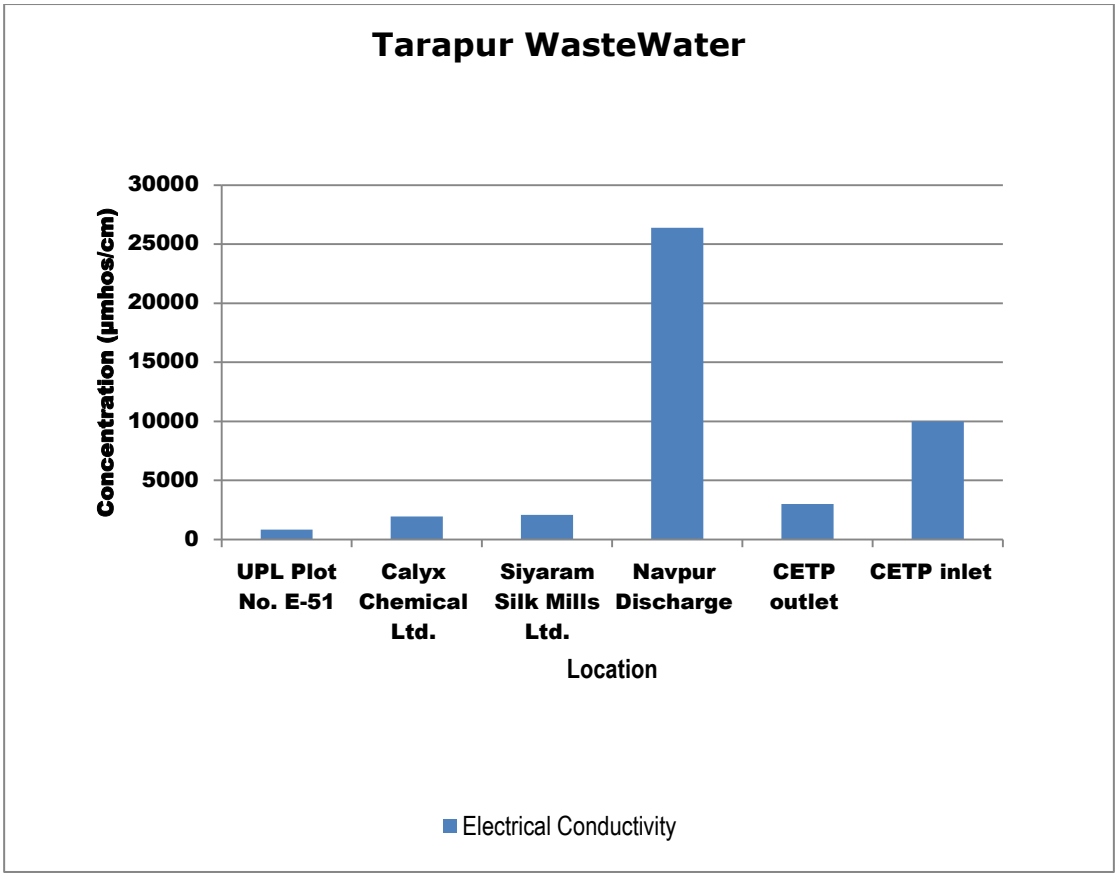
| **Location** | | | | **Navapur Discharge (CETP Discharge)** | **CETP Tarapur MIDC** | **CETP Tarapur MIDC** |
|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | **07.06.17** | **07.06.17** | **07.06.17** |
| **Sr.** | **Parameters** | **Unit** | **Std. Limit** | **Results** | | |
| | Butachlor | µg/L | **3.0** | BDL | BDL | BDL |
| | Chlorpryrifos | | | BDL | BDL | BDL |
| | Delta HCH | µg/L | **0.2** | BDL | BDL | BDL |
| | p,p DDT | µg/L | **0.05** | BDL | BDL | BDL |
| | o,p DDT | µg/L | **100.0** | BDL | BDL | BDL |
| | p,p DDE | µg/L | **250.0** | BDL | BDL | BDL |
| | o,p DDE | µg/L | **30.0** | BDL | BDL | BDL |
| | p,p DDD | µg/L | | BDL | BDL | BDL |
| | o,p DDD | µg/L | | BDL | BDL | BDL |
| | Alpha Endosulfan | µg/L | **10.0** | BDL | BDL | BDL |
| | Beta Endosulfan | µg/L | | BDL | BDL | BDL |
| | Endosulfan Sulphate | µg/L | **5.0** | BDL | BDL | BDL |
| | Y HCH (Lindane) | µg/L | **1.0** | BDL | BDL | BDL |
| 28. | Polynuclear aromatic hydrocarbons (as PAH) | µg/L | **0.2** | BDL | BDL | BDL |
| 29. | Polychlorinated Biphenyls (PCB) | µg/L | **2.0** | BDL | BDL | BDL |
| 30. | Zinc (as Zn) | mg/L | **5.0** | 0.395 | 0.184 | 1.01 |
| 31. | Nickel (as Ni) | mg/L | **3.0** | 0.036 | 0.012 | 0.019 |
| 32. | Copper (as Cu) | mg/L | | 0.288 | 0.048 | 0.213 |

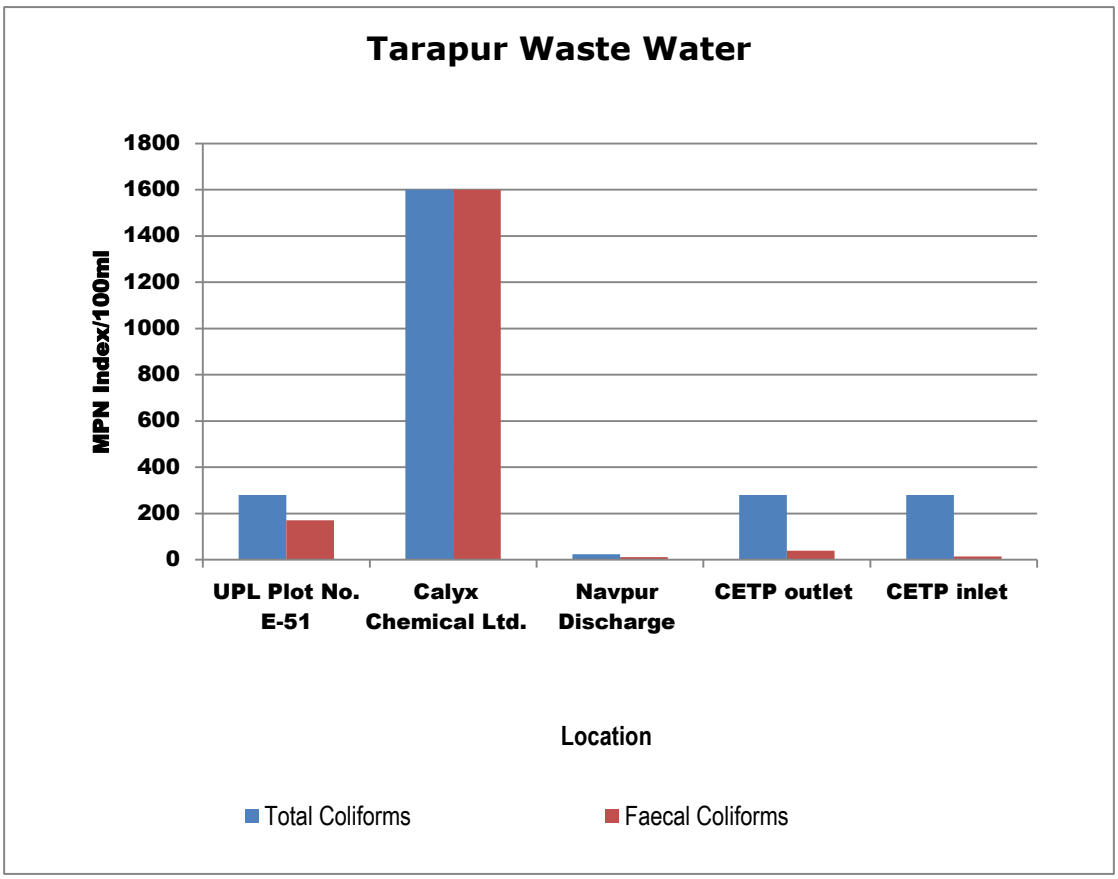
| **Location** | | | | **Navapur Discharge (CETP Discharge)** | **CETP Tarapur MIDC** | **CETP Tarapur MIDC** |
|---|---|---|---|---|---|---|
| **Date of Sampling** | | | | **07.06.17** | **07.06.17** | **07.06.17** |
| **Sr.** | **Parameters** | **Unit** | **Std. Limit** | **Results** | | |
| 33. | Hexavalent Chromium (as $Cr^{6+}$) | mg/L | **0.1** | BDL | BDL | BDL |
| 34. | Total Chromium (as Cr) | mg/L | **2.0** | 0.058 | 0.026 | 0.042 |
| 35. | Total Arsenic (as As) | mg/L | **0.2** | BDL | BDL | BDL |
| 36. | Lead (as Pb) | mg/L | **0.1** | BDL | BDL | BDL |
| 37. | Cadmium (as Cd) | mg/L | **2.0** | BDL | BDL | BDL |
| 38. | Mercury (as Hg) | mg/L | **0.01** | BDL | BDL | BDL |
| 39. | Manganese (as Mn) | mg/L | **2.0** | 0.42 | 0.188 | 0.217 |
| 40. | Iron (as Fe) | mg/L | **3.0** | 5.49 | 2.35 | 5.62 |
| 41. | Vanadium (as V) | mg/L | **0.2** | BDL | BDL | BDL |
| 42. | Selenium (as Se) | mg/L | **0.05** | BDL | BDL | BDL |
| 43. | Boron (as B) | mg/L | | 1.28 | 0.188 | 0.376 |
| 44. | Bioassay Test on fish | % survival | **90% survival after 96h in 100%effluent** | 0 | 70 | 0 |

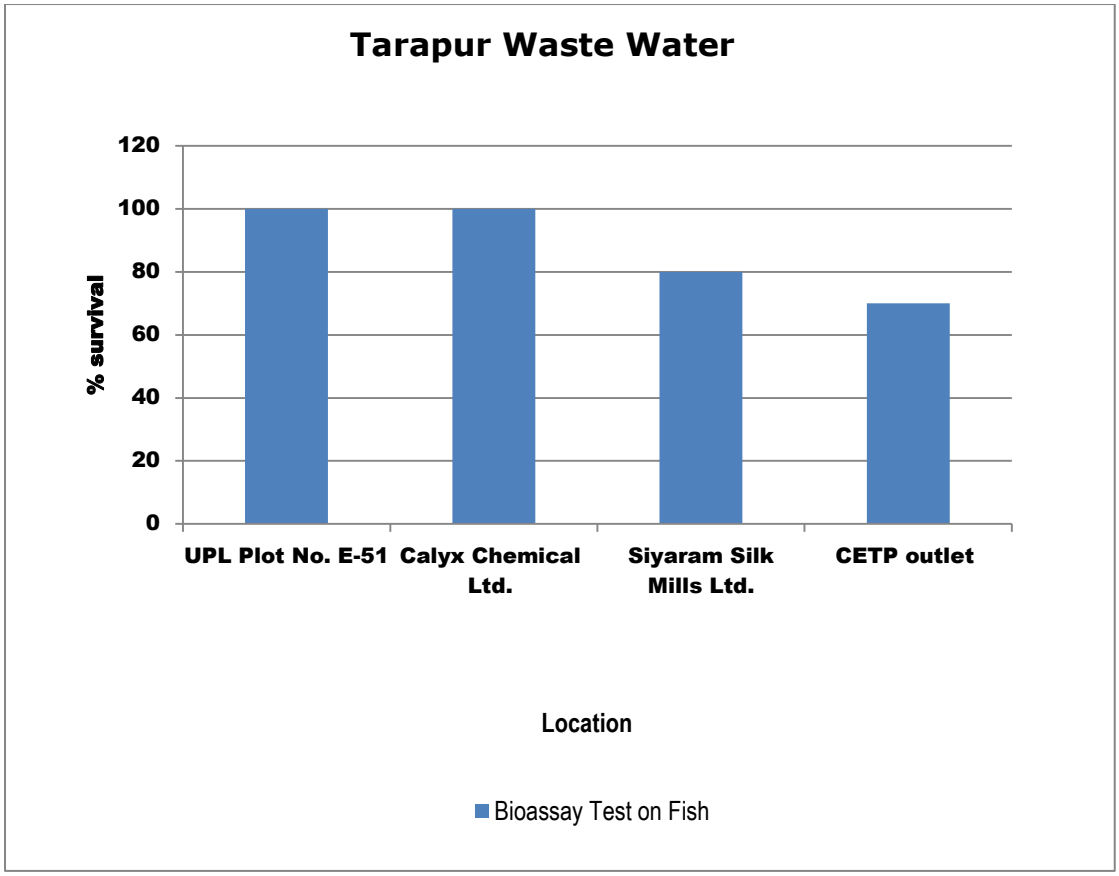
**Graphs: Waste Water Monitoring Results:**




Tarapur WasteWater
Concentration (µmhos/cm)
30000
25000
20000
15000
10000
5000
0
UPL Plot No. E-51
Calyx Chemical Ltd.
Siyaram Silk Mills Ltd.
Navpur Discharge
CETP outlet
CETP inlet
Location
Electrical Conductivity


Tarapur Waste Water
MPN Index/100ml
1800
1600
1400
1200
1000
800
600
400
200
0
UPL Plot No. E-51
Calyx Chemical Ltd.
Navpur Discharge
CETP outlet
CETP inlet
Location
Total Coliforms
Faecal Coliforms




### 3.3.2 Ground Water Analysis Results:

| Sr. No. | Locations | Denotation | Included in |
|---|---|---|---|
| 1. | Ankush Gharatwadi | A | Table I |
| 2. | Dhodi Pooja Area | B | Table I |
| 3. | Lala Vajpayee Area | C | Table I |
| 4. | Chiku Wadi | D | Table II |
| 5. | Kumbhavali Village | E | Table II |
| 6. | Salvad Village | F | Table II |

**Table I:**

| **Location** | | | | **Ankush Gharatwadi** | **Dhodi Pooja Area** | **Lala Vajpayee Area** |
|---|---|---|---|---|---|---|
| **Type** | | | | Well Water | Bore Well | Well Water |
| **Date of Sampling** | | | | **06.06.17** | **06.06.17** | **06.06.17** |
| **Sr.** | **Parameters** | **Unit** | **Std. Limit** | **Results** | | |
| 3. | Colour | Hazen | **5** | 1 | 1 | 1 |
| | Odour | | **Agreeable** | Agreeable | Agreeable | Agreeable |
| 6. | pH | - | **6.5-8.5** | 7.22 | 7.42 | 7.84 |
| 7. | Oil & Grease | mg/L | **100** | BDL | BDL | BDL |
| 8. | Suspended Solids | mg/L | **500** | 9 | 8 | 14 |
| 10. | Chemical Oxygen Demand | mg/L | **10 (WHO, 1993)** | 60 | 60 | 28 |
| 11. | Biochemical Oxygen Demand (3 days,27$^{o}$C) | mg/L | **6 (WHO, 1993)** | 21 | 21 | 9.6 |
| 12. | Electrical Conductivity (at 25$^{o}$C ) | µmhos/ cm | **750** | 761 | 545 | 1524 |
| 13. | Nitrite Nitrogen (as N) | mg/L | | BDL | BDL | BDL |
| 14. | Nitrate Nitrogen (as N) | mg/L | **45** | 2.21 | 1.05 | 4.57 |
| 15. | ($NO_2$ + $NO_3$)-Nitrogen | mg/L | **1.0** | 2.21 | 1.05 | 4.57 |
| 16. | Free Ammonia (as $NH_3$-N) | mg/L | **0.5** | BDL | BDL | BDL |
| 17. | Total Residual Chlorine | mg/L | **0.2** | BDL | BDL | BDL |
| 18. | Cyanide (as CN) | mg/L | | BDL | BDL | BDL |
| 19. | Fluoride (as F) | mg/L | **1** | 0.4 | 0.42 | 0.52 |
| 20. | Sulphide (as $S^{2-}$) | mg/L | **0.05** | BDL | BDL | BDL |

| **Location** | | | | **Ankush Gharatwadi** | **Dhodi Pooja Area** | **Lala Vajpayee Area** |
|---|---|---|---|---|---|---|
| **Type** | | | | Well Water | Bore Well | Well Water |
| **Date of Sampling** | | | | **06.06.17** | **06.06.17** | **06.06.17** |
| 21. | Dissolved Phosphate (as P) | mg/L | | BDL | BDL | BDL |
| 22. | Sodium Absorption Ratio | | | 0.41 | 1.02 | 0.57 |
| 23. | Total Coliforms | MPN index/ 100 mL | **ND** | 7.8 | 79 | 49 |
| 24. | Faecal Coliforms | MPN index/ 100 mL | **ND** | 4.5 | 33 | 23 |
| 25. | Total Phosphorous (as P) | mg/L | **0.5** | BDL | BDL | BDL |
| 26. | Total Kjeldahl Nitrogen | mg/L | **0.001** | 0.1 | 0.11 | 0.1 |
| 27. | Total Ammonia ($NH_4$+$NH_3$)-Nitrogen | mg/L | **0.5** | BDL | BDL | BDL |
| 28. | Phenols (as $C_6H_5OH$) | mg/L | **0.001** | BDL | BDL | BDL |
| 29. | Surface Active Agents (as MBAS) | mg/L | **0.05** | BDL | BDL | BDL |
| 30. | Organo Chlorine Pesticides | µg/L | | | | |
| i. | Alachlor | µg/L | | BDL | BDL | BDL |
| ii. | Atrazine | µg/L | **2** | BDL | BDL | BDL |
| iii. | Aldrin | µg/L | **0.03** | BDL | BDL | BDL |
| iv. | Dieldrin | µg/L | **0.03** | BDL | BDL | BDL |
| v | Alpha HCH | µg/L | **0.01** | BDL | BDL | BDL |
| vi. | Beta HCH | µg/L | **0.04** | BDL | BDL | BDL |

| **Location** | | | | **Ankush Gharatwadi** | **Dhodi Pooja Area** | **Lala Vajpayee Area** |
|---|---|---|---|---|---|---|
| **Type** | | | | Well Water | Bore Well | Well Water |
| **Date of Sampling** | | | | **06.06.17** | **06.06.17** | **06.06.17** |
| vii | Chlorpryriphos | µg/L | | BDL | BDL | BDL |
| vii. | Butachlor | µg/L | **125** | BDL | BDL | BDL |
| viii. | Delta HCH | µg/L | **0.04** | BDL | BDL | BDL |
| ix. | p,p DDT | µg/L | **1** | BDL | BDL | BDL |
| x. | o,p DDT | µg/L | **1** | BDL | BDL | BDL |
| xi. | p,p DDE | µg/L | **1** | BDL | BDL | BDL |
| xii. | o,p DDE | µg/L | **1** | BDL | BDL | BDL |
| xiii. | p,p DDD | µg/L | **1** | BDL | BDL | BDL |
| xiv. | o,p DDD | µg/L | **1** | BDL | BDL | BDL |
| xv. | Alpha Endosulfan | µg/L | **0.4** | BDL | BDL | BDL |
| xvi. | Beta Endosulfan | µg/L | **0.4** | BDL | BDL | BDL |
| xvii. | EndosulfanSulphate | µg/L | **0.4** | BDL | BDL | BDL |
| xviii. | Y HCH (Lindane) | µg/L | **2.0** | BDL | BDL | BDL |
| 31. | Polynuclear aromatic hydrocarbons (as PAH) | µg/L | **0.0001** | BDL | BDL | BDL |
| 32. | Polychlorinated Biphenyls (PCB) | µg/L | **0.0005** | BDL | BDL | BDL |
| 33. | Zinc (as Zn) | mg/L | **5.0** | BDL | BDL | BDL |
| 34. | Nickel (as Ni) | mg/L | **0.02** | BDL | BDL | BDL |
| 35. | Copper (as Cu) | mg/L | **0.05** | BDL | BDL | BDL |
| 36. | Hexavalent Chromium (as $Cr^{6+}$) | mg/L | **1** | BDL | BDL | BDL |

| **Location** | | | | **Ankush Gharatwadi** | **Dhodi Pooja Area** | **Lala Vajpayee Area** |
|---|---|---|---|---|---|---|
| **Type** | | | | Well Water | Bore Well | Well Water |
| **Date of Sampling** | | | | **06.06.17** | **06.06.17** | **06.06.17** |
| 37. | Total Chromium (as Cr) | mg/L | **0.05** | BDL | BDL | BDL |
| 38. | Total Arsenic (as As) | mg/L | **0.01** | BDL | BDL | BDL |
| 39. | Lead (as Pb) | mg/L | **0.01** | BDL | BDL | BDL |
| 40. | Cadmium (as Cd) | mg/L | **0.003** | BDL | BDL | BDL |
| 41. | Mercury (as Hg) | mg/L | **0.001** | BDL | BDL | BDL |
| 42. | Manganese (as Mn) | mg/L | **0.1** | BDL | BDL | BDL |
| 43. | Iron (as Fe) | mg/L | **0.3** | BDL | BDL | BDL |
| 44. | Vanadium (as V) | mg/L | | BDL | BDL | BDL |
| 45. | Selenium (as Se) | mg/L | **0.01** | BDL | BDL | BDL |
| 46. | Boron (as B) | mg/L | | BDL | BDL | 4.02 |
| 47. | Bioassay Test on fish | % survival | | 90 | 100 | 0 |
| | Dead after 24 h | | | 1 | 0 | 10 |
| | Dead after 48 h | | | 1 | 0 | 10 |
| | Dead after 72 h | | | 1 | 0 | 10 |
| | Dead after 96 h | | | 1 | 0 | 10 |
| | Dead after 24 h | | | 90 | 100 | 0 |

**Table II**

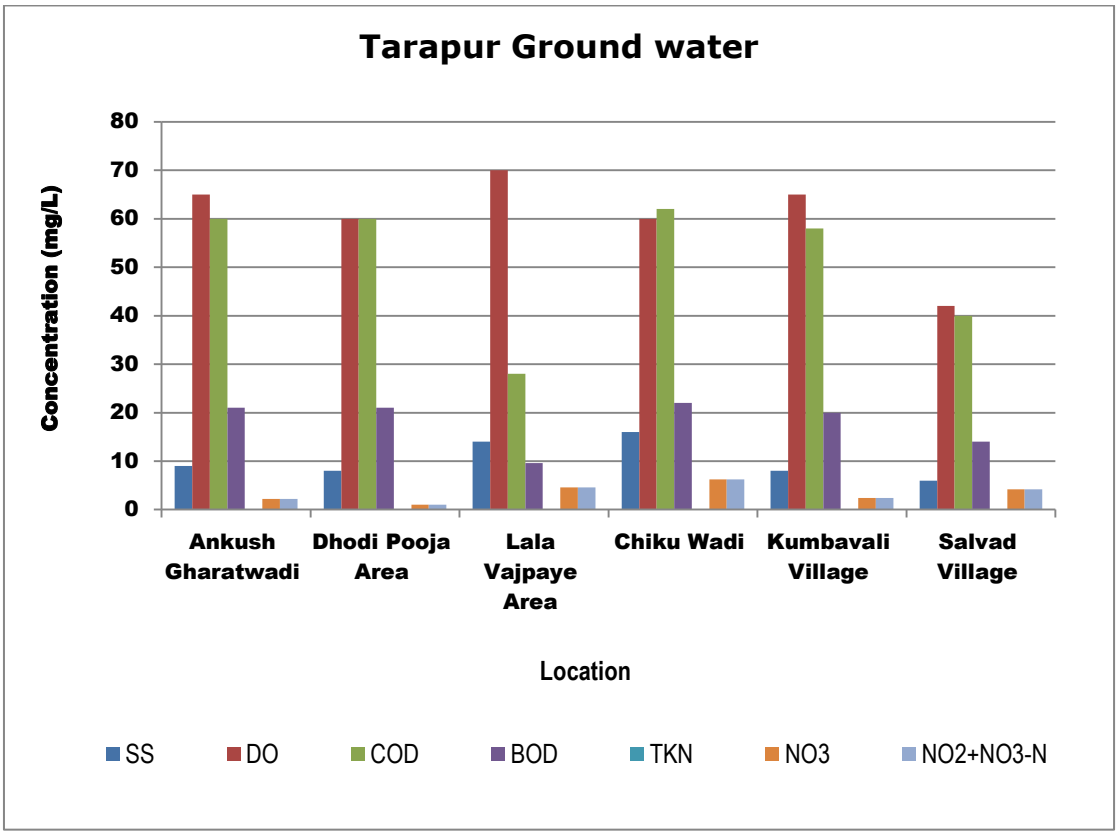
| **Location** | | | | **Chiku Wadi** | **Kumbhavali Village** | **Salvad Village** |
|---|---|---|---|---|---|---|
| **Type** | | | | Bore Well | Bore Well | Bore Well |
| **Date of Sampling** | | | | **06.06.17** | **06.06.17** | **06.06.17** |
| **Sr.** | **Parameter** | | **Std. Limit** | **Results** | | |
| 1. | Colour | Hazen | **5** | 1 | 1 | 1 |
| 2. | Odour | | **Agreeable** | Agreeable | Agreeable | Agreeable |
| 3. | pH | - | **6.5-8.5** | 7.09 | 7.64 | 7.33 |
| 4. | Oil & Grease | mg/L | **100** | BDL | BDL | BDL |
| 5. | Suspended Solids | mg/L | **500** | 16 | 8 | 6 |
| 6. | Chemical Oxygen Demand | mg/L | **10 (WHO, 1993)** | 62 | 58 | 40 |
| 7. | Biochemical Oxygen Demand (3 days,27$^{o}$C) | mg/L | **6 (WHO, 1993)** | 22 | 20 | 14 |
| 8. | Electrical Conductivity (at 25$^{o}$C ) | µmhos/ cm | **1000** | 4000 | 1910 | 1541 |
| 9. | Nitrite Nitrogen (as N) | mg/L | | BDL | BDL | BDL |
| 10. | Nitrate Nitrogen (as N) | mg/L | **45** | 6.21 | 2.42 | 4.19 |
| 11. | ($NO_2$ + $NO_3$)-Nitrogen | mg/L | **1.0** | 6.21 | 2.42 | 4.19 |
| 12. | Free Ammonia (as $NH_3$-N) | mg/L | **0.5** | BDL | BDL | BDL |
| 13. | Total Residual Chlorine | mg/L | **0.2** | BDL | BDL | BDL |
| 14. | Cyanide (as CN) | mg/L | | BDL | BDL | BDL |
| 15. | Fluoride (as F) | mg/L | **1** | 0.28 | 0.34 | 0.08 |
| 16. | Sulphide (as $S^{2-}$) | mg/L | **0.05** | BDL | BDL | BDL |
| 17. | Dissolved Phosphate (as P) | mg/L | | BDL | BDL | BDL |

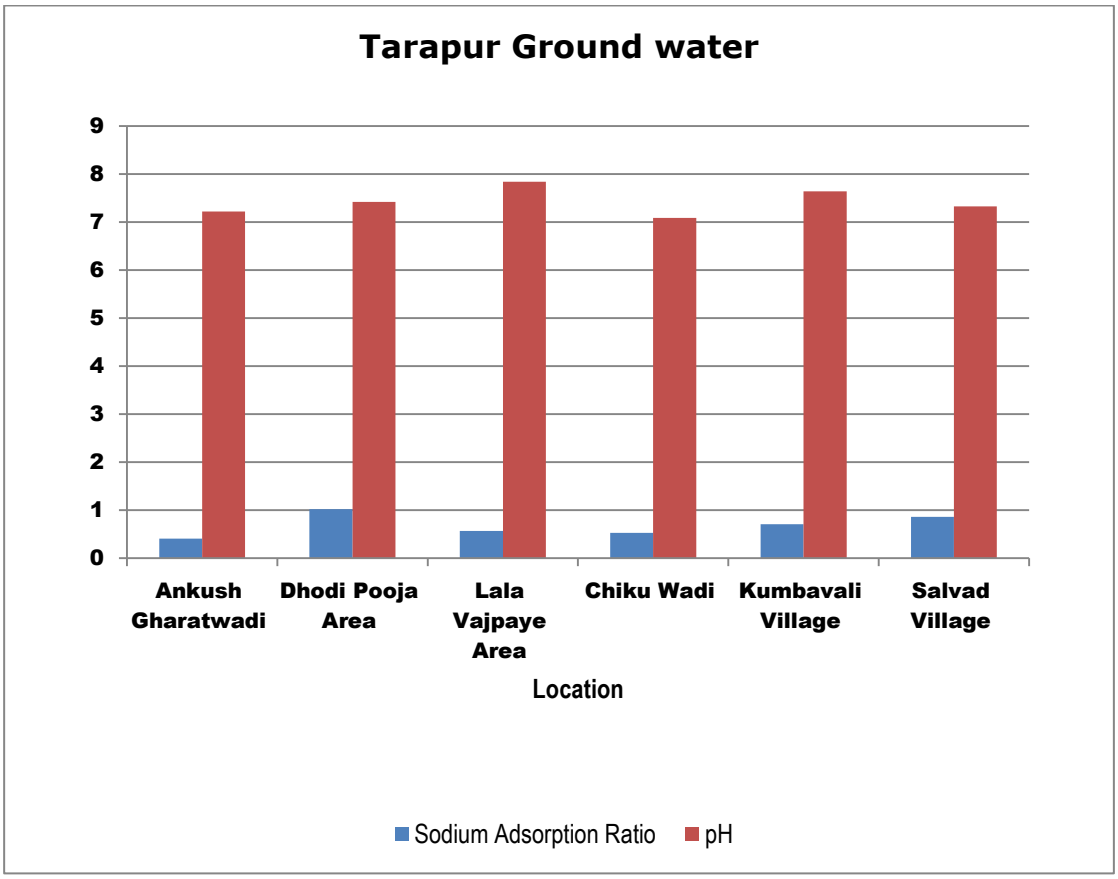
| **Location** | | | | **Chiku Wadi** | **Kumbhavali Village** | **Salvad Village** |
|---|---|---|---|---|---|---|
| **Type** | | | | Bore Well | Bore Well | Bore Well |
| **Date of Sampling** | | | | **06.06.17** | **06.06.17** | **06.06.17** |
| **Sr.** | **Parameter** | | **Std. Limit** | **Results** | | |
| 18. | Sodium Absorption Ratio | | | 0.53 | 0.71 | 0.86 |
| 19. | Total Coliforms | MPN index/ 100 mL | **ND** | BDL | BDL | BDL |
| 20. | Faecal Coliforms | MPN index/ 100 mL | **ND** | BDL | BDL | BDL |
| 21. | Total Phosphorous (as P) | mg/L | **0.5** | BDL | BDL | BDL |
| 22. | Total Kjeldahl Nitrogen | mg/L | **0.001** | BDL | BDL | BDL |
| 23. | Total Ammonia ($NH_4$+$NH_3$)-Nitrogen | mg/L | **0.5** | BDL | BDL | BDL |
| 24. | Phenols (as $C_6H_5OH$) | mg/L | **0.001** | BDL | BDL | BDL |
| 25. | Surface Active Agents (as MBAS) | mg/L | **0.05** | BDL | BDL | BDL |
| 26. | Organo Chlorine Pesticides | µg/L | | | | |
| i. | Alachlor | µg/L | | BDL | BDL | BDL |
| ii. | Atrazine | µg/L | **2** | BDL | BDL | BDL |
| iii. | Aldrin | µg/L | **0.03** | BDL | BDL | BDL |
| iv. | Dieldrin | µg/L | **0.03** | BDL | BDL | BDL |
| v | Alpha HCH | µg/L | **0.01** | BDL | BDL | BDL |
| vi. | Beta HCH | µg/L | **0.04** | BDL | BDL | BDL |
| vii. | Delta HCH | µg/L | **0.04** | BDL | BDL | BDL |

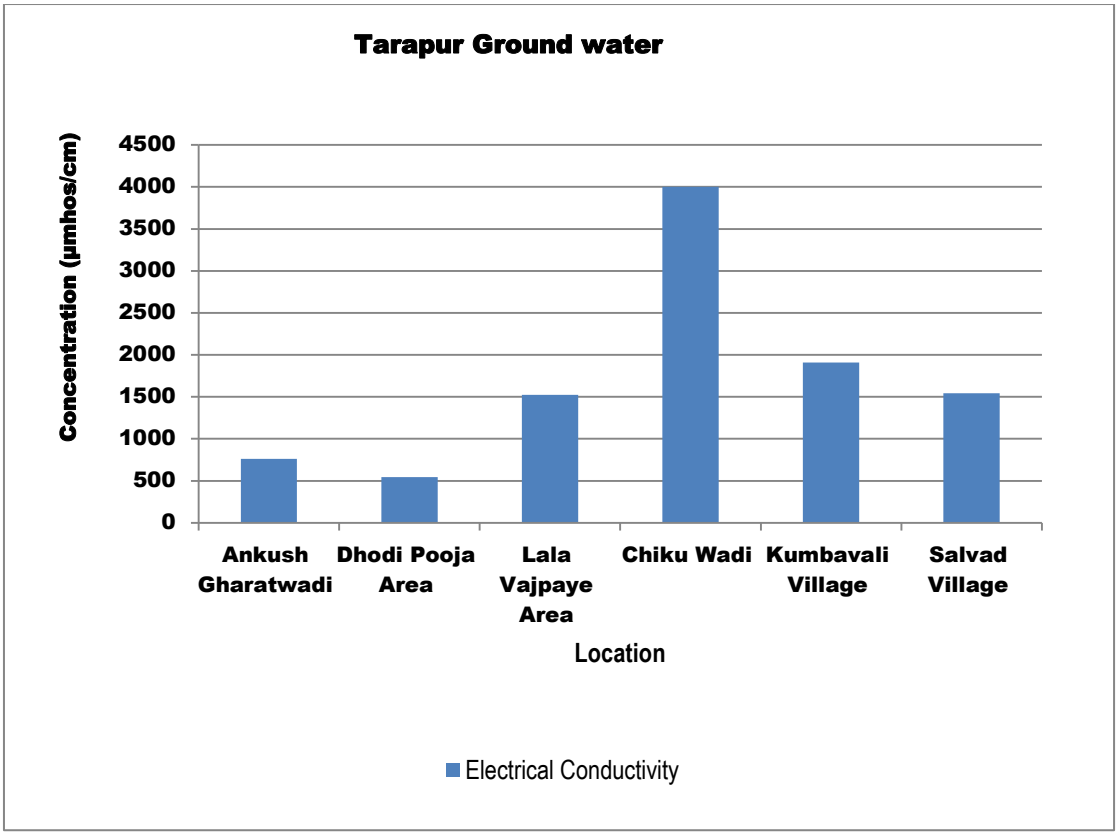
| **Location** | | | | **Chiku Wadi** | **Kumbhavali Village** | **Salvad Village** |
|---|---|---|---|---|---|---|
| **Type** | | | | Bore Well | Bore Well | Bore Well |
| **Date of Sampling** | | | | **06.06.17** | **06.06.17** | **06.06.17** |
| **Sr.** | **Parameter** | | **Std. Limit** | **Results** | | |
| viii | Chlorpyriphos | | | BDL | BDL | BDL |
| viii. | Butachlor | µg/L | **125** | BDL | BDL | BDL |
| ix. | p,p DDT | µg/L | **1** | BDL | BDL | BDL |
| x. | o,p DDT | µg/L | **1** | BDL | BDL | BDL |
| xi. | p,p DDE | µg/L | **1** | BDL | BDL | BDL |
| xii. | o,p DDE | µg/L | **1** | BDL | BDL | BDL |
| xiii. | p,p DDD | µg/L | **1** | BDL | BDL | BDL |
| xiv. | o,p DDD | µg/L | **1** | BDL | BDL | BDL |
| xv. | Alpha Endosulfan | µg/L | **0.4** | BDL | BDL | BDL |
| xvi. | Beta Endosulfan | µg/L | **0.4** | BDL | BDL | BDL |
| xvii. | Endosulfan Sulphate | µg/L | **0.4** | BDL | BDL | BDL |
| xviii. | Y HCH (Lindane) | µg/L | **2.0** | BDL | BDL | BDL |
| 31. | Polynuclear aromatic hydrocarbons (as PAH) | µg/L | **0.0001** | BDL | BDL | BDL |
| 32. | Polychlorinated Biphenyls (PCB) | µg/L | **0.0005** | BDL | BDL | BDL |
| 33. | Zinc (as Zn) | mg/L | **5.0** | BDL | BDL | BDL |
| 34. | Nickel (as Ni) | mg/L | **0.02** | BDL | BDL | BDL |
| 35. | Copper (as Cu) | mg/L | **0.05** | BDL | BDL | BDL |
| 36. | Hexavalent Chromium (as $Cr^{6+}$) | mg/L | **1** | BDL | BDL | BDL |

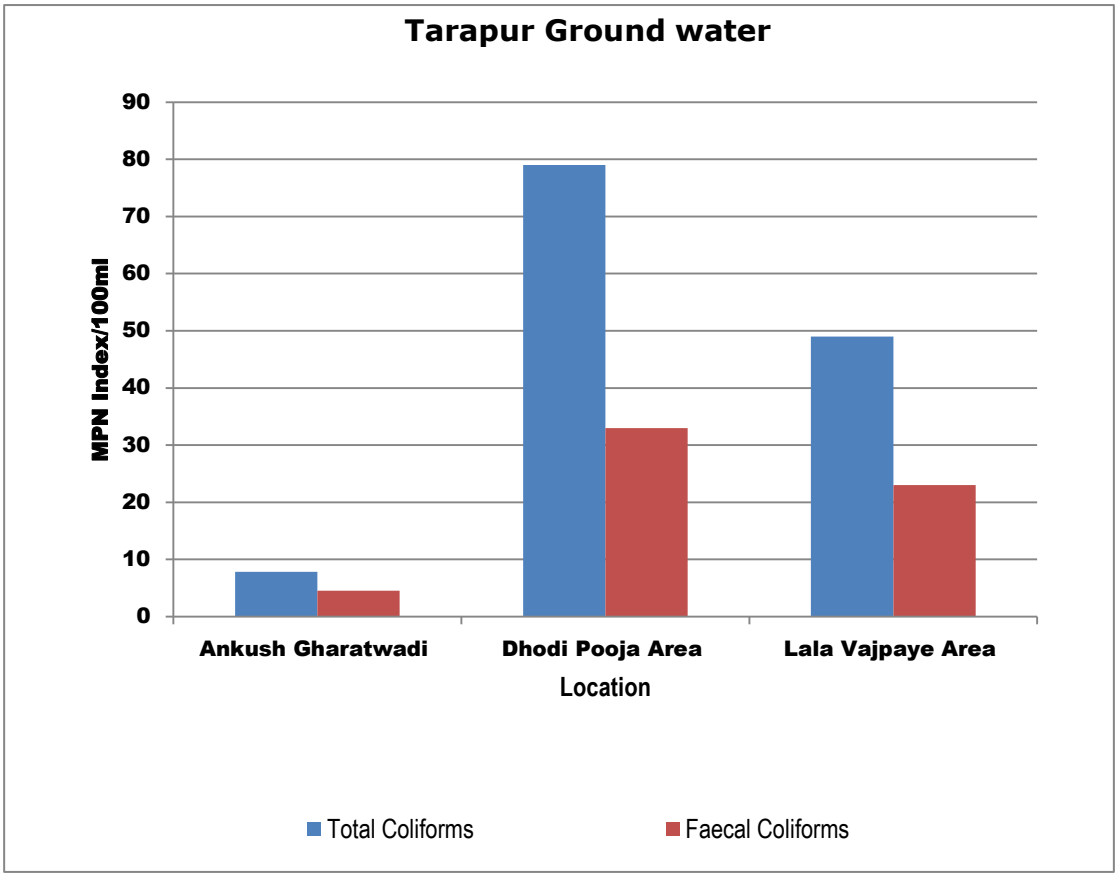
| **Location** | | | | **Chiku Wadi** | **Kumbhavali Village** | **Salvad Village** |
|---|---|---|---|---|---|---|
| **Type** | | | | Bore Well | Bore Well | Bore Well |
| **Date of Sampling** | | | | **06.06.17** | **06.06.17** | **06.06.17** |
| **Sr.** | **Parameter** | | **Std. Limit** | **Results** | | |
| 37. | Total Chromium (as Cr) | mg/L | **0.05** | BDL | BDL | BDL |
| 38. | Total Arsenic (as As) | mg/L | **0.01** | BDL | BDL | BDL |
| 39. | Lead (as Pb) | mg/L | **0.01** | BDL | BDL | BDL |
| 40. | Cadmium (as Cd) | mg/L | **0.003** | BDL | BDL | BDL |
| 41. | Mercury (as Hg) | mg/L | **0.001** | BDL | BDL | BDL |
| 42. | Manganese (as Mn) | mg/L | **0.1** | 0.803 | BDL | 0.189 |
| 43. | Iron (as Fe) | mg/L | **0.3** | BDL | BDL | BDL |
| 44. | Vanadium (as V) | mg/L | | BDL | BDL | BDL |
| 45. | Selenium (as Se) | mg/L | **0.01** | BDL | BDL | BDL |
| 46. | Boron (as B) | mg/L | **1.0-5.0** | 0.125 | BDL | BDL |
| 47. | Bioassay Test on fish | % survival | | 60 | 50 | 50 |
| | Dead after 24 h | | | 4 | 5 | 5 |
| | Dead after 48 h | | | 4 | 5 | 5 |
| | Dead after 72 h | | | 4 | 5 | 5 |
| | Dead after 96 h | | | 4 | 5 | 5 |

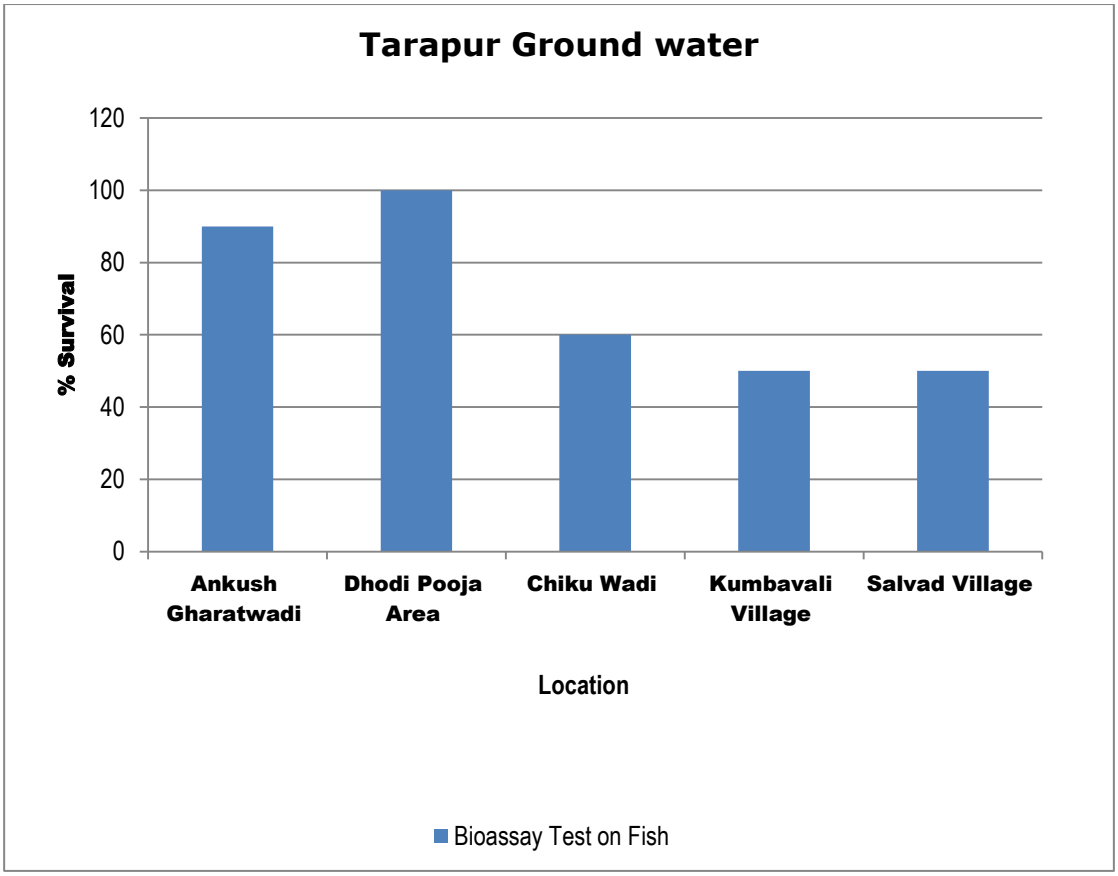
## Graphs: Ground Water Monitoring Results:




Tarapur Ground water
Concentration (µmhos/cm)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Ankush Gharatwadi
Dhodi Pooja Area
Lala Vajpaye Area
Chiku Wadi
Kumbavali Village
Salvad Village
Location
Electrical Conductivity


Tarapur Ground water
MPN Index/100ml
90
80
70
60
50
40
30
20
10
0
Ankush Gharatwadi
Dhodi Pooja Area
Lala Vajpaye Area
Location
Total Coliforms
Faecal Coliforms




# 4 Summary of the Results

Based on the study done, the results are summarised and concluded as follows:

## 4.1 Stack Emission Monitoring:

In Tarapur, seven different stacks were monitored at UPL, Plot No. E-51, Calyx Chemical Ltd., Siyaram Silk Mills Ltd., M/s Angadpal industries Pvt. Ltd., Gini Silk Mills Ltd., Mandhana Industrial Ltd. (Shirting Unit), and Mandhana Industrial Ltd. (Dyeing Unit-II). Results show that particulate matter as well as sulphur dioxide, both are below the standard limits. All the values of Particulate matter are observed below standard limit. It is ranged from 29 to 99 mg/Nm$^3$ and sulphur dioxide in the range of 5.33 to 21.33mg/Nm$^3$. However, the nitrogen dioxide is observed is observed with minimum concentration 382mg/Nm$^3$ at Mandhana Industrial Ltd. (Dyeing Unit- II) and maximum at M/s Angadpal industries Pvt. Ltd (584mg/Nm$^3$).

## 4.2 Ambient Air Monitoring:

At Tarapur, ambient air quality was monitored at six locations namely: UPL, Plot No. E-51, Calyx Chemical Ltd., Sumitomo Chemical India Pvt. Ltd., Siyaram Silk Mills Ltd., Mandhana Industrial Ltd. (Shirting Unit), Mandhana Industrial Ltd. (Dyeing Unit- II). At all these places 12 parameters of ambient air quality standards were monitored along with Volatile Organic Compounds.

1) **Suphur dioxide ($SO_2$):** All the results for $SO_2$ are observed lower than the standard limit of 80 µg/m$^3$. It is observed below the detection limit (<4 µg/m$^3$).

2) **Nitrogen Dioxide ($NO_x$):** All the results for $SO_2$ are observed lower than the standard limit of 80 µg/m$^3$. It is observed below the detection limit (<3 µg/m$^3$).

3) **Particulate Matter ($PM_{10}$):** It is the most critical parameter as its higher concentration in the air affects ecosystem health a lot. However, all the values of PM10 at all the locations are observed below the standard limit of 100µg/$m^3$. Minimum of 42 µg/$m^3$ is obtained at Sumitomo Chemical India Pvt. Ltd. and maximum of 95µg/$m^3$ at Calyx Chemical Ltd.

4) **Particulate Matter ($PM_{2.5}$):** Concentration of $PM_{2.5}$ also shows almost same pattern as $PM_{10}$. All the values are observed below the standard limit of 60 µg/$m^3$. It is observed in the range of 12 to 25µg/$m^3$.

5) **Ozone ($O_3$):** All values of $O_3$ recorded below the detection limit i.e.19.8.

6) **Lead (Pb):** Lead is categorised as known human carcinogen by CPCB. In our results, concentration of Lead is found below the standard limit.

7) **Carbon Monoxide (CO):** Values of Carbon Monoxide are also observed below standard limit at all the studied locations. It is observed minimum at BDL at Mandhana Industrial Ltd. (Shirting Unit)and 2.6µg/$m^3$at Mandhana Industrial Ltd. (Dyeing Unit).

8) **Ammonia ($NH_3$):**All values of $O_3$ recorded below the detection limit.

9) **Benzene:** Benzene falls under group C category, which includes known carcinogens. Study shows that all the locations has BDL i.e. <1µg/$m^3$benzene concentration i.e. below the standard limit (5µg/$m^3$).

10) **Benzo (a) Pyrene (BaP):** All values recorded below the detection limit i.e. <0.2.

11) **Arsenic:** Arsenic values are also observed well below the detection limit i.e. <0.3.

12) **Nickel:** All the values are observed below the standard limit of 20ng/$m^3$.

## 4.3 Waste Water Quality:

Six samples of ETP outlet and inlet were collected from different industries namely (i) UPL Plot No. E-51 (ii) Calyx Chemical Ltd.(iii) Siyaram Silk Mills Ltd. (iv) Navapur Discharge (CETP Discharge) (iv) CETP Tarapur MIDC(outlet) (v) CETP Tarapur MIDC(Inlet).

1) **pH:** At all the locations, pH of water samples is found well within the range prescribed by CPCB. It is ranged from 6.32 to 7.42.

2) **Oil and Grease:** All values within the acceptable range.

3) **Suspended Solids:** Except Navapur Discharge (200), CETP outlet (200mg/L) and CETP inlet(210mg/L), remaining three samples of different locations are found within the acceptable limits.

4) **Chemical Oxygen Demand:** Chemical Oxygen Demand is found above the standards of 250mg/L at three locations ranging from 892 to 3472mg/L.

5) **Biochemical Oxygen Demand:** Biochemical Oxygen demand also exhibits the same picture as COD. This is recorded highest (1133mg/L) at CETP inlet and minimum at Siyaram Silk Mills Ltd. (7mg/L).

6) **Total Kjeldahl Nitrogen:** CETP inlet (224mg/L) and Navapur CETP Discharge (140mg/L), all four exhibit value of TKN beyond standard limit (100mg/L).

7) **Total Ammonia:** Out of all values of four samples exhibit above standard limit in the range of 7.6 to 24.5 mg/L.

8) **Metals:** All metals like Arsenic, Nickel, Copper, Hexavalent Chromium ($Cr^{6+}$) are observed either below detection limit or below their standard limits. However, Iron concentration is observed high at 3 locations namely UPL (4.53mg/L), Navapur Discharge (5.49mg/L) and CETP Inlet (5.62mg/L).

9) **Fish Bioassay:** Fish bioassay exhibits 0-100% survival. CETP inlet and Navapur village, these 2 water samples has NIL (0%) survival.

Following parameters meet the criteria as prescribed by CPCB.

1) **Total Residual Chlorine**
2) **Cyanide**
3) **Fluoride**
4) **Sulphide**
5) **Dissolved Phosphate**
6) **Total Ammonical Nitrogen**
7) **Phenolic compounds**

## 4.4 Ground Water Quality:

Six Borewell samples were collected from different locations namely: (i) Ankush Gharatwadi (ii) Dhodi Pooja Area (3) Lala Vajpayee (iv) Chiku Wadi (v) Kumbhavali Village (vi) Salvad Village.

1) **Colour** (Hazen Units): Colour units are below the acceptable standard.

2) **Odour** of the sample is agreeable.

3) **pH:** At all the locations, pH of water samples is found well within the range prescribed by CPCB. It is ranged from 7.09 to 7.84.

4) **Chemical Oxygen Demand:** All the samples were detected above standard limits of 10mg/L set by WHO. It is ranged from 28 to 62mg/L.

5) **Biological Oxygen Demand:** BOD samples also followed the similar pattern as COD samples. All the samples are detected above the standard limit of 6mg/L (WHO, 1993). It is ranged from 9.6 to 22mg/L.

Following are the parameters which are compared with 10500:2012 Drinking water specifications.

1) **Nitrite**: Values of Nitrite are at below detection level.

2) **Nitrate:** Nitrate value ranged between 1.05 mg/L and 6.21mg/L. Nitrate concentrations are below the acceptable standards of IS 10500:2012.

3) **Residual Free Chlorine**: Values are below the acceptable standards.

4) **Total Ammonia**: is within the acceptable range.

5) **Cyanide:** Concentration of cyanide in all the bore well water is very much below the standard.

6) **Fluoride:**All the values are observed below standard limit. It is ranged from 0.08 to 0.52mg/L.

7) **Sulphide:** Analytical values are below the detection limits and below the standards.

8) **Sodium Absorption Ratio:** These values fit within range of water quality criteria of CPCB.

9) **Electrical Conductivity:** As per the water quality criteria of CPCB, water samples exceed the limit of electrical conductivity at all the locations except Dhodi Pooja Pooja area.

10) **Boron:** Chikkuwadi bore well water exceeds the limit showing the concentration of 1.09mg/L.

11) **Metals:** Metals like Copper, Total Chromium, Lead, Arsenic, Cadmium and Mercury are well within the acceptable limits of drinking water standards.

12) **PAH & PCB** are also below the acceptable limits.

# 5 CEPI Score:

Comprehensive Environmental Pollution Index (CEPI) is intended to act as early warning tool which helps in categorization of industrial clusters/areas in terms of priority of needing attention.

CPCB had evolved certain methodology to calculate CEPI, in which a score has been fixed for different environmental components based on the level of pollution. The scoring system involves an algorithm that takes into account the basic selection criteria. This approach is based on the basic hazard assessment logic that can be summarized as below.

**Hazard = pollutant source, pathways, and receptor**

CPCB has calculated CEPI for the identified critically polluted industrial clusters. It is calculated separately for air, water, and land. The basic framework and scoring system of the CEPI – based on three factors namely pollutant, pathway, and receptor – has been described further under this section

To overcome the subjectivity, revised concept is proposed by eliminating the subjective factors as described in the previous section, but retaining the factors which can be measured precisely.

i. Revised concept is prepared by eliminating the debatable factors but retaining the factors which can be measured precisely.

ii. It is decided to develop the Comprehensive Environmental Pollution Index (CEPI) retaining the existing algorithm of Source, Pathway and Receptor.

iii. Health component was also retained in the revised concept in line with the suggestions of Secretary, MoEFCC during the meeting held in MoEF.

**Outlines of revised CEPI 2016 criteria**

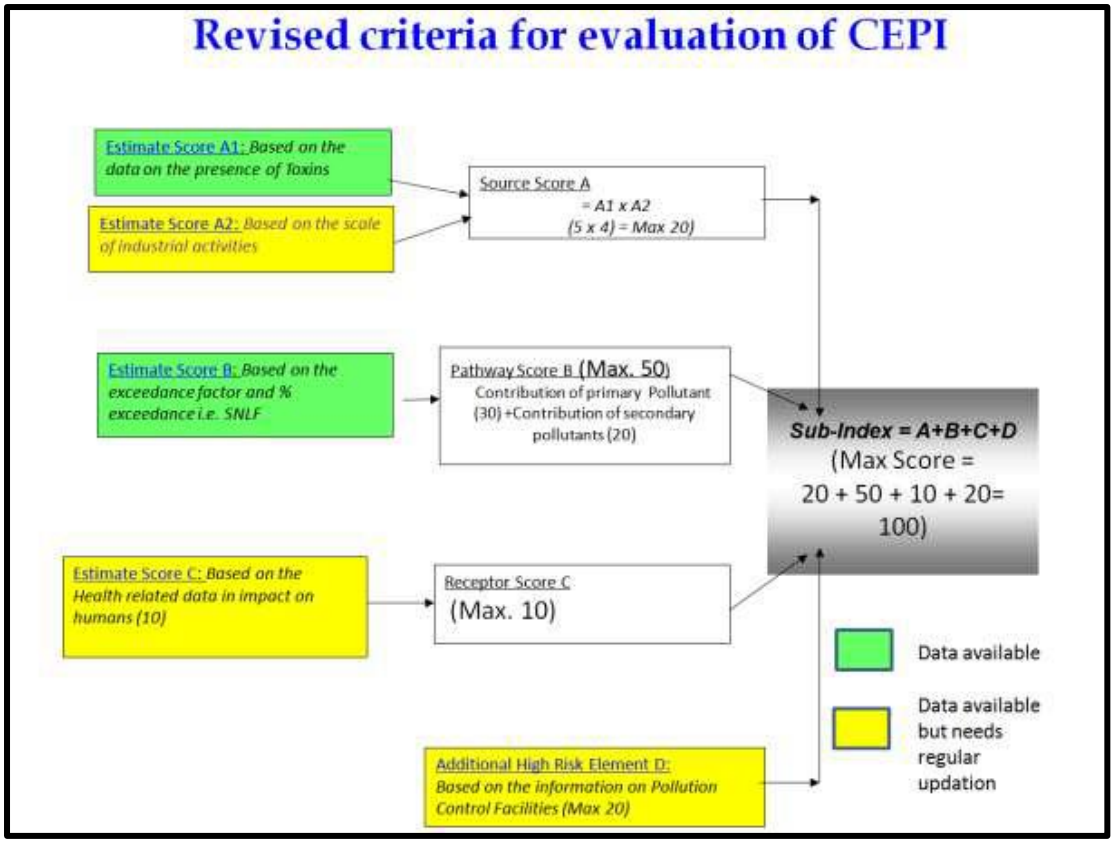
The outlines of the revised CEPI criteria are as follows:

1. It is proposed to develop the Comprehensive Environmental Pollution Index (CEPI) based on Sources of pollution, real time observed values of the pollutants in the ambient air, surface water and ground water in & around the industrial cluster and health related statistics.

2. For assessment of the environmental quality of the area i.e. CEPI score, the concept of SNLF i.e. a surrogate number which represents the level of exposure (a function of percentage sample exceedance & Exceedance Factor) shall be used.

3. Health component to be evaluated based on the health data available from major hospitals in the area was also retained in the revised concept.

4. The evaluation criterion of the revised CEPI version 2016 is described in the flowchart given below:




Here, health data collected for Receptor score C is included in **Annexure I**

Based on Sub-index Score (score of individual environmental component like air, water etc.):

- **Score more than 63:** A Critical Level of Pollution in the respective level of environmental component
- **Score between 51-63:** Severe to critical level of pollution with reference to respective environmental component

**Cut-off Score**

- **Score 50:** Severely Polluted Industrial Clusters/areas
- **Score 60:** Critically Polluted Industrial Clusters/areas

Based on Aggregated CEPI Score (score includes sub-index score of all individual environmental components together):

- **Aggregated CEPI score >70:** Critically polluted areas
- **Aggregated CEPI score between 60-70:** Severely polluted areas

Since the inception of the programme, MPCB has also formulated Action Plans to mitigate the environmental pollution problems for each of the 8 Critically Polluted Areas (CPAs) in Maharashtra. Based on available information, parameters selected and monitored in continuation with this, CEPI has been calculated and Short-Term Action Plan (STAP) as well as Long Term Action Plan (LTAP) was prepared in 2010.

Subsequently NAAQS 2009 came in force. List of parameters to be considered increased and expanded including more critical and hazardous pollutants like benzene, BaP, Metals, etc. existing in the environment. There was revision of standards (limiting values) as well. In this present report of 2016 prepared by MPCB, CEPI is calculated considering all these revised standards' limiting values, list of parameters and complete scope of monitoring.

The result shows that CEPI score of present report is 53.72. This is quite than the CEPI score of February, 2017 study (67.67).

Results show that, MPCB's efforts through the formulation of action plans decreased the overall concentration of pollutants in all aspects i.e. air, land and water in Tarapur area in past three years. This has also resulted in decreased score of CEPI now.

**Comparison of CEPI scores of 2013 and 2017 reports**:

Results show that present CEPI score (53.72) of Tarapur city considering all revised standards and parameters has decreased a lot if compared with the CEPI Score of February, 2017 (67.67) report. This clearly indicates the successful application of STAP and LTAP of MPCB which resulted in a cleaner environment of Tarapur city in past three years.

Detailed results of Air, Water and Land are given below:

**Air:**

| | A1 | A2 | A | B1 | B2 | B3 | B | C1 | C2 | C3 | C | D | CEPI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Present Report 2017 (Revised CEPI 2016)** | 2.5 | 4 | 10 | - | - | - | 0 | - | - | - | 0 | 10 | **20** |
| **CEPI Score, February, 2017** | 2 | 5 | 10 | 6 | 3 | 3 | 12 | 3 | 3 | 5 | 14 | 10 | **46** |
| **CEPI Score, 2016** | 4 | 5 | 20 | 6 | 3 | 3 | 12 | 3 | 3 | 5 | 14 | 10 | **56** |
| **CEPI score 2013 (considering all revised standards, scope and limiting values of 2013)** | 6 | 5 | 30 | 8 | 3 | 3 | 14 | 3 | 5 | 5 | 20 | 10 | **74** |
| **CPCB Report 2009** | 5.75 | 5.0 | 28.75 | 2.0 | 3 | 3 | 8 | 3 | 3 | 5 | 14 | 10 | **60.75** |

**Water:**

| | A1 | A2 | A | B1 | B2 | B3 | B | C1 | C2 | C3 | C | D | CEPI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Present Report 2017 (Revised CEPI 2016)** | 3.5 | 4 | 14 | - | - | - | 20 | - | - | - | 0 | 15 | **49** |
| **CEPI Score, February, 2017** | 1 | 5 | 5 | 8 | 3 | 3 | 14 | 5 | 5 | 0 | 25 | 15 | **59** |
| **CEPI Score, 2016** | 1 | 5 | 5 | 8 | 0 | 3 | 11 | 3 | 5 | 0 | 15 | 15 | **46** |
| **CEPI score 2013 (considering all revised standards, scope and limiting values of 2013)** | 4 | 5 | 20 | 8 | 0 | 3 | 11 | 3 | 3.75 | 0 | 11.25 | 15 | **57.25** |
| **CPCB Report 2009** | 3 | 5 | 15 | 8 | 0 | 3 | 11 | 3 | 5 | 0 | 15 | 15 | **56** |

**Land:**

| | A1 | A2 | A | B1 | B2 | B3 | B | C1 | C2 | C3 | C | D | CEPI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Present Report 2017 (Revised CEPI 2016)** | 3.5 | 4 | 14 | - | - | - | 17.25 | - | - | - | 0 | 15 | **46.25** |
| **CEPI Score, February, 2017** | 1 | 5 | 5 | 8 | 0 | 3 | 11 | 3 | 5 | 0 | 15 | 15 | **46** |
| **CEPI Score, 2016** | 1 | 5 | 5 | 6 | 3 | 3 | 12 | 5 | 3 | 0 | 15 | 15 | **47** |
| **CEPI score 2013 (considering all revised standards, scope and limiting values of 2013)** | 4 | 5 | 20 | 8 | 3 | 3 | 14 | 5 | 5 | 0 | 25 | 15 | **74** |
| **CPCB Report 2009** | 3 | 5 | 15 | 7.75 | 3 | 3 | 13.75 | 5 | 1.5 | 0 | 7.5 | 15 | **51.25** |

**Aggregated CEPI:**

| | Air index | Water Index | Land Index | CEPI |
|---|---|---|---|---|
| **Present Report 2017 (Revised CEPI 2016)** | 20 | 49 | 46.25 | **53.72** |
| **CEPI Score, February, 2017** | 46 | 59 | 46 | **67.67** |
| **CEPI Score, 2016** | 56 | 46 | 47 | **65.51** |
| **CEPI score 2013 (considering all revised standards, scope and limiting values of 2013)** | 74 | 57.25 | 74 | **85.01** |
| **CPCB Report 2009** | 60.75 | 51.25 | 56 | **72.01** |

# 6 Conclusions

This is an attempt to check the characteristics and status of environment among the different industrial clusters of Tarapur city. Revised CEPI version 2016 includes 2 major modifications in terms of evaluation of data: (1) It includes Contribution of primary as well as secondary pollutants under Factor B (Max Value 50) and (2) Exhaustive collection of health data of people residing in the vicinity of industrial clusters under study, Factor C (Max Value 10). This has changed the entire criteria of calculating CEPI as compared to the previous CEPI version and hence affected the overall CEPI score also. It shows that the concentration of pollutants in air, ground water and surface water is lowered down as compared to past studies, as most of the results are observed below their standards with an exception of one or two parameters.

Parameters of air sampling are observed within the standard limit all the sampling locations. Among waste water samples, BOD and COD of CETP Inlet, CETP outlet and Navapur Discharge samples are found beyond standard limit. Nitrate and nitrogen are also observed higher in these samples. All the ground water samples are found within the limits except BOD and COD of all the water samples, which are observed above standard limits.

Moreover, the lower value (53.72) of Comprehensive Environmental Pollution Index (CEPI) in the present study as compared to past few years study also reveals the fact that the environmental pollution in this city is substantially decreased over the period of times. To achieve this target, improvement in conventional practice and procedures adopted by the industries coupled with initiatives taken by Maharashtra Pollution Control Board played a major role. Although, a decrease in environmental pollution is observed, but still there is lot of scope to improve the environmental quality of the city, for which continuous efforts, strategies, planning and actions are required. Overall CEPI figures are comprised in the table below:

| | **A1** | **A2** | **A** | **B** | **C** | **D** | **CEPI** |
|---|---|---|---|---|---|---|---|
| **Air Index** | 2.5 | 4 | 10 | 0 | 0 | 10 | **20** |
| **Water Index** | 3.5 | 4 | 14 | 20 | 0 | 15 | **49** |
| **Land Index** | 3.5 | 4 | 14 | 17.25 | 0 | 15 | **46.25** |
| **Aggregated CEPI** | | | | | | | **53.72** |

# 7 Efforts Taken For the Abatement and Control of Pollution

The regional office of Maharashtra pollution control board has taken various initiatives in reducing the CEPI Score of 67.67 of February, 2017 to 53.2. Below mentioned are some of the efforts:

a) Expansion of TEPS-CETP from existing 25 MLD to 37 MLD
b) Due to various measures taken by the industries solvent recovery improved. And following industries has taken measures

- M/s. Arti Drugs Ltd, Plot No. N-198, MIDCTarapur, Tal.Palghar.This industry has developed new technology for the recovery of ammonium sulphate 2000 Mt/month by unit operation like evaporation, crystallization. Earlier the same was treated in their ETP.
- M/s Camlin Fine Chemicals. Ltd., Plot No. D,MIDC Tarapur has segregated of high COD stream.
- M/s. Arti Industries Ltd., Plot No E-50, has installed zero discharge plant such as incineration high COD.
- M/s Lupin Limited Plt No. T-142 MIDC, Tarapur has provided Anaerobic Digestor for segregated effluents.

c) Board has informed CHWTSDF to increase the frequency of collecting of HW and its transportation.
d) MIDC is carrying out massive tree plantation program on empty/ reserved plots, and on boundary of MIDC. 4500 nos of trees have been distributed by MIDC to TIMA.
e) Replacement of RCC drainage by HDPE within MIDC area.
f) Five nos of industries has started and recycling 50 % of their treated effluent i.e 1604.5 CMD • 7 No. of Textile industries has provided zero discharge system and recycling about 2434 CMD

# 8. Photographs

**Calyx Chemicals Ltd. - Ambient Air Monitoring**


**Mandhana Industries Ltd. – Ambient Air Monitoring**

**Siyaram Silk Mills - Ambient Air Monitoring**


**UPL – Ambient Air Monitoring**

**Sumitomo Chemical India Ltd. – Ambient Air Monitoring**

**Ankush Gharatwadi – Groundwater Monitoring**

**Chikuwadi – Ground Water Monitoring**

**Dhodi Pooja Area – Ground water Monitoring**

**Salvad Village - Ground water Monitoring**

**UPL –Waste Water Monitoring**

**Siyaram Silk Mills - Waste Water Monitoring**

**Navapur Discharge – Waste Water Sampling**

**CETP Inlet – Waste Water Sampling**

**DhodiPooja – Ground Water Sampling**

**CETP Outlet – Waste Water Sampling**

**Calyx Chemicals Ltd. – Waste Water Sampling**

# 9. References

1. Criteria for Comprehensive Environmental Assessment of Industrial Clusters, December 2009,CPCB, EIAS/4/2009-10
2. Comprehensive Environmental Assessment of Industrial Clusters, December 2009,CPCB, EIAS/5/2009-10
3. Action Plan for Industrial Cluster:Chandrapur,November 2010,MPCB
4. Action Plan for Industrial Cluster:Dombivali,November 2010,MPCB
5. Action Plan for Industrial Cluster:Aurangabad,November 2010,MPCB
6. Action Plan for Industrial Cluster:NaviMumbai,November 2010,MPCB
7. Action Plan for Industrial Cluster:Tarapur,November 2010,MPCB
8. Standard Methods for the Examination of Water and Waste Water,American Public Health Association, 22nd Edition, 2012.
9. IS 3025 (various parts)
10. www.mpcb.gov.in
11. www.cpcb.gov.in

# 10. Annexures

## Annexure I Health related data in impact on humans

**C: Receptor**

| Component C<br>(Impact on Human Health)<br>10 | |
|---|---|
| **Main - 10** | |
| **% increase in cases** | **Marks** |
| **<5%** | **0** |
| **5-10%** | **5** |
| **>10%** | **10** |

- % increase is evaluated based on the total no. of cases recorded during two consecutive years.
- For Air Environment, total no. of cases related to Asthma, Bronchitis, Cancer, Acute respiratory infections etc. are to be considered.
- For surface water/ ground water Environment, cases related to Gastroenteritis, Diarrhoea, renal (kidney) malfunction, cancer etc are to be considered.
- For the above evaluation, the previous 5 years records of 3-5 major hospitals of the area shall be considered.

**Attached below health data collected for the region**

# MAHARASHTRA POLLUTION CONTROL BOARD

**Sub Regional Office Tarapur-II**

**Tel : (02525) 273314**
email:srotarapur2@mpcb.gov.in

**M.I.D.C. Office Compound,**
**Tarapur,Post-TAPS,Boisar(w).**
**Tal- Palghar, Dist-Thane -401504**

**MPCB/SROTR-II/TB-**

**Date:-** 15 **/06/2017**

**To,**

1. **Thunga Hospital, Boisar**
2. **Anand Hospital, Boisar**
3. **TAPS Hospital, Boisar**

**Sub:-** Health related data collection for CEPI REV.

**Ref:-** Request from representative of Ashwamedh Engineers & Consultant C.S.I.

Sir,

Board has the contrasted the work for project on Monitoring Sampling, Analysis for Stack, Ambient Air Quality, Surface Water, Waste Water and Ground Water Quality in critically polluted areas in Maharashtra including Tarapur for Pre-Mansoon season Vide letter dtd.29.05.2017, further vide mail from JD Air Section dtd.07.06.2017 has asked to collect the Health related data for CEPI revision to Ashwamedh Engineers, accordingly you are requested to give the data in prescribed format for Health related data in respect of discuses for the year 2012, 2013, 2014, 2015, 2016 & 2017 at earliest.

Further as per a direction from CPCB vide letter dtd.26.04.2016 they have mentioned revised CEPI score calculation where is the weight age for Health related study is 10, Hence as per the said directions information is required at the earliest.

(Dr.R.A.Rajput)
**Sub–Regional officer, Tarapur-II**
9766029991

| | | Diseases caused by Air pollution | | | | | Diseases caused by Water pollution | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name of Hospital** | **Year** | **Asthma** | **Bronchitis** | **Pulmonary cancer** | **Mesothelioma (lung cancer)** | **Acute respiratory infections** | **Gastroenteritis** | **Typhoid** | **Diarrhea** | **Liver damage and even cancer** (due to presence of chlorinated solvents in the polluted water) | **Kidney damage** (because of various harmful chemicals present in the polluted water) |
| Thunga Hospital<br>15/6/2017 | 2012 | — | — | — | — | — | — | — | — | — | — |
| | 2013 | 63 | 56 | 14 | 7 | 168 | 126 | 147 | 63 | 2+1 | 2 |
| | 2014 | 97 | 86 | 15 | 10 | 293 | 195 | 285 | 97 | 2 | 1 |
| | 2015 | 121 | 108 | 13 | 15 | 364 | 243 | 351 | 121 | 4 | 0 |
| | 2016 | 140 | 125 | 14 | 11 | 422 | 248 | 453 | 142 | 3 | 1 |
| | 2017 | 48 | 42 | 3 | 5 | 144 | 101 | 154 | 133 | 0 | 0 |
| 19/6/17<br>Anand Hospital<br>Only Gynaecology & ortho specrality<br>(So above diseased Patient are not treated at Anand Hospital) | 2012 | | | | | | | | | | |
| | 2013 | | | | | | | | | | |
| | 2014 | | | | | | | | | | |
| | 2015 | | | | | | | | | | |
| | 2016 | | | | | | | | | | |
| | 2017 | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ~~TAPS HOSPITAL~~<br>तारापोर हॉस्पीटल<br>बोईसर<br>19/6/17 | 2012 | — | — | — | — | — | — | — | — | — | — |
| | 2013 | — | — | — | — | — | — | — | — | — | — |
| | 2014 | — | — | — | — | — | — | — | — | — | — |
| | 2015 | — | — | — | — | — | — | — | — | — | — |
| | 2016 | 103 | — | — | — | 198 | 30 | 84 | 67 | — | — |
| | may 2017 | 42 | — | — | — | 63 | 31 | 09 | 37 | — | — |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ~~CARE HOSPITAL~~<br>Saileela Hospital<br>Tarapur Boisar | 2012 | | | | | | | | | | |
| | 2013 | | | | | | | | | | |
| | 2014 | | | | | | | | | | |
| | 2015 | 35 | 10 | — | — | 74 | 80 | 58 | — | — | — |
| | 2016 | 39 | 31 | — | — | 68 | 71 | 52 | — | — | — |
| | 2017 | 18 | 22 | — | — | 29 | 20 | 14 | — | — | — |

## Annexure II: Stack Emission Sampling and Analysis Methodology

| Sr. | Parameters | Method References | Techniques | Detection Limit |
|---|---|---|---|---|
| 1. | Acid Mist (as Sulphuric Acid) | US EPA Method no.m-8 | Barium thorine titration Method | 0.6 mg/Nm$^3$ |
| 2. | Ammonia | IS 11255 (Part 6):1999, Reaffirmed 2003 | Titration/Nessler Reagent / Spectrophotometric Method | 1 mg/Nm$^3$ |
| 3. | Carbon Monoxide | USEPA Method 10B | GC-FID Method | 0.2 mg/Nm$^3$ |
| 4. | Chlorine | US EPA Method 26 for sampling | Titrimetric | 0.001 mg/Nm$^3$ |
| 5. | Fluoride (Gaseous) | US EPA Method 13 A | SPADNS Zirconium Lake Spectrophotometric Method | 0.025 mg/Nm$^3$ |
| 6. | Fluoride (Particulate) | US EPA Method 13 A | SPADNS Zirconium Lake Spectrophotometric Method | 0.005 mg/Nm$^3$ |
| 7. | Hydrogen Chloride | US EPA Method 26 for sampling | Titrimetric | 0.25 mg/Nm$^3$ |
| 8. | Hydrogen Sulphide | IS 11255 (Part 4):1985 | Titrimetric | 1 mg/Nm$^3$ |
| 9. | Oxides of Nitrogen | IS 11255 (Part 7): 2005 | PDSA Colorimetric Method | 10 mg/Nm$^3$ |
| 10. | Oxygen | IS 13270 : 1992 | ORSAT Apparatus | 1 % |
| 11. | Poly Aromatic Hydrocarbons (Particulate) | IS 5182 (Part 12) : 2004, Reaffirmed 2009<br>CPCB Guidelines, May 2011, Page No.39 | GC-FID Method | 0.25 mg/Nm$^3$ |
| 12. | Suspended Particulate Matter | IS 11255 (Part 1):1985, Reaffirmed 2003 | Gravimetric Method | 10 mg/Nm$^3$ |
| 13. | Sulphur Dioxide | IS 11255 (Part 2): 1985, Reaffirmed 2003 | Titrimetric IPA thorine Method | 5.0mg/Nm$^3$<br>0.02kg/day |

| Sr. | Parameters | Method References | Techniques | Detection Limit |
|---|---|---|---|---|
| 14. | BTX (Benzene, Toluene, Xylene) | NIOSH (NMAM) 1501 | Adsorption and Desorption followed by GC-FID analysis | 0.001 mg/$Nm^3$ |
| 15. | VOC (Volatile Organic Compounds) | NIOSH (NMAM) 1501 for sampling | Adsorption and Desorption followed by GC-FID or GC/MS analysis | - |
| i | Methyl Isobutyl Ketone | - | - | 0.001 mg/$Nm^3$ |
| ii | Benzene | - | - | 0.001 mg/$Nm^3$ |
| iii | Toluene | - | - | 0.001 mg/$Nm^3$ |
| iv | Xylene | - | - | 0.001 mg/$Nm^3$ |
| v | Ethyl Benzene | - | - | 0.001 mg/$Nm^3$ |
| vi | Ethyl Acetate | - | - | 0.001 mg/$Nm^3$ |

## Annexure III: Ambient Air Sampling and Analysis Methodology

| Sr. | Parameters | Method References | Techniques | Detection Limit |
|---|---|---|---|---|
| 1. | Sulphur Dioxide ($SO_2$) | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No.1 | Improved West & Gaeke Method | 4 µg/$m^3$ |
| 2. | Nitrogen Dioxide ($NO_2$) | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No.7 | Modified Jacob & Hochheiser Method | 3 µg/$m^3$ |
| 3. | Particulate Matter (size less than 10 µm) or $PM_{10}$ | CPCB Guidelines for the Measurement of Ambient Air Pollutants,Volume I, May 2011, Page No.11 | Gravimetric Method | 2 µg/$m^3$ |
| 4. | Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$ | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 15 | Gravimetric Method | 0.4 µg/$m^3$ |
| 5. | Ozone ($O_3$) | APHA, Method No. 820, Page no. 836 | Chemical Method | 19.6 µg/$m^3$ |
| 6. | Lead (Pb) | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 47 | AAS Method | 0.02 µg/$m^3$ |
| 7. | Carbon Monoxide (CO) | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume II, May 2011, Page No. 16 | Non Dispersive Infra Red (NDIR) spectroscopy | 0.05 mg/$m^3$ |
| 8. | Ammonia ($NH_3$) | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 35 | Indophenol Blue Method | 4.0µg/$m^3$ |
| 9. | Benzene ($C_6H_6$) | IS 5182 (Part 11):2006 | Adsorption and Desorption followed by GC-FID analysis | 1.0 µg/$m^3$ |
| 10. | Benzo (a) Pyrene (BaP) – particulate phase only, | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 39 | Solvent extraction followed by GC-FID analysis | 0.2 ng/$m^3$ |
| 11. | Arsenic (As) | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, | AAS Method | 0.3ng/$m^3$ |

| Sr. | Parameters | Method References | Techniques | Detection Limit |
|---|---|---|---|---|
| | | May 2011, Page No. 47 | | |
| 12. | Nickel (Ni) | CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 47 | AAS Method | 3.0ng/$m^3$ |

## Annexure IV: Water/Wastewater Sampling and Analysis Methodology

| Sr. | Parameters | Methods References | Techniques | Detection Limit |
|---|---|---|---|---|
| | Sampling Procedure for Chemical Parameters | IS 3025 (Part 1): 1987, Reaffirmed 1998, Amds.1& APHA, 22nd Ed., 2012, 1060 B, 1-39 | - | - |
| | Sampling Procedure for Microbiological Parameters | APHA, 22nd Ed., 2012,1060 B, 1-39, 9040, 9-17, and 9060B, 9-35 | - | - |
| | Temperature | APHA, 22nd Ed., 2012, 2550-B, 2-69 | By Thermometer | - |
| | Colour | APHA, 22nd Ed., 2012 , 2120-B, 2-26 | Visible Comparison Method | 1 Hazen Unit |
| | Odour | IS 3025 (Part 5): 1983, Reaffirmed 2006 | Qualitative Method | - |
| | pH | APHA, 22nd Ed., 2012, 4500-$H^+$- B, 4-92 | By pH Meter | 1 |
| | Oil & Grease | APHA, 22nd Ed., 2012, 5520-B, 5-40 | Liquid -liquid Partition-Gravimetric Method | 1.0 mg/L |
| | Suspended Solids | IS 3025( Part 17): 1984, Reaffirmed 2006,Amds.1 | Filtration /Gravimetric Method | 5.0 mg/L |
| | Dissolved Oxygen | IS 3025( Part 38): 1989, Reaffirmed 2009 | Iodometric Method-Azide modification | 0.05 mg/L |
| . | Chemical Oxygen Demand | APHA,22nd Ed., 2012 , 5220-B, 5-17 | Open Reflux Method | 5.0 mg/L |
| . | Biochemical Oxygen Demand | IS 3025( Part 44): 1993,Reaffirmed 2009,Amds.1 | Iodometric Method | 5.0 mg/L |
| . | Electrical Conductivity | APHA, 22nd Ed., 2012, 2510- B, 2-54 | By Conductivity Meter | 0.1 µmho/cm |
| . | Nitrite-Nitrogen | APHA, 22nd Ed., 2012, 4500-$NO_2$-B, 4-120 | Colorimetric Method | 0.006 mg/L |
| . | Nitrate-Nitrogen | APHA,22nd Ed.,2012 ,4500-$NO_3$,B-4-122 | UV Spectrophotometer Screening | 0.2 mg/L |

| Sr. | Parameters | Methods References | Techniques | Detection Limit |
|---|---|---|---|---|
| | | | Method | |
| . | ($NO_2$ + $NO_3$)-Nitrogen | APHA, 22nd Ed., 2012, 4500-$NO_2$-B, 4-120<br><br>APHA,22nd Ed.,2012,4500-$NO_3$,B-4-122 | Colorimetric Method<br><br>UV Spectrophotometer Screening Method | 0.2 mg/L |
| . | Free Ammonia | APHA, 22nd Ed., 2012 , 4500 $NH_3$, F, 4 -115 | Colorimetric Method | 0.006 mg/L |
| . | Total Residual Chlorine | IS 3025 (Part 26) :1986 , Reaffirmed 2009, Ed. 2.1(2004-02) | Iodometric Method | 0.1 mg/L |
| . | Cyanide (CN) | APHA, 22nd Ed., 2012 ,4500-CN, C & E, 4-41 & 4-43 | Colorimetric Method | 0.001 mg/L |
| . | Fluoride (F) | APHA, 22nd Ed., 2012, 4500-$F^-$, D, 4-87 | SPADNS Method | 0.05 mg/L |
| . | Sulphide ($S^{2-}$) | APHA, 22nd Ed., 2012, 4500 –$S^2$ , C-4-175, F-4-178 | IodometricMethod | 0.08 mg/L |
| . | Dissolved Phosphate (P) | APHA,22nd Ed., 2012 , 4500 P,E, 4-155 | Ascorbic Acid Method | 0.03 mg/L |
| . | Sodium Absorption Ratio | IS11624 :1986, Reaffirmed 2006 | By Calculation | 0.3 |
| . | Total Phosphorous (P) | APHA,22nd Ed., 2012 , 4500 P,E, 4-155 | Ascorbic Acid Method | 0.03 mg/L |
| . | Total Kjeldahl Nitrogen | APHA, 22nd Ed., 2012, 4500 $NH_3$, B & C, 4 -110, 4-112 | Titrimetric Method | 0.1 mg/L |
| . | Total Ammonia ($NH_4$ +$NH_3$)-Nitrogen | APHA,22d Ed., 2012 , 4500 $NH_3$, F, 4 -115 | Colorimetric Method | 0.001 mg/L |
| . | Phenols ($C_6H_5OH$) | APHA,22nd Ed., 2012 , 5530- B & C, 5-44 & 5-47 | Chloroform Extraction Method | 0.001 mg/L |

| Sr. | Parameters | Methods References | Techniques | Detection Limit |
|---|---|---|---|---|
| . | Surface Active Agents | APHA,22nd Ed., 2012 , 5540-B & C,5-50 | Methylene Blue Extraction Method | 0.1 mg/L |
| . | Organo Chlorine Pesticides | APHA, 22nd Ed., 2012,6410B,6-74 | GC MS-MS Method | 0.01 µg/L |
| . | Polynuclear aromatic hydrocarbons (PAH) | APHA, 22nd Ed., 2012,6410B,6-74 | GC MS-MS Method | 0.01 µg/L |
| . | Polychlorinated Biphenyls (PCB) | APHA, 22nd Ed., 2012,6410B,6-74 | GC MS-MS Method | 0.01 µg/L |
| . | Zinc (Zn) | IS 3025(Part 2): 2004 | ICP Method | 0.1 mg/L |
| . | Nickel (Ni) | IS 3025(Part 2): 2004 | ICP Method | 0.05 mg/L |
| . | Copper (Cu) | IS 3025(Part 2): 2004 | ICP Method | 0.03 mg/L |
| . | Hexavalent Chromium ($Cr^{6+}$) | APHA, 22ndEd., 2012,3500-Cr,B,3-69 | Colorimetric Method | 0.02 mg/L |
| . | Total Chromium (Cr) | IS 3025(Part 2): 2004 | ICP Method | 0.02 mg/L |
| . | Total Arsenic (As) | IS 3025(Part 2): 2004 | ICP Method | 0.005 mg/L |
| . | Lead (Pb) | IS 3025(Part 2): 2004 | ICP Method | 0.008 mg/L |
| . | Cadmium (Cd) | IS 3025(Part 2): 2004 | ICP Method | 0.002 mg/L |
| . | Mercury (Hg) | IS 3025(Part 2): 2004 | ICP Method | 0.0008 mg/L |
| . | Manganese (Mn) | IS 3025(Part 2): 2004 | ICP Method | 0.02 mg/L |
| . | Iron (Fe) | IS 3025(Part 2): 2004 | ICP Method | 0.06 mg/L |
| . | Vanadium (V) | IS 3025(Part 2): 2004 | ICP Method | 0.05 mg/L |
| . | Selenium (Se) | IS 3025(Part 2): 2004 | ICP Method | 0.005 mg/L |
| . | Boron (B) | IS 3025(Part 2): 2004 | ICP Method | 0.1 mg/L |
| . | Total Coliforms | APHA, 22nd Ed., 2012,9221-B, 9-66 | Multiple tube fermentation technique (MPN/100ml) | 1.1 MPN/100ml |

| Sr. | Parameters | Methods References | Techniques | Detection Limit |
|---|---|---|---|---|
| . | Faecal Coliforms | APHA, 22nd Ed., 2012,9221-E, 9-74 | Multiple tube fermentation technique (MPN/100ml) | 1.1 MPN/100ml |
| . | Bioassay (Zebra Fish) Test | IS 6582, 1971, Reaffirmed 1987 | Static Technique | - |

## Annexure V: National Ambient Air Quality Standards, 2009

The Gazette of India

EXTRAORDINARY PART III-Section 4 PUBLISHED BY AUTHORITY
NEW DELHI, WEDNESDAY, **NOBEMBER 18, 2009** No. B-29016/20/90/PCI-I

### National Ambient Air Quality Standards: Central Pollution Control Board

In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevntion and Control of Pollution) Act, 1981 (Act No.14 of 1981), and in suppression of the Notification No(s). S.O.384(E), dated 11th April, 1994 and S.O.935(E), dated 14th October, 1998, the Central Pollution Control Board hereby notify the National Ambient Air Quality Standards **with immediate effect**, namely:

| Sr. No. | Pollutant | Time Weighted Average | Concentration in Ambient Air | | |
|---|---|---|---|---|---|
| | | | Industrial, Residential, Rural and Other Areas | Ecologically Sensitive Areas (Notified by Central Government) | Methods of Measurement |
| (1) | (2) | (3) | (4) | (5) | (6) |
| 1 | Sulphur Dioxide ($SO_2$) µg/m$^3$ | Annual * | 50 | 20 | – Improved West and Gaeke<br>– Ultraviolet fluorescence |
| | | 24 hours ** | 80 | 80 | |
| 2 | Nitrogen Dioxide ($NO_2$) µg/m$^3$ | Annual * | 40 | 30 | – Modified Jacob & Hochheiser (Na-Arsenite)<br>– Chemilminescence |
| | | 24 hours ** | 80 | 80 | |
| 3 | Particulate Matter (size less than 10 µm) or $PM_{10}$ µg/m$^3$ | Annual * | 60 | 60 | – Gravimetric<br>– TOEM<br>– Beta attenuation |
| | | 24 hours ** | 100 | 100 | |
| 4 | Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$ µg/m$^3$ | Annual * | 40 | 40 | – Gravimetric<br>– TOEM<br>– Beta attenuation |
| | | 24 hours ** | 60 | 60 | |
| 5 | Ozone ($O_3$) µg/m$^3$ | 8 hours ** | 100 | 100 | – UV photometric<br>– Chemiluminescence<br>– Chemical Method |
| | | 1 hour ** | 180 | 180 | |
| 6 | Lead (Pb) µg/m$^3$ | Annual * | 0.50 | 0.50 | – AAS/ICP method after sampling on EPM 2000 or equivalent filter paper<br>– EDXRF using Teflon filter |
| | | 24 hours ** | 1.0 | 1.0 | |
| 7 | Carbon Monoxide (CO) mg/m$^3$ | 8 hours ** | 02 | 02 | – Non Dispersive Infra Red (NDIR) spectroscopy |
| | | 1 hour ** | 04 | 04 | |
| 8 | Ammonia ($NH_3$) µg/m$^3$ | Annual * | 100 | 100 | – Chemiluminescence<br>– Indophenol blue method |
| | | 24 hours ** | 400 | 400 | |
| 9 | Benzene ($C_6H_6$) µg/m$^3$ | Annual * | 05 | 05 | – Gas Chromatography based continuous analyzer<br>– Adsorption and Desorption followed by GC analysis |
| 10 | Benzo (a) Pyrene (BaP) – particulate phase only, ng/m$^3$ | Annual * | 01 | 01 | – Solvent extraction followed by HPLC/GC analysis |
| 11 | Arsenic (As) ng/m$^3$ | Annual * | 06 | 06 | – AAS/ICP method after sampling on EPM 2000 or equivalent filter paper. |
| 12 | Nickel (Ni) ng/m$^3$ | Annual * | 20 | 20 | – AAS/ICP method after sampling on EPM 2000 or equivalent filter paper. |

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 08 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2 % of the time, they may exceed the limits but not on two consecutive days of monitoring.

**Note:** Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.

**SANT PRASAD GAUTAM, Chairman, Central Pollution Control Board [ADVT-III/4/184/09/Exty.]**

**Note:** The notifications on National Ambient Air Quality Standards were published by the Central Pollution Control Board in the Gazette of India. Extraordinary vide notification No(s). S.O. 384(E), dated 11th April, 1994 and S.O. 935(E), dated 14th October,1998.

**µg/m$^3$:** micro-gram/m$^3$ i.e. $10^{-6}$gm/m$^3$ ng/m$^3$ : nano-gram/m$^3$ i.e. $10^{-9}$gm/m$^3$

## Annexure VI: General Standards for Discharge of Environmental Pollutants, Part A: Effluents (The Environment (Protection) Rules, 1986, Schedule VI)

| Sr. | Parameter | Standards | | | |
|---|---|---|---|---|---|
| | | **Inland surface Water** | **Public Sewers** | **Land for Irrigation** | **Marine Coastal Areas** |
| 1. | Colour and Odour | See Note 1 | -- | See Note I | See Note 1 |
| 2. | Suspended solids, mg/L, Max. | 100 | 600 | 200 | For process waste water - 100<br>For cooling water effluent- 10 percent above total suspended mailer of influent cooling water. |
| 3. | Particle size of suspended solids | Shall pass 850 micron IS Sieve | | | Floatable solids, Max 3 mm<br>Settleable solids Max 850 microns |
| 4. | Dissolved solids (Inorganic), mg/L, Max. | 2100 | 2100 | 2100 | -- |
| 5. | pH value | 5.5 -9.0 | 5.5 -9.0 | 5.5 -9.0 | 5.5-9.0 |
| 6. | Temperature °C, Max | Shall not exceed 40 in any section of the stream within 15 mts. Downstream from the effluent outlet | 45 at the point of discharge | -- | 45 at the point of discharge |
| 7. | Oil and Grease, mg/L, Max | 10 | 20 | 10 | 20 |

| Sr. | Parameter | Standards | | | |
|---|---|---|---|---|---|
| | | **Inland surface Water** | **Public Sewers** | **Land for Irrigation** | **Marine Coastal Areas** |
| 8., | Total Residual chlorine, mg/L, Max | 1.0 | -- | -- | 1.0 |
| 9. | Ammonical Nitrogen (as N), mg/L, Max | 50 | 50 | -- | 50 |
| 10. | Total Kjeldahl Nitrogen (as N), mg/L, Max. | 100 | -- | -- | 100 |
| 11. | Free Ammonia (as $NH_3$), mg/L, Max | 5.0 | -- | -- | 5.0 |
| 12. | Biochemical oxygen demand (5 days, at 20° c) mg/L, Max | 30 | 350 | 100 | 100 |
| 13. | Chemical oxygen demand, mg/L, Max | 250 | -- | -- | 250 |
| 14. | Arsenic (as As), mg/l, Max | 0.2 | 0.2 | 0.2 | 0.2 |
| 15. | Mercury (as Hg). Mg/L, Max | 0.01 | 0.01 | -- | 0.01 |
| 16. | Lead (as Pb), mg/L, Max | 0.1 | 1.0 | - | 1.0 |
| 17. | Cadmium (as Cd), mg/L, | 2.0 | 1.0 | -- | 2.0 |
| 18. | Hexavalent Chromium (as $Cr^{+6}$) mg/L, Max | .1 | 2.0 | -- | 1.0 |
| 19. | Total Chromium (as Cr), mg/L, Max | 2.0 | 2.0 | -- | 2.0 |

| Sr. | Parameter | Standards | | | |
|---|---|---|---|---|---|
| | | **Inland surface Water** | **Public Sewers** | **Land for Irrigation** | **Marine Coastal Areas** |
| 20. | Copper (as Cu), mg/L, Max. | 3.0 | 3.0 | -- | 3.0 |
| 21. | Zinc (as Zn), mg/L, Max. | 5.0 | 15 | 0-- | 15 |
| 22 | Selenium (as Se), mg/l, Max. | 0.05 | 0.05 | -- | 0.05 |
| 23 | Nickel (as Ni), mg/l, Max. | 3.0 | 3.0 | -- | 5.0 |
| 24 | Boron (as B), mg/l, Max. | 2.0 | 2.0 | 2.0 | -- |
| 25. | Percent Sodium, Max. | -- | 60 | 60 | -- |
| 26. | Residual Sodium carbonate, mg/l, Max. | -- | -- | 5.0 | -- |
| 27. | Cyanide (as Cn), mg/L, Max. | 0.2 | 2.0 | 0.2 | 0.2 |
| 28. | Chloride (as Cl), mg/L, Max. | 1000 | 1000 | 600 | -- |
| 29. | Fluoride (as F), mg/IL, Max. | 2.0 | 15 | -- | 15 |
| 30. | Dissolved Phosphate (as P), mg/L, Max. | 5.0 | -- | -- | -- |
| 31. | Sulphate (as $SO_4$), mg/L, Max. | 1000 | 1000 | 1000 | -- |
| 32. | Sulphide (as S), mg/L, Max. | 2.0 | -- | -- | 5.0 |
| 33. | Pesticides | Absent | Absent | Absent | Absent |

| Sr. | Parameter | Standards | | | |
|---|---|---|---|---|---|
| | | **Inland surface Water** | **Public Sewers** | **Land for Irrigation** | **Marine Coastal Areas** |
| 34. | Phenolic compounds (as $C_6H_5OH$), mg/L, Max. | 1.0 | 5.0 | -- | 5.0 |
| 35. | Radioactive materials: | | | | |
| | Alpha emitters MC/ml., Max. | $10^{-7}$ | $10^{-7}$ | $10^{-8}$ | $10^{-7}$ |
| | Beta emitters µc/ml., Max | $10^{-6}$ | $10^{-6}$ | $10^{-7}$ | $10^{-6}$ |

## Annexure VII: Drinking Water Specification-IS 10500:2012

| Sr. | Characteristic | Unit | Requirement (Acceptable Limit) | Permissible Limit in the Absence of Alternate Source |
|---|---|---|---|---|
| **Table 1** | **Organoleptic and Physical Parameters** | | | |
| 1. | Colour | Hazen units | Max 5 | Max 15 |
| 2. | Odour | - | Agreeable | Agreeable |
| 3. | pH value | - | 6.5-8.5 | No relaxation |
| 4. | Taste | - | Agreeable | Agreeable |
| 5. | Turbidity | NTU | Max 1 | Max 5 |
| 6. | Total dissolved solids | mg/L | Max 500 | Max 2000 |
| **Table 2** | **General parameters concerning substances undesirable in excessive amounts** | | | |
| 7. | Aluminium (as Al) | mg/L | Max 0.03 | Max 0.2 |
| 8. | Ammonia (as total ammonia- N) | mg/L | Max 0.5 | No relaxation |
| 9. | Anionic detergents (as MBAS) | mg/L | Max 0.2 | Max 1.0 |
| 10. | Barium (as Ba) | mg/L | Max 0.7 | No relaxation |
| 11. | Boron (as B) | mg/L | Max 0.5 | Max 1.0 |
| 12. | Calcium (as Ca) | mg/L | Max 75 | Max 200 |
| 13. | Chloramines (as $C1_2$) | mg/L | Max 4.0 | No relaxation |
| 14. | Chlorides (as Cl) | mg/L | Max 250 | Max 1000 |
| 15. | Copper (as Cu) | mg/L | Max 0.05 | Max 1.5 |
| 16. | Fluoride (as F) | mg/L | Max 1.0 | Max 1.5 |

| **Sr.** | **Characteristic** | **Unit** | **Requirement (Acceptable Limit)** | **Permissible Limit in the Absence of Alternate Source** |
|---|---|---|---|---|
| 17. | Free residual chlorine | mg/L | Min 0.2 | Min 1 |
| 18. | Iron (as Fe) | mg/L | Max 0.3 | No relaxation |
| 19. | Magnesium (as Mg) | mg/L | Max 30 | Max100 |
| 20. | Manganese (as Mn) | mg/L | Max 0.1 | Max 0.3 |
| 21. | Mineral Oil | mg/L | Max 0.5 | No relaxation |
| 22. | Nitrate (as $NO_3$) | mg/L | Max 45 | No relaxation |
| 23. | Phenolic compounds (as $C_6H_5OH$) | mg/L | Max 0.001 | Max 0.002 |
| 24. | Selenium (as Se) | mg/L | Max 0.01 | No relaxation |
| 25. | Silver (as Ag) | mg/L | Max 0.1 | No relaxation |
| 26. | Sulphate (as $SO_4$) | mg/L | Max 200 | Max 400 |
| 27. | Sulphide (as $H_2S$) | mg/L | Max 0.05 | No relaxation |
| 28. | Total Alkalinity as calcium carbonate | mg/L | Max 200 | Max600 |
| 29. | Total hardness (as $CaCO_3$) | mg/L | Max 200 | Max 600 |
| 30. | Zinc (as Zn) | mg/L | Max 5 | Max15 |
| **Table 3** | **Parameters Concerning Toxic Substances** | | | |
| 31. | Cadmium (asCd) | mg/L | Max 0.003 | No relaxation |
| 32. | Cyanide (asCN) | mg/L | Max 0.05 | No relaxation |
| 33. | Lead (as Pb) | mg/L | Max 0.01 | No relaxation |
| 34. | Mercury (asHg) | mg/L | Max 0.001 | No relaxation |
| 35. | Molybdenum (as Mo) | mg/L | Max 0.07 | No relaxation |
| 36. | Nickel (as Ni) | mg/L | Max 0.02 | No relaxation |

| Sr. | Characteristic | Unit | Requirement (Acceptable Limit) | Permissible Limit in the Absence of Alternate Source |
|---|---|---|---|---|
| 37. | Pesticides | mg/L | See Table 5 | No relaxation |
| 38. | Polychlorinatedbiphenyls | mg/L | Max 0.0005 | No relaxation |
| 39. | Poly nuclear aromatic Hydrocarbons (as PAH) | mg/L | Max 0.0001 | No relaxation |
| 40. | Total Arsenic(as As) | mg/L | Max 0.01 | Max0.05 |
| 41. | Total Chromium (as Cr) | mg/L | Max 0.05 | No relaxation |
| 42. | Trihalomethanes | | | |
| a) | Bromoform | mg/L | Max 0.1 | No relaxation |
| b) | DibromochloroMethane | mg/L | Max 0.1 | No relaxation |
| c) | Bromodichloromethane | mg/L | Max 0.06 | No relaxation |
| d) | Chloroform | mg/L | Max 0.2 | No relaxation |
| **Table 4** | **Parameters Concerning Radioactive Substances** | | | |
| 43. | Radioactive Materials | | | |
| a) | Alpha emitters | Bq/L | Max 0.1 | No relaxation |
| b) | Beta emitters | Bq/L | Max 1.0 | No relaxation |
| **Table 5** | **Pesticide Residues Limits and Test Method** | | | |
| i) | Alachor | µg/L | 20 | No relaxation |
| ii) | Atrazine | µg/L | 2 | No relaxation |
| iii) | Aldrin/ Dieldrin | µg/L | 0.03 | No relaxation |
| iv) | Alpha HCH | µg/L | 0.01 | No relaxation |
| v) | Beta HCH | µg/L | 0.04 | No relaxation |

| Sr. | Characteristic | Unit | Requirement (Acceptable Limit) | Permissible Limit in the Absence of Alternate Source |
|---|---|---|---|---|
| vi) | Butachlor | µg/L | 125 | No relaxation |
| vii) | Chlorpyriphos | µg/L | 30 | No relaxation |
| viii) | Delta HCH | µg/L | 0.04 | No relaxation |
| ix) | 2,4- Dichlorophenoxyacetic acid | µg/L | 30 | No relaxation |
| x) | DDT (o,p&p,p — Isomers of DDT, DDE and DDD) | µg/L | 1 | No relaxation |
| xi) | Endosulfan (α,β & sulphate) | µg/L | 0.4 | No relaxation |
| xii) | Ethion | µg/L | 3 | No relaxation |
| xiii) | Gamma - HCH (Lindane) | µg/L | 2 | No relaxation |
| xiv) | Isoproturon | µg/L | 9 | No relaxation |
| xv) | Malathion | µg/L | 190 | No relaxation |
| xvi) | Methyl parathion | µg/L | 0.3 | No relaxation |
| xvii) | Monocrotophos | µg/L | 1 | No relaxation |
| xviii) | Phorate | µg/L | 2 | No relaxation |
| **Table 6** | **Bacteriological Quality of Drinking Water** | | | |
| 44. | E.coli or thermotolerant coliform bacteria | /100 | Not detectable | - |
| 45. | Total coliform bacteria | /100 mL | Not detectable | - |
| | **Virological Requirements** | | | |
| 46. | MS2 phage | /1 L | Absent | - |
| | **Biological Requirements** | | | |

| Sr. | Characteristic | Unit | Requirement (Acceptable Limit) | Permissible Limit in the Absence of Alternate Source |
|---|---|---|---|---|
| 47. | Cryptosporidium | /10 L | Absent | - |
| 48. | Giardia | /10 L | Absent | - |
| 49. | Microscopic organisms such as algae,zooplanktons,flagellates,parasites and toxin producing organisms | | Free from microscopic organisms | - |

## Annexure VIII: CPCB Water Quality Criteria:

| Designated best use | Quality Class | Primary Water Quality Criteria |
|---|---|---|
| Drinking water source without conventional treatment but with chlorination | A | Total coliform organisms (MPN*/100 ml) shall be 50 or less<br>pH between 6.5 and 8.5<br>Dissolved Oxygen 6 mg/l or more, and<br>Biochemical Oxygen Demand 2 mg/l or less |
| Outdoor bathing (organized) | B | Total coliform organisms (MPN/100 ml) shall be 500 or less<br>pH between 6.5 and 8.5<br>Dissolved Oxygen 5 mg/l or more, and<br>Biochemical Oxygen Demand 3 mg/l or less |
| Drinking water source with conventional treatment | C | Total coliform organisms (MPN/100ml) shall be 5000 or less<br>pH between 6 and 9<br>Dissolved Oxygen 4 mg/l or more, and<br>Biochemical Oxygen Demand 3 mg/L or less |
| Propagation of wildlife and fisheries | D | pH between 6.5 and 8.5<br>Dissolved Oxygen 4 mg/l or more, and<br>Free ammonia (as N) 1.2 mg/L or less |
| Irrigation, industrial cooling, and controlled disposal | E | pH between 6.0 and 8.5<br>Electrical conductivity less than 2250 micro mhos/cm,<br>Sodium Absorption Ratio less than 26,<br>and Boron less than 2 mg/l. |

| | | |
|---|---|---|
| | Below E | Not Meeting A, B, C, D & E Criteria |

## Annexure IX: Water Quality Parameters Requirements and Classification

Water quality parameters are classified into three categories, given in Table (i), (ii) and (iii) (Source: CPCB, 2002, "Water Quality Criteria and Goals", Monitoring of Indian National aquatic Resources Series: MINARS/17/2001-2002).

Table: Basic Water Quality Requirement and Classification (Surface Water + Ground Water)

**i) Simple Parameters:**

| Sr. | Parameters | Requirement for Waters of Class | | |
|---|---|---|---|---|
| | | **A-Excellent** | **B-Desirable** | **C-Acceptable** |
| (i) | Sanitary Survey | Very Clean neighborhood and catchment | Reasonably clean neighborhood | Generally clean neighborhood |
| (ii) | General Appearance | No floating matter | No floating matter | No floating matter |
| (iii) | Colour | Absolutely Colourless | Almost colourless, very light shade if any | No colour of anthropogenic origin |
| (iv) | Smell | Odourless | Almost odourless | No unpleasant odour |
| (v) | Transparency | >1.0 depth | >0.5 to 0.1m depth | >0.2 to 0.5 m depth |
| (vi) | Ecological* (Presence of Animals) | Fish & Insects | Fish & Insects | Fish & Insects |

* Applicable to only surface water

**ii) Regular Monitoring Parameters:**

| Sr. | Parameters | Requirement for Waters of Class | | |
|---|---|---|---|---|
| | | **A Excellent** | **B-Desirable** | **C-Acceptable** |
| (i) | pH | 7.0 to 8.5 | 6.5 to 9.0 | 6.5 to 9.0 |
| (ii) | DO (% Saturation) | 90-110 | 80-120 | 60-140 |
| (iii) | BOD, mg/l | Below 2 | Below 5 | Below 8 |
| (iv) | EC, µmhos/cm | <1000 | <2250 | <4000 |
| (v) | $(NO_2+NO_3)$-Nitrogen, mg/l | <5 | <10 | <15 |
| (vi) | Suspended solid, | <25 | <50 | <100 |

| | | | | |
|---|---|---|---|---|
| | mg/l | | | |
| (vii) | Feacal Coliform, MPN/ 100 ml | <20 per 100 ml | <200 per 100 ml | <2000 per 100 ml |
| (viii) | Bio-assay (Zebra Fish) | No death in 5 days | No death in 3 days | No death in 2 days |

**Note:**

1. Dissolved Oxygen (DO) not applicable for ground waters.
2. Dissolved Oxygen in eutrophicated waters should include measurement for diurnal variation.
3. Suspended solid limit is applicable only during non-monsoon period.
4. Faecal Coliform values should meet for 90% times.
5. Static Bio-Assay method may be adopted.

**iii) Specific Parameters: (Only in case of need/apprehensions)**

| **Sr.** | **Parameters** | **Requirement for Waters of Class** | | |
|---|---|---|---|---|
| | | **A- Excellent** | **B-Desirable** | **C-Acceptable** |
| (i) | Total Phosphorous | <0.1 mg/l | < 0.2 mg/l | < 0.3 mg/l |
| (ii) | T.K.N | < 1.0 mg/l | <2.0 mg/l | <3.0 mg/l |
| (iii) | Total Ammonia (NH4 + NH3)-Nitrogen | < 0.5 mg/l | < 1.0 mg/l | < 1.5 mg/l |
| (iv) | Phenols | < 2µg/l | < 5µg/l | <10 µg/l |
| (v) | Surface Active Agents | <20 µg/l | <100µg/l | < 200µg/l |
| (vi) | Organo Chlorine Pesticides | < 0.05µg/l | < 0.1µg/l | < 0.2µg/l |
| (vii) | PAH | < 0.05µg/l | <0.1 µg/l | <0.2 µg/l |
| (viii) | PCB and PCT | < 0.01µg/l | < 0.01µg/l | < 0.02µg/l |
| (ix) | Zinc | < 100µg/l | < 200µg/l | <300 µg/l |
| (x) | Nickel | < 50µg/l | < 100µg/l | < 200µg/l |
| (xi) | Copper | < 20µg/l | < 50µg/l | <100µg/l |
| (xii) | Chromium (Total) | < 20µg/l | < 50µg/l | < 100µg/l |
| (xiii) | Arsenic (Total) | < 20µg/l | <50 µg/l | <100 µg/l |

| | | | | |
|---|---|---|---|---|
| (xiv) | Lead | < 20µg/l | < 50µg/l | < 100µg/l |
| (xv) | Cadmium | < 1.0µg/l | <2.5 µg/l | < 5.0µg/l |
| (xvi) | Mercury | < 0.2µg/l | < 0.5µg/l | < 1.0µg/l |