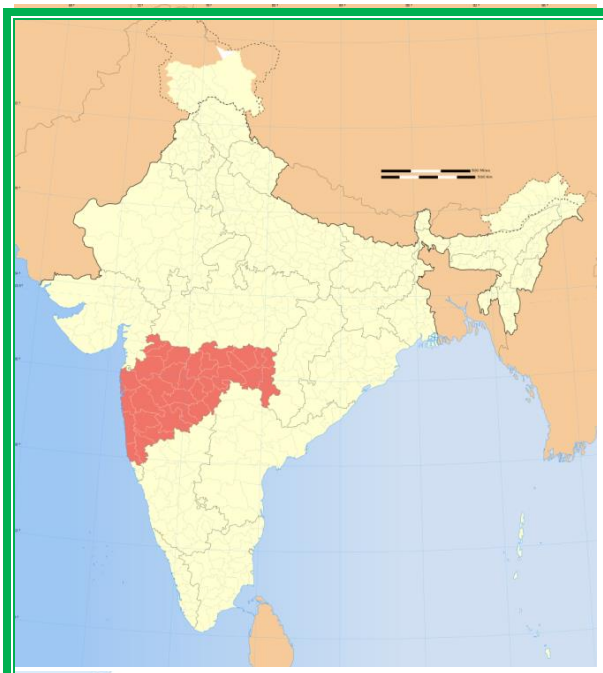
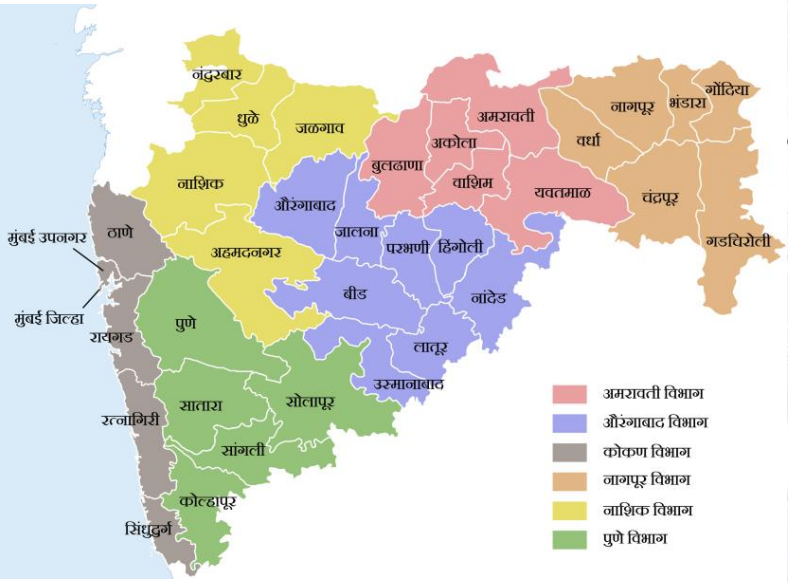
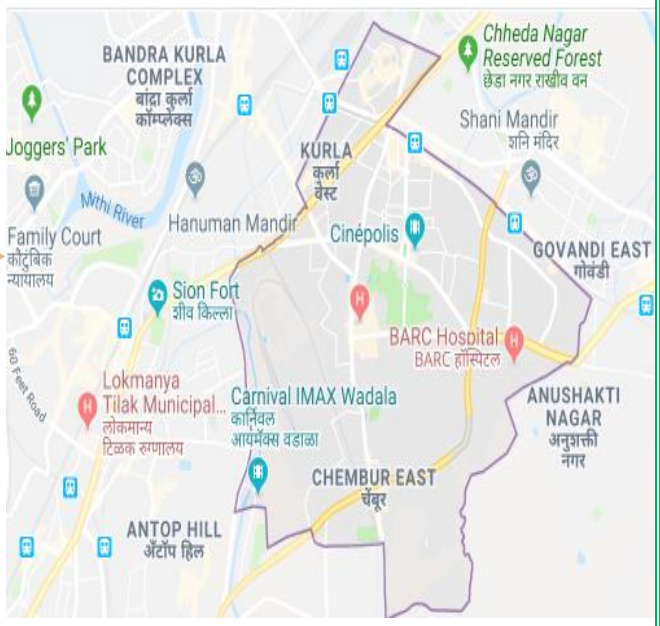


Action Plan for Industrial Cluster in Severely Polluted Areas

Monitoring, sampling, analysis of Stack, Ambient Air Quality, Surface Water, Ground Water, Waste Water

चेंबूर Chembur





MAHARASHTRA

Maharashtra Pollution Control Board

महाराष्ट्र प्रदूषण नियंत्रण मंडळ

February, 2019

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Acknowledgement:

We gratefully acknowledge **E. Ravendiran**, Member Secretary, Maharashtra Pollution Control Board, for entrusting this very important and prestigious project to us.

Our special thanks are to Regional and Sub Regional Officer of the concerned areas, for guidance during the sampling. The contribution of **Shri V. M Motghare** (Joint director APC) and Mr. Sameer Hundlekar (Field officer) is appreciated.

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
SPA	Severely 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:

Although industries contribute significantly to India's economic growth and development, the increase in pollution of land, water, air, noise and resulting degradation of environment that they have caused, cannot be overlooked. Industries are responsible for four types of pollution: a) Air b) water c) land d) noise. Rapid industrialization carries with it the seeds of environmental damage. Pollution of natural environment not only affects people but also have adverse impact on economic growth in the long run. Analysis of pollution load shows that there are few industries in the country which contribute to more than 90percent of the pollution. Hence, 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.

Industrial pollution takes on many faces. It contaminates many sources of drinking water, releases unwanted toxins into the air and reduces the quality of soil all over the world. Every litre of waste water discharged by our industries pollute eight times the quantity of fresh water. The extent of pollution varies with the size of the industry, the nature of the industry, the type of products used and produced etc. 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.

Chembur is a suburb in eastern Mumbai, India. Chembur has pollution problems and was ranked 46th in a list of the most polluted industrial clusters in India. Effluents from oil refineries, fertilizer plants and reactors located in Chembur are also said to have polluted sea water in Thane Creek and affected marine life. The Deonar dumping ground in Deonar has caused health issues for the residents of Chembur. In 2008, around 40 residents of Chembur went on a hunger strike to protest against the frequent fires and smoke. Again in 2012, the residents complained to the Brihanmumbai Municipal Corporation on the smoke coming out of the dumping ground, which has been affecting asthma patients.

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, Dombivli, 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 Chembur:

- The sampling was carried out in 4 days i.e. from 31st December 2018 to & 2nd January 2019 for Chembur region.
- A total of 6 Stack Monitoring Samples, 8 Ambient Air Quality Monitoring Samples, 6 Waste Water Samples and 4 Ground Water Samples were collected and analyzed.

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 II**
2. Ambient Air Sampling and Analysis Methodology **- Annexure III**
3. Water/Wastewater Sampling and Analysis Methodology - **Annexure IV**

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 in the graphs

3.1 Stack Emission:

Stack Emission Monitoring Results are compared against The Environment (Protection) Rules, 1986 General Emission Standard - Part D.

Sr.	Name of Industry	Stack Identity	Table No.
1.	Bharat Petroleum Corporation Ltd.	CCR HRSG -101 F2001	**I**
2.	RCF Mahul	Stack 2	**I**
3.	RCF Mahul	Stack 1	**I**

Sr.	Name of Industry	Stack Identity	Table No.
4.	RCF Mahul	Stack 6	**II**
5.	Bharat Petroleum Corporation Ltd.	HRSG-3	**II**
6.	Tata Power Chembur	Unit No. 5	**II**

Table No. I

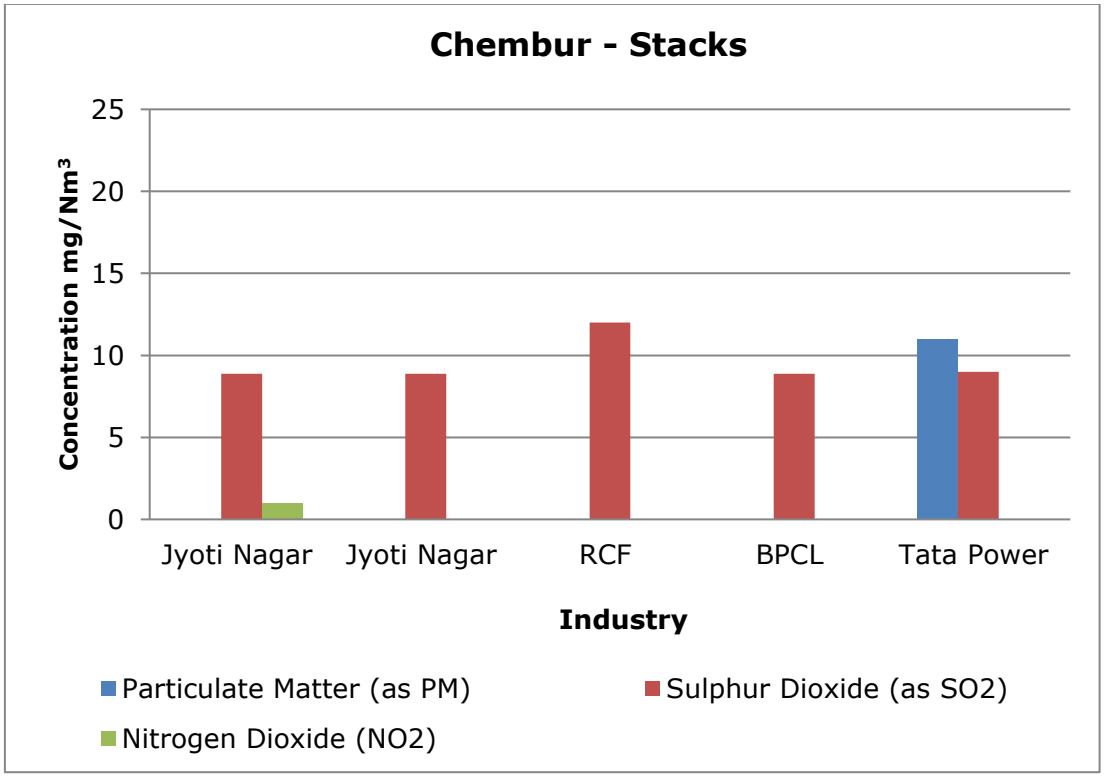
Name of Industry			**Bharat Petroleum Corporation Ltd.**	**RCF Mahul**	**RCF Mahul**
Date of Sampling			**31.12.2018**	**31.12.2018**	**31.12.2018**
Sr.	**Parameter**	**Unit**	**Results**		
1.	Particulate Matter (as PM)	mg/Nm^3	BDL	BDL	BDL
	Std. Limit	**mg/Nm^3**	**100**	**150**	**150**
2.	Sulphur Dioxide (as SO_2)	mg/Nm^3	8.88	8.88	12
		kg/day	10.5	12.6	78
	Std. Limit	**mg/Nm^3**	**200**	**200**	**200**
3.	Nitrogen Dioxide (NO_2)	mg/Nm^3	26.6	16.4	23
	Std. Limit	**mg/Nm^3**	**450**	**400**	**400**

Table No. II

Name of Industry			**RCF Mahul**	**Bharat Petroleum Corporation Ltd.**	**TATA Power**
Date of Sampling			**31.12.2018**	**01.01.2019**	**01.01.2019**
Sr.	**Parameter**	**Unit**	**Results**		
1.	Particulate Matter (as PM)	mg/Nm^3	NA	BDL	11
	Std. Limit	**mg/Nm^3**	**150**	**100**	**150**
2.	Sulphur Dioxide (as SO_2)	mg/Nm^3	NA	8.88	9
		kg/day	NA	16.8	383

Name of Industry			RCF Mahul	Bharat Petroleum Corporation Ltd.	TATA Power
Date of Sampling			**31.12.2018**	**01.01.2019**	**01.01.2019**
Sr.	**Parameter**	**Unit**	**Results**		
	Std. Limit	**mg/Nm^3**	**200**	**200**	**200**
3.	Nitrogen Dioxide (NO_2)	mg/Nm^3	NA	23	26.4
	Std. Limit	**mg/Nm^3**	**400**	**450**	**400**
4.	Ammonia (NH_3)		51.3	-	-

Graphs: Stack Monitoring for Chembur:



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 V**).

Sr.	Location	Location detail	Table No.
1.	Aegis Logistic Ltd.	Near Main Gate	**I**
2.	Sealord Containers Ltd.	Near Main Gate	**I**

Sr.	Location	Location detail	Table No.
3.	RCF	Near Main Gate	**I**
4.	HPCL	Near Main Gate	**II**
5.	BPCL	Near Admin	**II**
6.	Tata Power	Near Colony	**II**
7.	Indian Navy	Gate no. 2	**III**
8.	Chearesh Society	Near Main Gate	**III**

***The VOC result of ambient emission is provided in Table No. III**

Table No. I

Location				**Aegis Logistic Ltd.**	**Sealord Containers Ltd.**	**RCF**
Date of Sampling				**30.12.2018**	**29.12.2018**	**31.12.2018**
Sr.	**Parameters**	**Unit**	**Std. Limit (NAAQS 2009)**	**Results**		
1.	Sulphur Dioxide (SO_2)	$\mu g/m^3$	**80**	6.22	5.53	5.93
2.	Nitrogen Dioxide (NO_2)	$\mu g/m^3$	**80**	7.84	9.21	8.71
3.	Particulate Matter (size less than 10 µm) or PM_{10}	$\mu g/m^3$	**100**	278	217	224
4.	Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$	$\mu g/m^3$	**60**	65	53	58
5.	Ozone (O_3)	$\mu g/m^3$	**180**	BDL	BDL	BDL
6.	Lead (Pb)	$\mu g/m^3$	**1**	BDL	BDL	BDL
7.	Carbon Monoxide (CO)	mg/m^3	**4**	2.42	2.61	6.27
8.	Ammonia (NH_3)	$\mu g/m^3$	**400**	BDL	BDL	BDL
9.	Benzene (C_6H_6)	$\mu g/m^3$	**5**	3.07	9.26	BDL

Location				**Aegis Logistic Ltd.**	**Sealord Containers Ltd.**	**RCF**
Date of Sampling				**30.12.2018**	**29.12.2018**	**31.12.2018**
Sr.	**Parameters**	**Unit**	**Std. Limit (NAAQS 2009)**	**Results**		
10.	Benzo (a) Pyrene (BaP) – particulate phase only	ng/m^3	**1**	BDL	BDL	BDL
11.	Arsenic (As)	ng/m^3	**6**	1.88	1.46	0.631
12.	Nickel (Ni)	ng/m^3	**20**	4.82	3.05	BDL

Table No. II

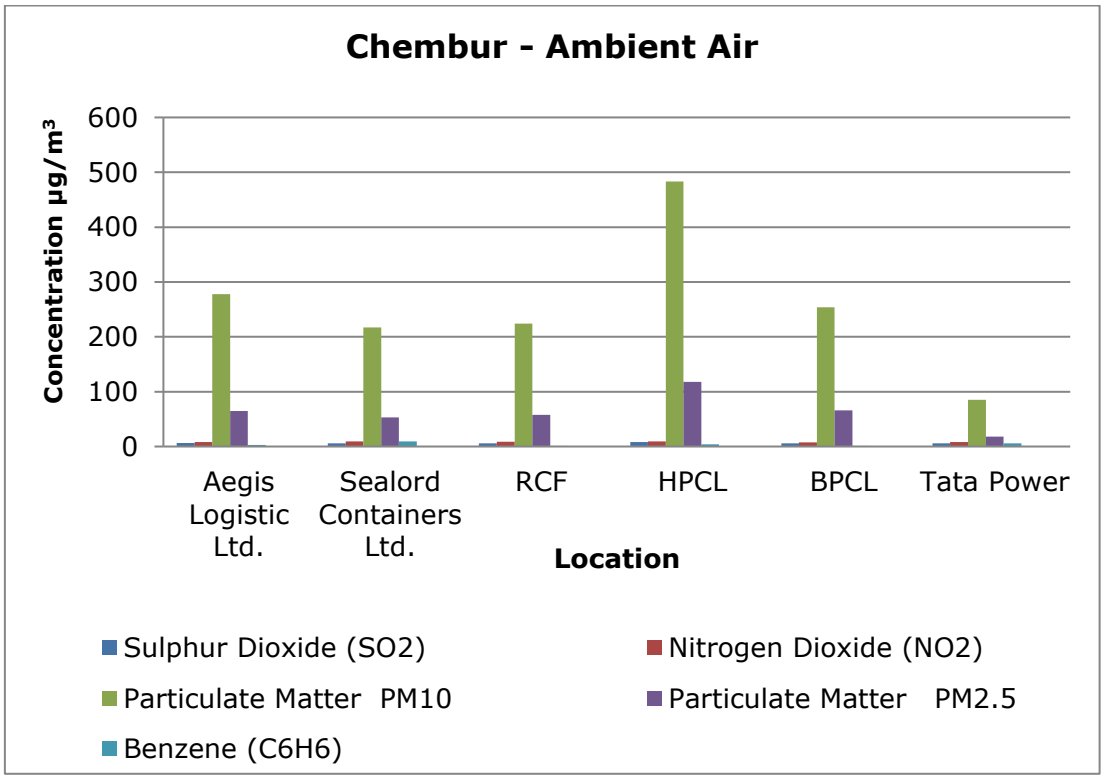
Location				**HPCL**	**BPCL**	**Tata Power**
Date of Sampling				**31.12.2018**	**01.01.2019**	**01.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit (NAAQS 2009)**	**Results**		
1.	Sulphur Dioxide (SO_2)	µg/m^3	**80**	7.84	5.76	5.76
2.	Nitrogen Dioxide (NO_2)	µg/m^3	**80**	9.47	7.46	8.21
3.	Particulate Matter (size less than 10 µm) or PM_{10}	µg/m^3	**100**	483	254	85
4.	Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$	µg/m^3	**60**	118	66	18
5.	Ozone (O_3)	µg/m^3	**180**	BDL	BDL	BDL
6.	Lead (Pb)	µg/m^3	**1**	BDL	BDL	BDL
7.	Carbon Monoxide (CO)	mg/m^3	**4**	3.09	10	5.09
8.	Ammonia (NH_3)	µg/m^3	**400**	BDL	BDL	BDL

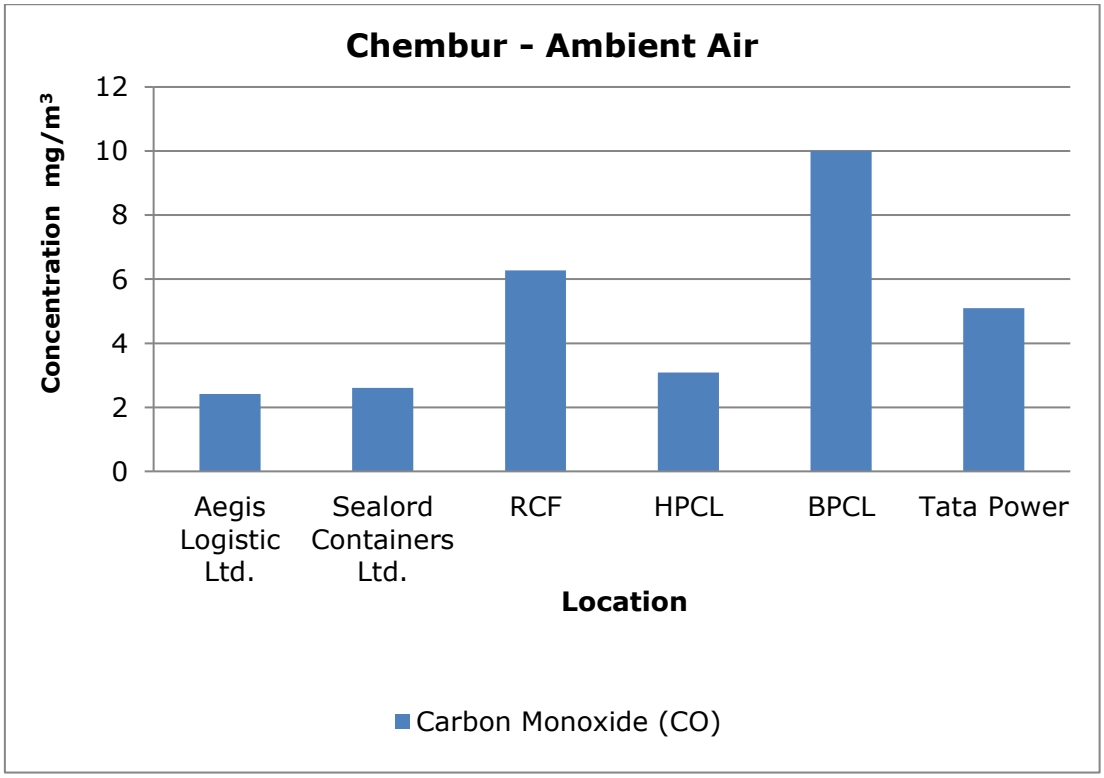
Location				**HPCL**	**BPCL**	**Tata Power**
Date of Sampling				**31.12.2018**	**01.01.2019**	**01.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit (NAAQS 2009)**	**Results**		
9.	Benzene (C_6H_6)	$\mu g/m^3$	**5**	4.23	BDL	6.08
10.	Benzo (a) Pyrene (BaP) – particulate phase only	ng/m^3	**1**	BDL	BDL	BDL
11.	Arsenic (As)	ng/m^3	**6**	3.31	1.12	1.13
12.	Nickel (Ni)	ng/m^3	**20**	7.26	5.53	BDL

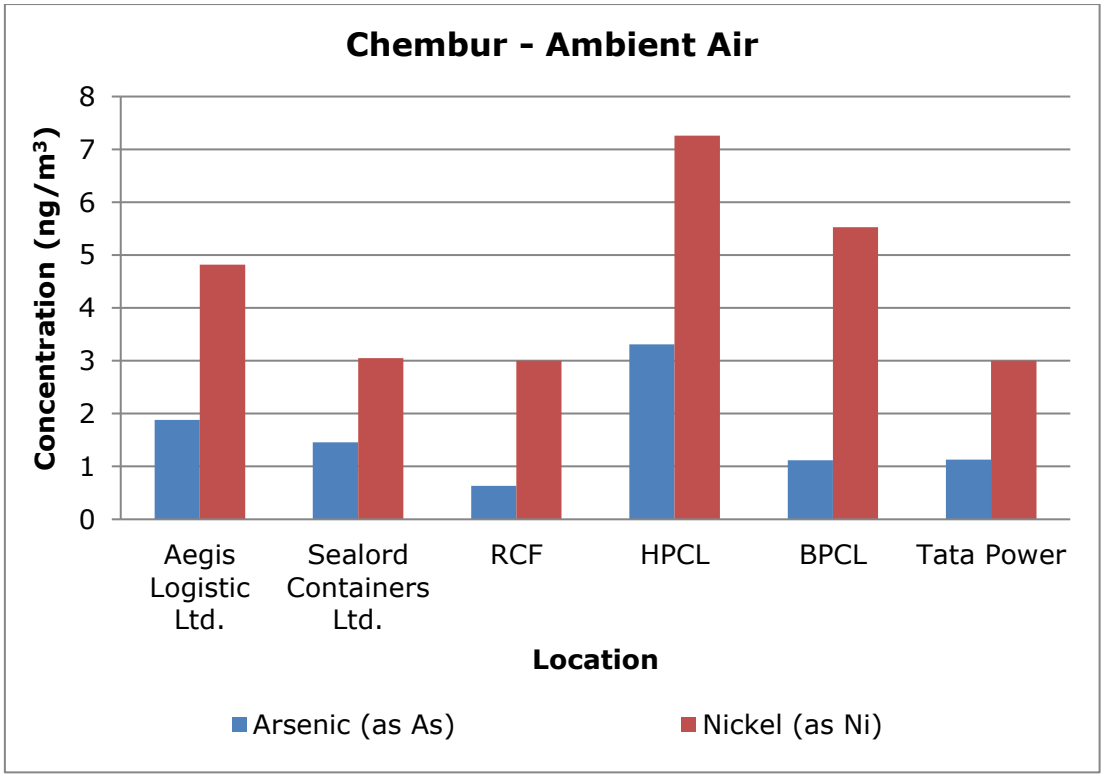
Table No. III

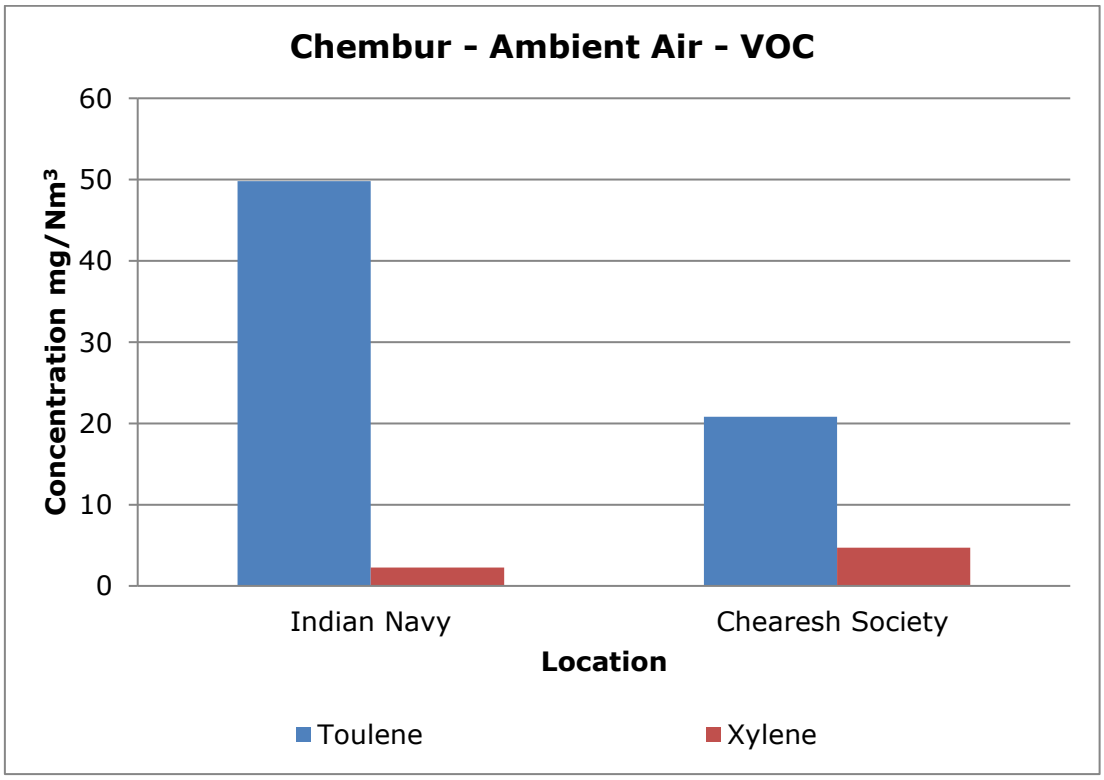
Location			**Indian Navy**	**Chearesh Society**
Date of Sampling			**02.01.2019**	**02.01.2019**
Sr.	**Parameters**	**Unit**	**Results**	
	Volatile Organic Compounds (VOC)			
1.	Methyl Isobutyl Ketone	mg/Nm^3	ND	ND
2.	Benzene	mg/Nm^3	BDL	BDL
3.	Toulene	mg/Nm^3	49.8	20.8
4.	Xylene	mg/Nm^3	2.26	4.71
5.	Isopropyl Alcoho	mg/Nm^3	ND	ND
6.	Ethyl Acetate	mg/Nm^3	ND	ND

Graphs: Ambient Air Quality Monitoring for Chembur:









3.3 Water/ Waste Water Quality:

Water Analysis Results are compared against CPCB document on criteria for Comprehensive Environmental Assessment of Industrial Clusters-Water Quality Parameters Requirement and Classification (Annexure IX), CPCB Water Quality Criteria (Annexure VIII) and Drinking Water Specification, IS 10500:2012 (Annexure VII),

Wastewater Analysis Results are compared with General Standards for Discharge of Environmental Pollutants Part A: Effluents, The Environment (Protection) Rules, 1986, Schedule VI

Sr.	Location	Source	Table No.
1.	Gadkari KHN	Surface Water Nala	**I**
2.	HPCL	Surface Water (Nala)	**I**
3.	RCF	Surface Water	**I**
4.	Malgaon Dock Material Gate	Surface Water	**II**
5.	Freeway Mysore colony outside nala	Surface Water (Nala)	**II**
6.	BPCL	Surface Water (Nala)	**II**

Table No. I

Location				**Gadkari KHN**	**HPCL**	**RCF**
Date of Sampling				**31.12.2018**	**31.12.2018**	**02.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
1.	Colour	Hazen		1	1	1
2.	Smell	-	**Agreeable**	Agreeable	Agreeable	Agreeable
3.	pH	-	**5.5 -9.0**	7.83	7	7.21
4.	Oil & Grease	mg/L	**10.0**	BDL	BDL	BDL
5.	Suspended Solids	mg/L	**100.0**	BDL	64	52
6.	Dissolved Oxygen (%Saturation)	%		22	28	20
7.	Chemical Oxygen Demand	mg/L	**250.0**	BDL	64	56
8.	Biochemical Oxygen Demand (3 days, 27^{o}C)	mg/L	**30.0**	BDL	22	18

Location				**Gadkari KHN**	**HPCL**	**RCF**
Date of Sampling				**31.12.2018**	**31.12.2018**	**02.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
9.	Electrical Conductivity (at 25°C)	µmhos/ cm		536	23500	483
10.	Nitrite Nitrogen (as NO_2)	mg/L		BDL	BDL	BDL
11.	Nitrate Nitrogen (as NO_3)	mg/L	**10.0**	3.82	4.79	15.1
12.	(NO_2+ NO_3)-Nitrogen	mg/L		3.82	4.79	15.1
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**	1.66	1.42	1.75
17.	Sulphide (as S^{2-})	mg/L	**2.0**	BDL	BDL	BDL
18.	Dissolved Phosphate (as P)	mg/L	**5.0**	BDL	0.1	0.4
19.	Sodium Absorption Ratio			0.33	BDL	0.55
20.	Total Coliforms	MPN index /100 mL	**100.0**	BDL	1600	920
21.	Faecal Coliforms	MPN index /100 mL	**1000.0**	BDL	280	26
22.	Total Phosphate (as P)	mg/L		BDL	0.16	1
23.	Total Kjeldahl Nitrogen	mg/L	**100.0**	0.67	1.12	19.5

Location				**Gadkari KHN**	**HPCL**	**RCF**
Date of Sampling				**31.12.2018**	**31.12.2018**	**02.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
24.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**50**	BDL	1.5	2.3
25.	Phenols (as C_6H_5OH)	mg/L	**1.0**	BDL	BDL	BDL
26.	Surface Active Agents (as MBAS)	mg/L		BDL	BDL	BDL
27.	Organo Chlorine Pesticides					
I.	Alachlor	µg/L	**2.0**	BDL	BDL	BDL
II.	Atrazine	µg/L	**0.2**	BDL	BDL	BDL
III.	Aldrin	µg/L	**0.1**	BDL	BDL	BDL
IV.	Dieldrin	µg/L	**2.0**	BDL	BDL	BDL
V.	Alpha HCH	µg/L	**0.01**	BDL	BDL	BDL
VI.	Beta HCH	µg/L	**2.0**	BDL	BDL	BDL
VII.	Chlorpyriphos	µg/L	**3.0**	BDL	BDL	BDL
VIII.	Butachlor	µg/L		BDL	BDL	BDL
IX.	Delta HCH	µg/L	**0.2**	BDL	BDL	BDL
X.	p,p DDT	µg/L	**0.05**	BDL	BDL	BDL
XI.	o,p DDT	µg/L	**100.0**	BDL	BDL	BDL
XII.	p,p DDE	µg/L	**250.0**	BDL	BDL	BDL
XIII.	o,p DDE	µg/L	**30.0**	BDL	BDL	BDL
XIV.	p,p DDD	µg/L		BDL	BDL	BDL
XV.	o,p DDD	µg/L		BDL	BDL	BDL
XVI.	Alpha Endosulfan	µg/L	**10.0**	BDL	BDL	BDL
XVII.	Beta Endosulfan	µg/L		BDL	BDL	BDL

Location				**Gadkari KHN**	**HPCL**	**RCF**
Date of Sampling				**31.12.2018**	**31.12.2018**	**02.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
XVIII.	Endosulfan Sulphate	µg/L	**5.0**	BDL	BDL	BDL
XIX.	Y HCH (Lindane)	µg/L	**1.0**	BDL	BDL	BDL
28.	Polynuclear aromatic hydrocarbons (as PAH)	mg/L	**0.2**	BDL	BDL	BDL
29.	Polychlorinated Biphenyls (PCB)	mg/L	**2.0**	BDL	BDL	BDL
30.	Zinc (as Zn)	mg/L	**5.0**	BDL	BDL	BDL
31.	Nickel (as Ni)	mg/L	**3.0**	BDL	BDL	BDL
32.	Copper (as Cu)	mg/L	**3.0**	BDL	BDL	BDL
33.	Hexavalent Chromium (as Cr^{6+})	mg/L	**0.1**	BDL	BDL	BDL
34.	Total Chromium (as Cr)	mg/L	**2.0**	BDL	BDL	0.335
35.	Total Arsenic (as As)	mg/L	**0.2**	BDL	BDL	BDL
36.	Lead (as Pb)	mg/L	**0.1**	BDL	0.04	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**	0.034	0.043	0.261
40.	Iron (as Fe)	mg/L	**3.0**	0.061	0.313	1.12
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		BDL	2.74	0.106

Location				**Gadkari KHN**	**HPCL**	**RCF**
Date of Sampling				**31.12.2018**	**31.12.2018**	**02.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
44.	Bioassay Test on fish	% survival	**90% survival of fish after 96 hours in 100% effluent**	100	70	90

Table No. II

Location				**Malgaon Dock Material Gate**	**Freeway Mysore colony outside nala**	**BPCL**
Date of Sampling				**02.01.2019**	**02.01.2019**	**01.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
1.	Colour	Hazen		1	1	1
2.	Smell	-	**Agreeable**	Disagreeable	Agreeable	Agreeable
3.	pH	-	**5.5 -9.0**	7.22	7.16	7.19
4.	Oil & Grease	mg/L	**10.0**	BDL	BDL	BDL
5.	Suspended Solids	mg/L	**100.0**	62	72	6
6.	Dissolved Oxygen (% Saturation)	%		5	32	28
7.	Chemical Oxygen Demand	mg/L	**250.0**	188	36	37
8.	Biochemical Oxygen Demand (3 days, 27^{o}C)	mg/L	**30.0**	63	12	12

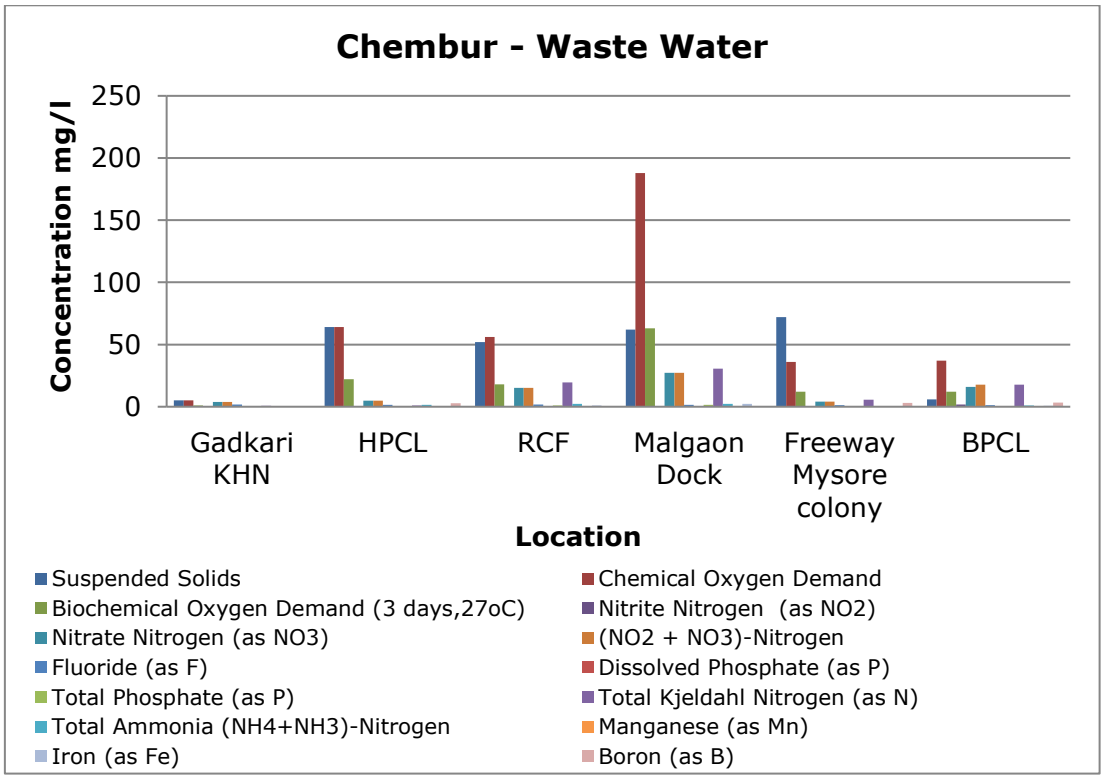
Location				**Malgaon Dock Material Gate**	**Freeway Mysore colony outside nala**	**BPCL**
Date of Sampling				**02.01.2019**	**02.01.2019**	**01.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
9.	Electrical Conductivity (at 25°C)	µmhos/ cm		922	26600	26600
10.	Nitrite Nitrogen (as NO_2)	mg/L		BDL	0.06	1.74
11.	Nitrate Nitrogen (as NO_3)	mg/L	**10.0**	27.3	3.97	16
12.	(NO_2+ NO_3)-Nitrogen	mg/L		27.3	4.03	17.7
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**	1.54	1.33	1.20
17.	Sulphide (as S^{2-})	mg/L	**2.0**	BDL	BDL	BDL
18.	Dissolved Phosphate (as P)	mg/L	**5.0**	0.4	0.12	BDL
19.	Sodium Absorption Ratio			0.52	BDL	BDL
20.	Total Coliforms	MPN index /100 mL	**100.0**	350	79	<1.8
21.	Faecal Coliforms	MPN index/ 100 mL	**1000.0**	94	14	<1.8
22.	Total Phosphate (as P)	mg/L		1.4	0.2	BDL
23.	Total Kjeldahl Nitrogen	mg/L	**100.0**	30.5	5.6	17.8

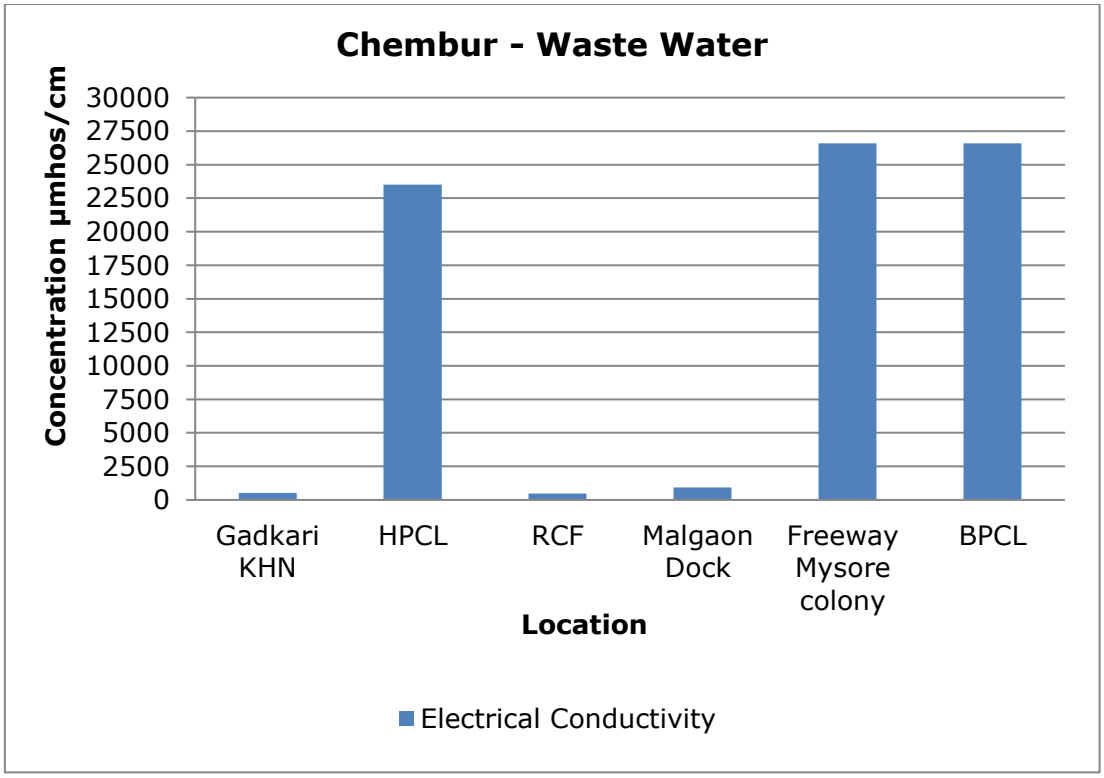
Location				**Malgaon Dock Material Gate**	**Freeway Mysore colony outside nala**	**BPCL**
Date of Sampling				**02.01.2019**	**02.01.2019**	**01.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
24.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**50**	2.3	0.2	1
25.	Phenols (as C_6H_5OH)	mg/L	**1.0**	BDL	BDL	BDL
26.	Surface Active Agents (as MBAS)	mg/L		BDL	BDL	BDL
27.	Organo Chlorine Pesticides					
I.	Alachlor	µg/L	**2.0**	BDL	BDL	BDL
II.	Atrazine	µg/L	**0.2**	BDL	BDL	BDL
III.	Aldrin	µg/L	**0.1**	BDL	BDL	BDL
IV.	Dieldrin	µg/L	**2.0**	BDL	BDL	BDL
V.	Alpha HCH	µg/L	**0.01**	BDL	BDL	BDL
VI.	Beta HCH	µg/L	**2.0**	BDL	BDL	BDL
VII.	Chlorpyriphos	µg/L	**3.0**	BDL	BDL	BDL
VIII.	Butachlor	µg/L		BDL	BDL	BDL
IX.	Delta HCH	µg/L	**0.2**	BDL	BDL	BDL
X.	p,p DDT	µg/L	**0.05**	BDL	BDL	BDL
XI.	o,p DDT	µg/L	**100.0**	BDL	BDL	BDL
XII.	p,p DDE	µg/L	**250.0**	BDL	BDL	BDL
XIII.	o,p DDE	µg/L	**30.0**	BDL	BDL	BDL
XIV.	p,p DDD	µg/L		BDL	BDL	BDL
XV.	o,p DDD	µg/L		BDL	BDL	BDL

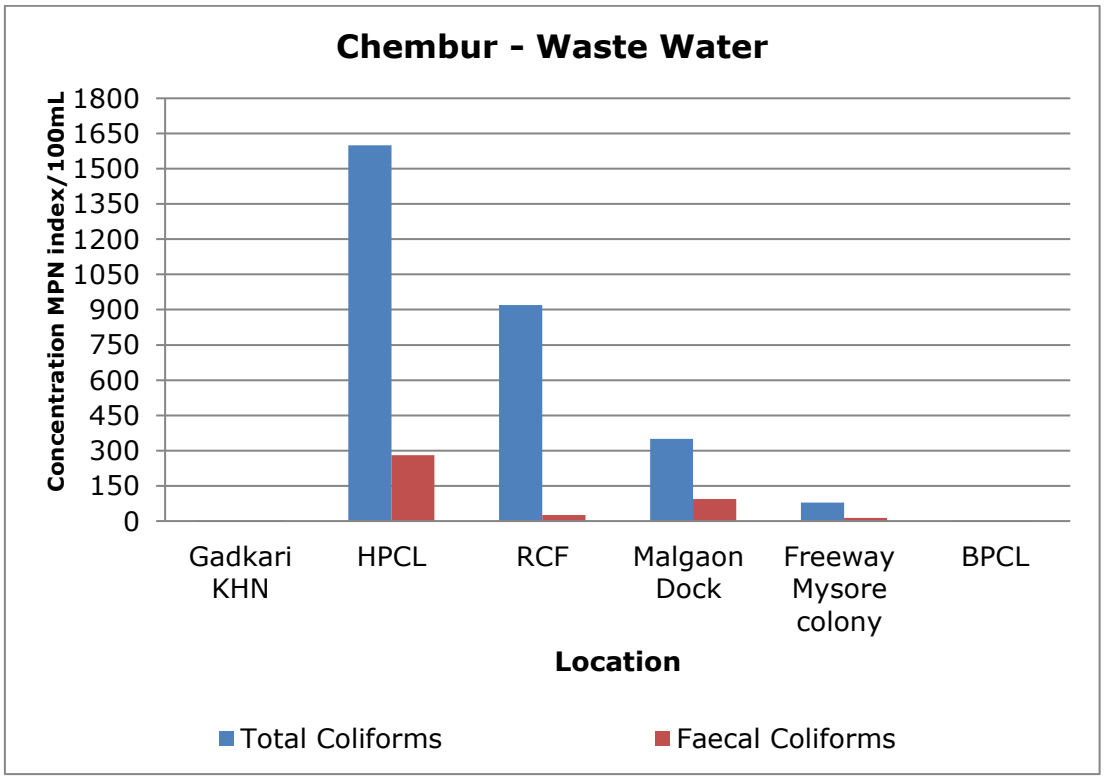
Location				**Malgaon Dock Material Gate**	**Freeway Mysore colony outside nala**	**BPCL**
Date of Sampling				**02.01.2019**	**02.01.2019**	**01.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
XVI.	Alpha Endosulfan	µg/L	**10.0**	BDL	BDL	BDL
XVII.	Beta Endosulfan	µg/L		BDL	BDL	BDL
XVIII.	Endosulfan Sulphate	µg/L	**5.0**	BDL	BDL	BDL
XIX.	Y HCH (Lindane)	µg/L	**1.0**	BDL	BDL	BDL
28.	Polynuclear aromatic hydrocarbons (as PAH)	mg/L	**0.2**	BDL	BDL	BDL
29.	Polychlorinated Biphenyls (PCB)	mg/L	**2.0**	BDL	BDL	BDL
30.	Zinc (as Zn)	mg/L	**5.0**	0.101	0.109	BDL
31.	Nickel (as Ni)	mg/L	**3.0**	BDL	BDL	BDL
32.	Copper (as Cu)	mg/L	**3.0**	BDL	BDL	BDL
33.	Hexavalent Chromium (as Cr^{6+})	mg/L	**0.1**	BDL	BDL	BDL
34.	Total Chromium (as Cr)	mg/L	**2.0**	0.034	BDL	BDL
35.	Total Arsenic (as As)	mg/L	**0.2**	BDL	BDL	BDL
36.	Lead (as Pb)	mg/L	**0.1**	0.013	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**	0.217	0.082	0.22
40.	Iron (as Fe)	mg/L	**3.0**	2.17	0.396	0.735

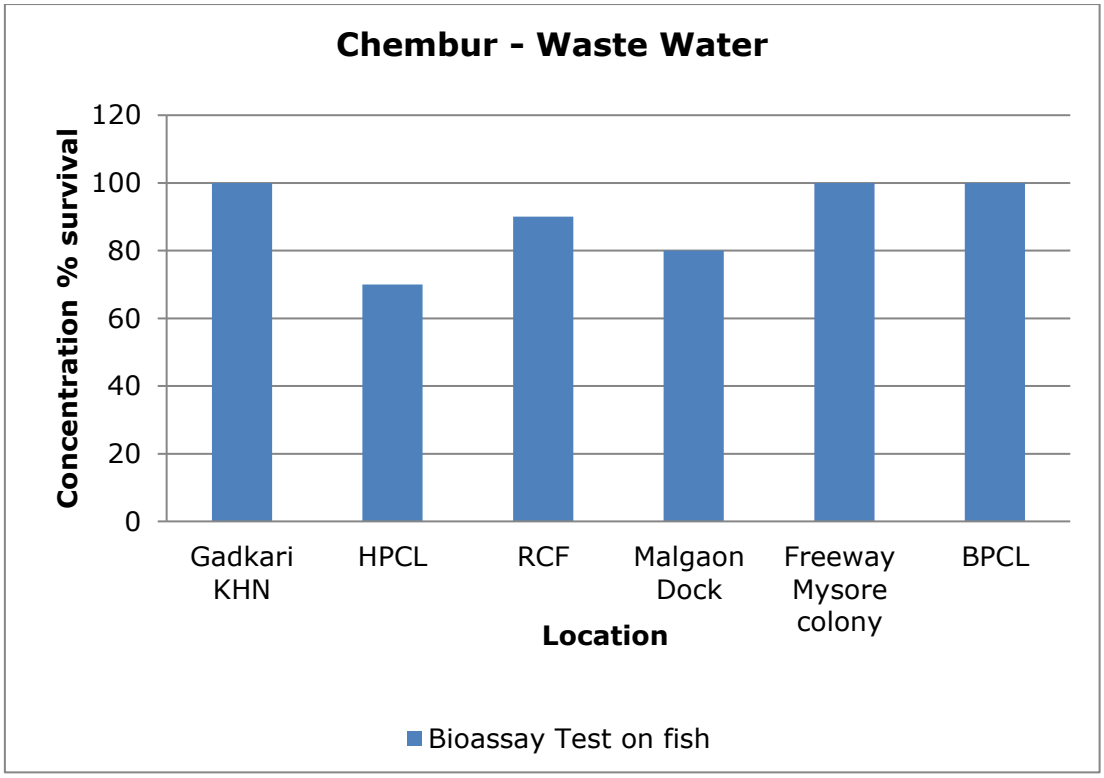
Location				Malgaon Dock Material Gate	Freeway Mysore colony outside nala	BPCL
Date of Sampling				02.01.2019	02.01.2019	01.01.2019
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
41.	Vanadium (as V)	mg/L	**0.2**	BDL	BDL	BDL
42.	Selenium (as Se)	mg/L	**0.05**	BDL	BDL	BDL
43.	Boron (as B)	mg/L		BDL	3.18	3.22
44.	Bioassay Test on fish	% survival	**90% survival of fish after 96 hours in 100% effluent**	80	100	100

Graphs: Water/ Waste Water Quality Monitoring for Chembur:




Chembur - Waste Water
Concentration µmhos/cm
30000
27500
25000
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
Gadkari KHN
HPCL
RCF
Malgaon Dock
Freeway Mysore colony
BPCL
Location
Electrical Conductivity


Chembur - Waste Water
Concentration MPN index/100mL
1800
1650
1500
1350
1200
1050
900
750
600
450
300
150
0
Gadkari KHN
HPCL
RCF
Malgaon Dock
Freeway Mysore colony
BPCL
Location
Total Coliforms
Faecal Coliforms



3.4 Ground Water Quality:

Sr.	Location	Source	Table No.
1.	Sealord Containers Ltd.	Near Raw Water Tank	**I**
2.	HPCL Guest House	Drinking Water	**I**
3.	RCF	Bore well water	**II**
4.	HPCL	Bore well water	**II**

Table No. I

Location				**Sealord Containers Ltd.**	**HPCL Guest House**
Date of Sampling				**30.12.2018**	**31.12.2018**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**	
1.	Colour	Hazen	**5**	1	1
2.	Smell	-	**Agreeable**	Agreeable	Agreeable
3.	pH	-	**6.5-8.5**	7.13	7.54

Location				**Sealord Containers Ltd.**	**HPCL Guest House**
Date of Sampling				**30.12.2018**	**31.12.2018**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**	
4.	Oil & Grease	mg/L		BDL	BDL
5.	Suspended Solids	mg/L	**100**	BDL	5
6.	Dissolved Oxygen (%Saturation)	%		65	100
7.	Chemical Oxygen Demand	mg/L	**10 (WHO, 1993)**	BDL	BDL
8.	Biochemical Oxygen Demand (3 days, 27° C)	mg/L	**6 (WHO, 1993)**	BDL	BDL
9.	Electrical Conductivity (at 25° C)	µmho/cm		954	230
10.	Nitrite Nitrogen (as NO_2)	mg/L		0.02	BDL
11.	Nitrate Nitrogen (as NO_3)	mg/L	**45**	5.39	0.95
12.	(NO_2 + NO_3)-Nitrogen	mg/L		5.41	0.95
13.	Free Ammonia (as NH_3-N)	mg/L	**0.5**	BDL	BDL
14.	Total Residual Chlorine	mg/L	**0.2**	BDL	BDL
15.	Cyanide (as CN)	mg/L	**0.05**	BDL	BDL
16.	Fluoride (as F)	mg/L	**1.0**	0.2	0.24
17.	Sulphide (as S^{2-})	mg/L	**0.05**	BDL	BDL
18.	Dissolved Phosphate (as P)	mg/L		BDL	BDL
19.	Sodium Absorption Ratio	mg/L		0.4	BDL
20.	Total Coliforms	MPN index/ 100 ml		1600	BDL

Location				**Sealord Containers Ltd.**	**HPCL Guest House**
Date of Sampling				**30.12.2018**	**31.12.2018**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**	
21.	Faecal Coliforms	MPN index/ 100 ml		47	BDL
22.	Total Phosphorous (as P)	mg/L		BDL	BDL
23.	Total Kjeldahl Nitrogen	mg/L		BDL	12.3
24.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**0.5**	BDL	BDL
25.	Phenols (as C_6H_5OH)	mg/L	**0.001**	BDL	BDL
26.	Surface Active Agents (as MBAS)	mg/L		BDL	BDL
27.	Organo Chlorine Pesticides				
I.	Alachlor	µg/L	**20.0**	BDL	BDL
II.	Atrazine	µg/L	**2.0**	BDL	BDL
III.	Aldrin	µg/L	**0.03**	BDL	BDL
IV.	Dieldrin	µg/L	**0.03**	BDL	BDL
V.	Alpha HCH	µg/L	**0.01**	BDL	BDL
VI.	Beta HCH	µg/L	**0.04**	BDL	BDL
VII.	Delta HCH	µg/L	**0.04**	BDL	BDL
VIII.	Chlorpyriphos	µg/L	**30.0**	BDL	BDL
IX.	Butachlor	µg/L	**125.0**	BDL	BDL
X.	p,p DDT	µg/L	**1.0**	BDL	BDL
XI.	o,p DDT	µg/L	**1.0**	BDL	BDL
XII.	p,p DDE	µg/L	**1.0**	BDL	BDL
XIII.	o,p DDE	µg/L	**1.0**	BDL	BDL
XIV.	p,p DDD	µg/L	**1.0**	BDL	BDL

Location				**Sealord Containers Ltd.**	**HPCL Guest House**
Date of Sampling				**30.12.2018**	**31.12.2018**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**	
XV.	o,p DDD	µg/L	**1.0**	BDL	BDL
XVI.	Alpha Endosulfan	µg/L	**0.4**	BDL	BDL
XVII.	Beta Endosulfan	µg/L	**0.4**	BDL	BDL
XVIII.	Endosulfan Sulphate	µg/L	**0.4**	BDL	BDL
XIX.	Y HCH (Lindane)	µg/L	**2.0**	BDL	BDL
28.	Polynuclear aromatic hydrocarbons (as PAH)	mg/L	**0.0001**	BDL	BDL
29.	Polychlorinated Biphenyls (PCB)	mg/L	**0.0005**	BDL	BDL
30.	Zinc (as Zn)	mg/L	**5.0**	BDL	0.146
31.	Nickel (as Ni)	mg/L	**0.02**	BDL	BDL
32.	Copper (as Cu)	mg/L	**0.05**	BDL	BDL
33.	Hexavalent Chromium (as Cr^{6+})	mg/L		BDL	BDL
34.	Total Chromium (as Cr)	mg/L	**0.05**	BDL	BDL
35.	Total Arsenic (as As)	mg/L	**0.01**	BDL	BDL
36.	Lead (as Pb)	mg/L	**0.01**	BDL	BDL
37.	Cadmium (as Cd)	mg/L	**0.003**	BDL	BDL
38.	Mercury (as Hg)	mg/L	**0.001**	BDL	BDL
39.	Manganese(as Mn)	mg/L	**0.1**	BDL	BDL
40.	Iron (as Fe)	mg/L	**0.3**	0.200	0.578
41.	Vanadium (as V)	mg/L		BDL	BDL
42.	Selenium (as Se)	mg/L	**0.01**	BDL	BDL
43.	Boron (as B)	mg/L	**0.5**	BDL	BDL

Location				**Sealord Containers Ltd.**	**HPCL Guest House**
Date of Sampling				**30.12.2018**	**31.12.2018**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**	
44.	Bioassay Test on fish	% survival		80	100

Table No. II

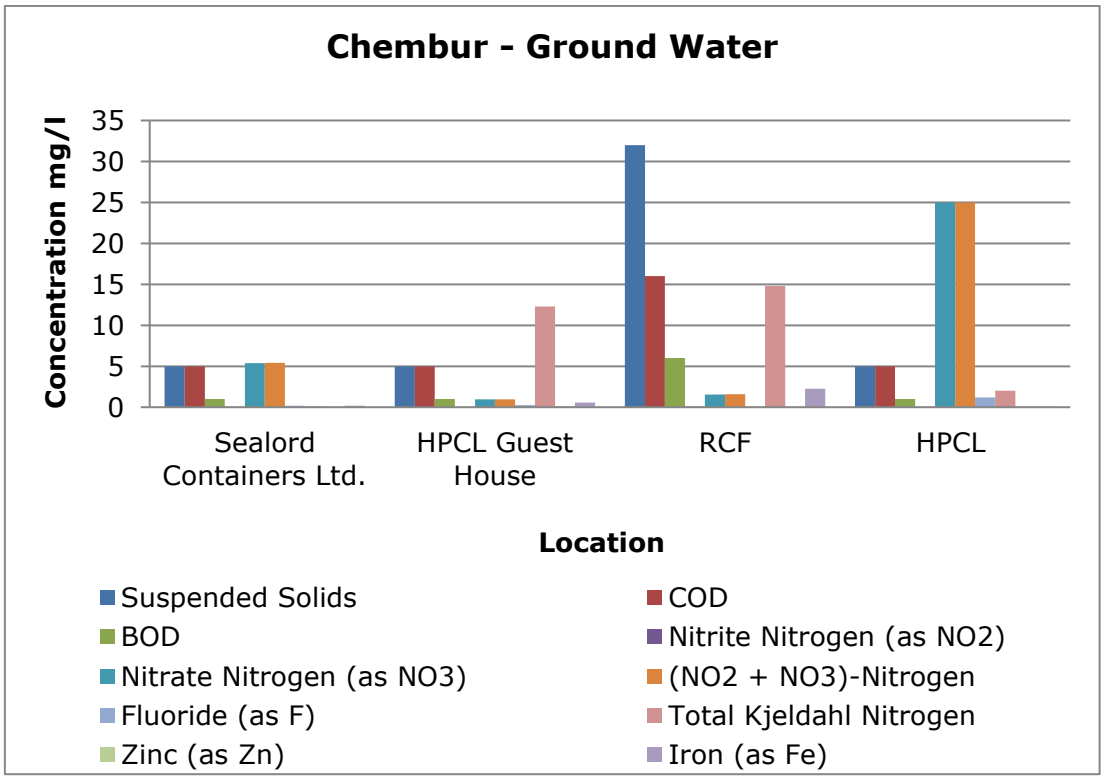
Location				**RCF**	**HPCL**
Date of Sampling				**02.01.2019**	**02.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**	
1.	Colour	Hazen	**5**	1	1
2.	Smell	-	**Agreeable**	Agreeable	Agreeable
3.	pH	-	**6.5-8.5**	7	7.85
4.	Oil & Grease	mg/L		BDL	BDL
5.	Suspended Solids	mg/L	**100**	32	5
6.	Dissolved Oxygen (%Saturation)	%		30	63
7.	Chemical Oxygen Demand	mg/L	**10 (WHO, 1993)**	16	BDL
8.	Biochemical Oxygen Demand (3 days, 27° C)	mg/L	**6 (WHO, 1993)**	6	BDL
9.	Electrical Conductivity (at 25° C)	µmho/cm		378	556
10.	Nitrite Nitrogen (as NO_2)	mg/L		0.06	BDL
11.	Nitrate Nitrogen (as NO_3)	mg/L	**45**	1.53	25
12.	(NO_2 + NO_3)-Nitrogen	mg/L		1.59	25
13.	Free Ammonia (as NH_3-N)	mg/L	**0.5**	BDL	BDL

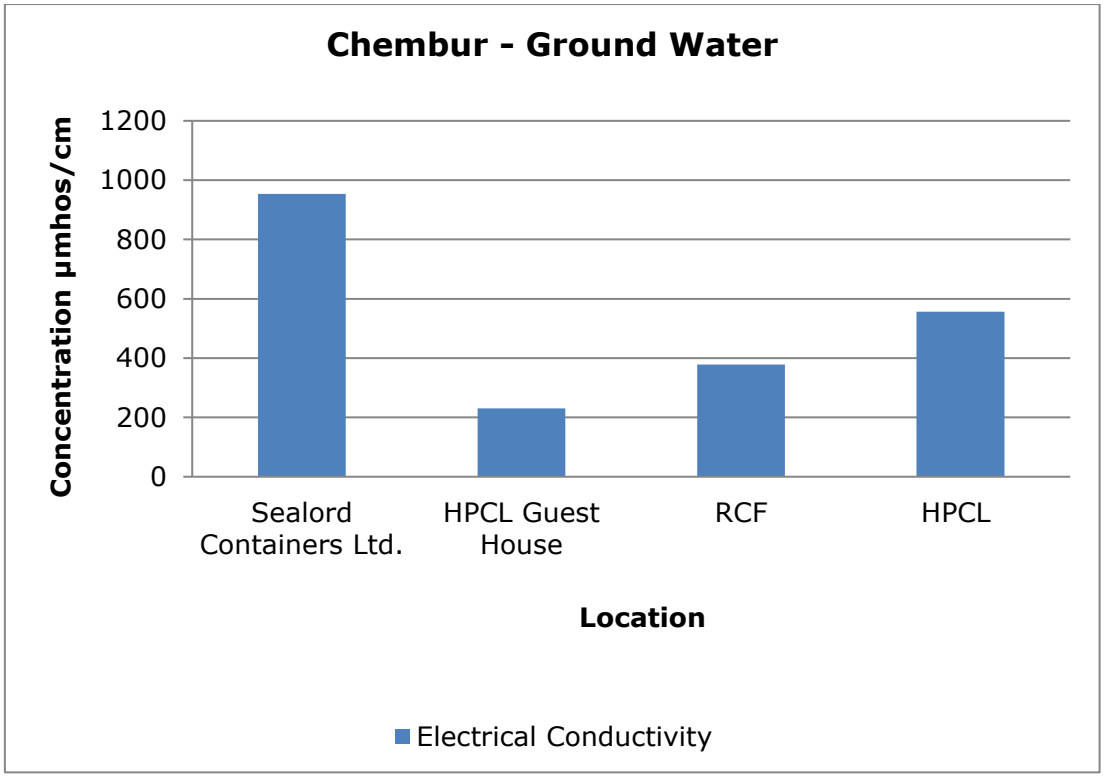
Location				**RCF**	**HPCL**
Date of Sampling				**02.01.2019**	**02.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**	
14.	Total Residual Chlorine	mg/L	**0.2**	BDL	BDL
15.	Cyanide (as CN)	mg/L	**0.05**	BDL	BDL
16.	Fluoride (as F)	mg/L	**1.0**	BDL	1.20
17.	Sulphide (as S^{2-})	mg/L	**0.05**	BDL	BDL
18.	Dissolved Phosphate (as P)	mg/L		0.2	BDL
19.	Sodium Absorption Ratio	mg/L		0.38	0.36
20.	Total Coliforms	MPN index/ 100 ml		280	130
21.	Faecal Coliforms	MPN index/ 100 ml		37	24
22.	Total Phosphorous (as P)	mg/L		0.4	BDL
23.	Total Kjeldahl Nitrogen	mg/L		14.8	2.02
24.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**0.5**	2.2	BDL
25.	Phenols (as C_6H_5OH)	mg/L	**0.001**	BDL	BDL
26.	Surface Active Agents (as MBAS)	mg/L		BDL	BDL
27.	Organo Chlorine Pesticides				
I.	Alachlor	µg/L	**20.0**	BDL	BDL
II.	Atrazine	µg/L	**2.0**	BDL	BDL
III.	Aldrin	µg/L	**0.03**	BDL	BDL
IV.	Dieldrin	µg/L	**0.03**	BDL	BDL
V.	Alpha HCH	µg/L	**0.01**	BDL	BDL
VI.	Beta HCH	µg/L	**0.04**	BDL	BDL

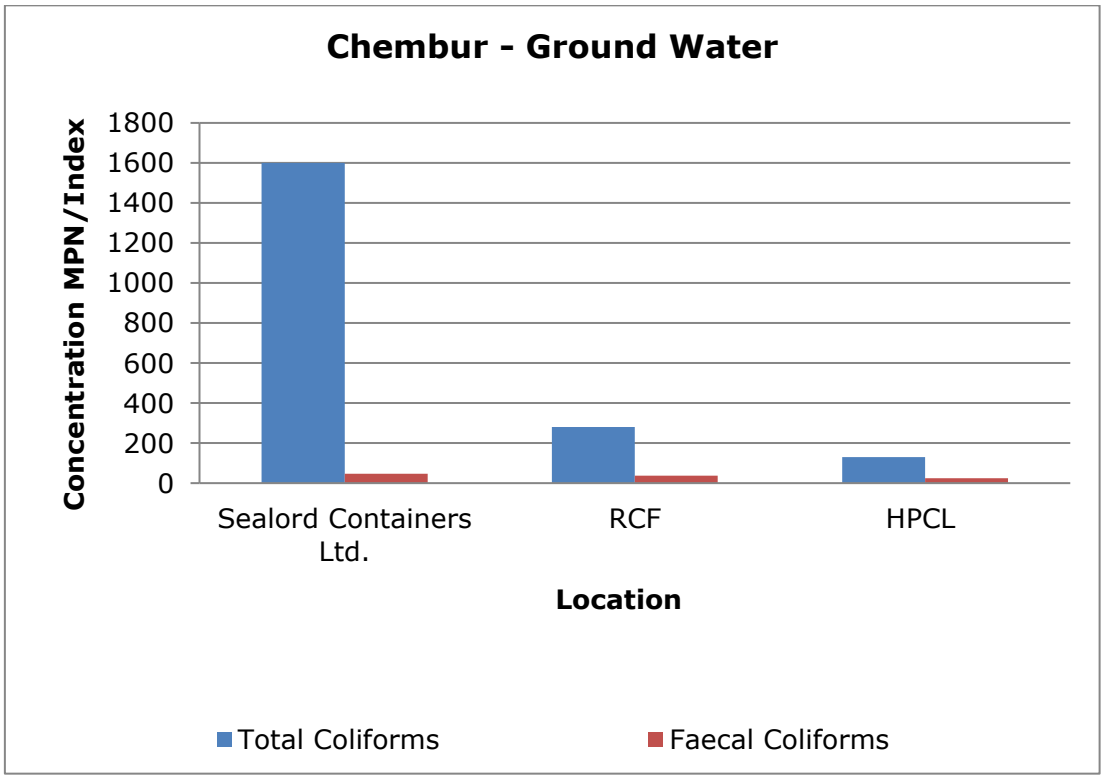
Location				**RCF**	**HPCL**
Date of Sampling				**02.01.2019**	**02.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**	
VII.	Delta HCH	µg/L	**0.04**	BDL	BDL
VIII.	Chlorpyriphos	µg/L	**30.0**	BDL	BDL
IX.	Butachlor	µg/L	**125.0**	BDL	BDL
X.	p,p DDT	µg/L	**1.0**	BDL	BDL
XI.	o,p DDT	µg/L	**1.0**	BDL	BDL
XII.	p,p DDE	µg/L	**1.0**	BDL	BDL
XIII.	o,p DDE	µg/L	**1.0**	BDL	BDL
XIV.	p,p DDD	µg/L	**1.0**	BDL	BDL
XV.	o,p DDD	µg/L	**1.0**	BDL	BDL
XVI.	Alpha Endosulfan	µg/L	**0.4**	BDL	BDL
XVII.	Beta Endosulfan	µg/L	**0.4**	BDL	BDL
XVIII.	Endosulfan Sulphate	µg/L	**0.4**	BDL	BDL
XIX.	Y HCH (Lindane)	µg/L	**2.0**	BDL	BDL
28.	Polynuclear aromatic hydrocarbons (as PAH)	mg/L	**0.0001**	BDL	BDL
29.	Polychlorinated Biphenyls (PCB)	mg/L	**0.0005**	BDL	BDL
30.	Zinc (as Zn)	mg/L	**5.0**	BDL	0.113
31.	Nickel (as Ni)	mg/L	**0.02**	BDL	BDL
32.	Copper (as Cu)	mg/L	**0.05**	BDL	BDL
33.	Hexavalent Chromium (as Cr^{6+})	mg/L		BDL	BDL
34.	Total Chromium (as Cr)	mg/L	**0.05**	0.030	BDL
35.	Total Arsenic (as As)	mg/L	**0.01**	BDL	BDL
36.	Lead (as Pb)	mg/L	**0.01**	BDL	BDL
37.	Cadmium (as Cd)	mg/L	**0.003**	BDL	BDL

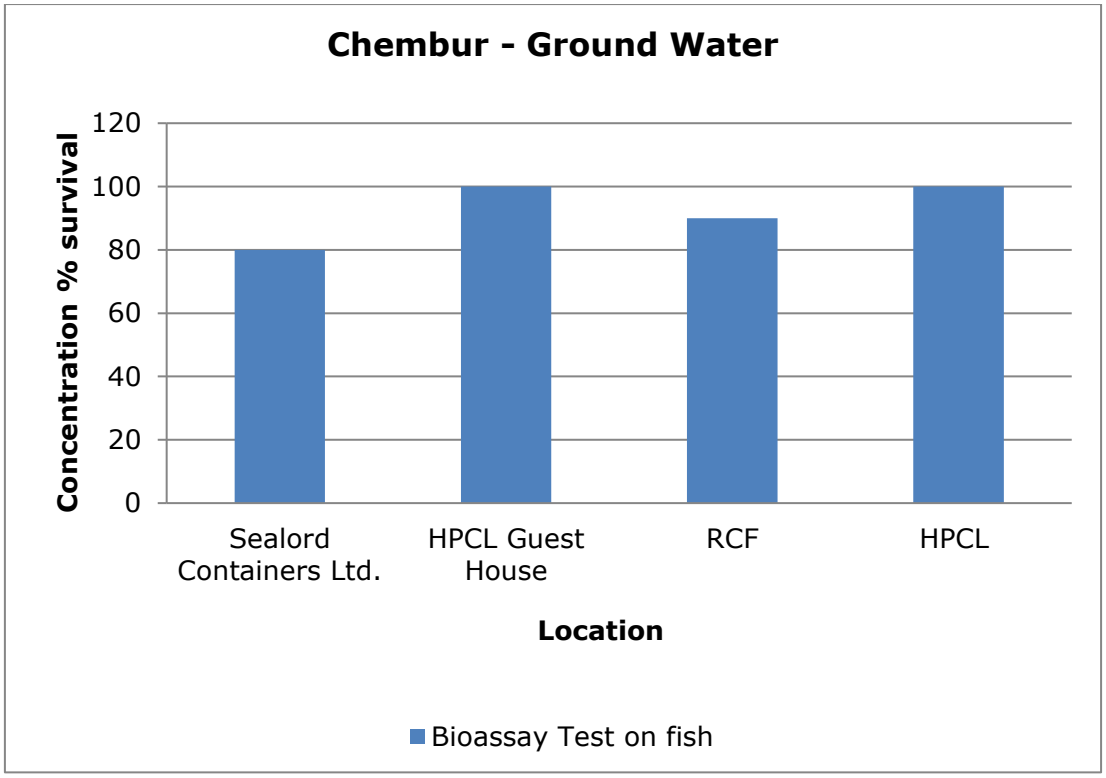
Location				**RCF**	**HPCL**
Date of Sampling				**02.01.2019**	**02.01.2019**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**	
38.	Mercury (as Hg)	mg/L	**0.001**	BDL	BDL
39.	Manganese(as Mn)	mg/L	**0.1**	0.355	BDL
40.	Iron (as Fe)	mg/L	**0.3**	2.26	BDL
41.	Vanadium (as V)	mg/L		BDL	BDL
42.	Selenium (as Se)	mg/L	**0.01**	BDL	BDL
43.	Boron (as B)	mg/L	**0.5**	BDL	BDL
44.	Bioassay Test on fish	% survival		90	100

Graphs: Ground Water Quality Monitoring for Chembur:




Chembur - Ground Water
Concentration µmhos/cm
1200
1000
800
600
400
200
0
Sealord Containers Ltd.
HPCL Guest House
RCF
HPCL
Location
Electrical Conductivity


Chembur - Ground Water
Concentration MPN/Index
1800
1600
1400
1200
1000
800
600
400
200
0
Sealord Containers Ltd.
RCF
HPCL
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:

Six industries from Chembur were selected for Stack emission monitoring.

1. **Particulate matter (PM):** Particulate matter was detected only at Tata power Unit No. 5 stack and was well within the limits prescribed by MPCB.
2. **Sulphur dioxide (SO_2):** The Sulphur dioxide was well within the limits at all locations monitored.
3. **Nitrogen dioxide (NO_2):** The Nitrogen dioxide also was well within the limits at all locations monitored.

4.2 Ambient Air Quality Monitoring:

Eight ambient air samples were collected from Chembur region. The parameters monitored were studied as per the NAAQ standards. The variations of each parameter within the area under study are discussed below:

1. **Sulphur dioxide (SO_2):** Out of the eight locations monitored SO_2 was detected at 6 locations only and the concentration was well within the limts at all locations.
2. **Nitrogen dioxide (NO_2):** Values of nitrogen dioxide are observed well within the standard limit of 80 $\mu g/m^3$ at 6 locations monitored and at Indian Navy and Chearesh Society locations the results was observed bellow the detectable limit.
3. **Particulate Matter (PM_{10}):** 5 sampled locations in Chembur region showed higher level of PM_{10} concentration than the standard limit of NAAQS. The level of PM_{10} was

higher at Aegis Logistic Ltd., Sealord Containers Ltd., RCF, HPCL and BPCL with 278 µg/m^3, 217 µg/m^3, 224 µg/m^3, 483 µg/m^3 and 254 µg/m^3 respectively.

4. **Particulate Matter ($PM_{2.5}$):** 3 sampled locations in Chembur region showed higher level of $PM_{2.5}$ concentration than the standard limit of NAAQS. The level of $PM_{2.5}$ was higher at Aegis Logistic Ltd., HPCL and BPCL with 65 µg/m^3, 118 µg/m^3 and 66 µg/m^3 respectively.
5. .**Ozone (O_3):** Ozone was found to be below detectable limit in all 8 locations monitored.
6. **Lead (Pb):** Lead also was found to be below detectable limit in all 8 locations monitored.
7. **Carbon Monoxide (CO):** 3 sampled locations in Chembur region showed higher level of CO concentration than the standard limit of NAAQS. The level of CO was higher at RCF, BPCL and Tata Power with 6.27 µg/m^3, 10 µg/m^3 and 5.09 µg/m^3 respectively.
8. .**Ammonia (NH_3):** Ammonia was below the detectable limit at all 8 locations monitored.
9. **Benzene (C_6H_6):** Out of 8 locations monitored, 2 locations have benzene concentration higher than 5 µg/m^3 which is the standard limit as per NAAQS. The level of C_6H_6 was higher at Sealord Containers Ltd and Tata Power with 9.26 µg/m^3 and 9.26 µg/m^3 respectively.
10. **Benzo(a)pyrene (BaP):** BaP was below detectable limit in all 8 locations monitored.
11. **Arsenic (As):** At all 8 locations monitored, the concentration of Arsenic was found well with the standard limit of 6 µg/m^3.
12. **Nickel (Ni):** Concentration of Nickel also At all 8 locations monitored was well within the standard limit of 20 µg/m^3.

4.3 Waste Water Quality Monitoring:

To understand the quality of waste water quality, surface water samples was collected from 6 surface water source of Chembur. Considering the general parameters, following are the conclusions:

1. **Colour:** Colour units were 1 Hazen unit at all six surface water samples collected.
2. **Odour**: odour of all waste water samples collected is found agreeable except Malgaon Dock Material Gate surface water.
3. **pH**: it is observed in between 7 and 7.83 which is well within the range.
4. **Suspended Solids**: Suspended solids of all 6 water sample was below the detectable limit at all 6 surface water samples collected.
5. **Chemical Oxygen Demand**: All samples collected, were well within the limit required as per standard. The highest COD was observed at Malgaon Dock Material Gate with 188 mg/L concentration.
6. **Biochemical Oxygen Demand**: One out of the 6 surface water samples collected the concentration of BOD have exceeding only at Malgaon Dock Material Gate than the limit required as per standard of BOD.
7. **Sulphide:** 6 samples collected were found to have below detectable limit.
8. **Total Ammoia**: All 6 samples collected had concentration of Total ammonia well within the limits.

9. **Total Kjeldahl Nitrogen**: All 6 water samples collected had TKN concentration well, within the limit of 100 mg/L.
10. **Fish Bioassay**: 100% Survival was attained in 3 water samples collected for Bioassay test.
11. **Heavy metals**: All the heavy metals are found below the standard limits in all the samples.

4.4 Ground Water Quality Monitoring:

Four ground water samples were collected from Chembur region.

1. **Colour** (Hazen Units): Colour units are below the acceptable standard of all water samples collected.
2. **Odour**: odour of all the samples is found agreeable.
3. **Chemical Oxygen Demand:** The COD was detected only at bore well water of RCF near Shivaji Chowk with 16 mg/L out the 4 samples collected.
4. **Biological Oxygen Demand:** The BOD was also detected only at bore well water of RCF near Shivaji Chowk with 6 mg/L out the 4 samples collected.

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

1. **Nitrite**: Values of Nitrite at all location was well within the standard.
2. **Nitrate:** Results of Nitrate are also observed below standard limit (45mg/l).
3. **Total Residual Chlorine**: Values are below the detectable limit in all 4 samples collected.
4. **Total Ammonia**: Values are below the detectable limit in 3 samples collected. At bore well water sample at RCF near Shivaji Chowk, 2.2 mg/L total ammonia was observed.
5. **Fluoride:** Values are below the acceptable standards, below 1 mg/L.
6. **Sulphide:** All the results obtained at 4 samples collected, the concentration of Sulphide are below detectable limit.
7. **Sodium Absorption Ratio:** These values fit within range of water quality criteria of CPCB.
8. **Total Kjeldahl nitrogen:** Three water sample collected exceeded the standard limit of TKN and ranged in between 2.02 mg/L to 12.3 mg/L concentration.
9. **Fish Bioassay**: At Sealoard containers Ltd. raw water tank and bore well water sample at RCF near Shivaji Chowk had 80% and 90% survival of fishes. Remaining 2 locations 100% survival was observed.
10. **Boron:** Values are below the detectable limit at all 4 samples collected.
11. **Surface Active Agents:** All 4 samples showed below detectable limit.

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.

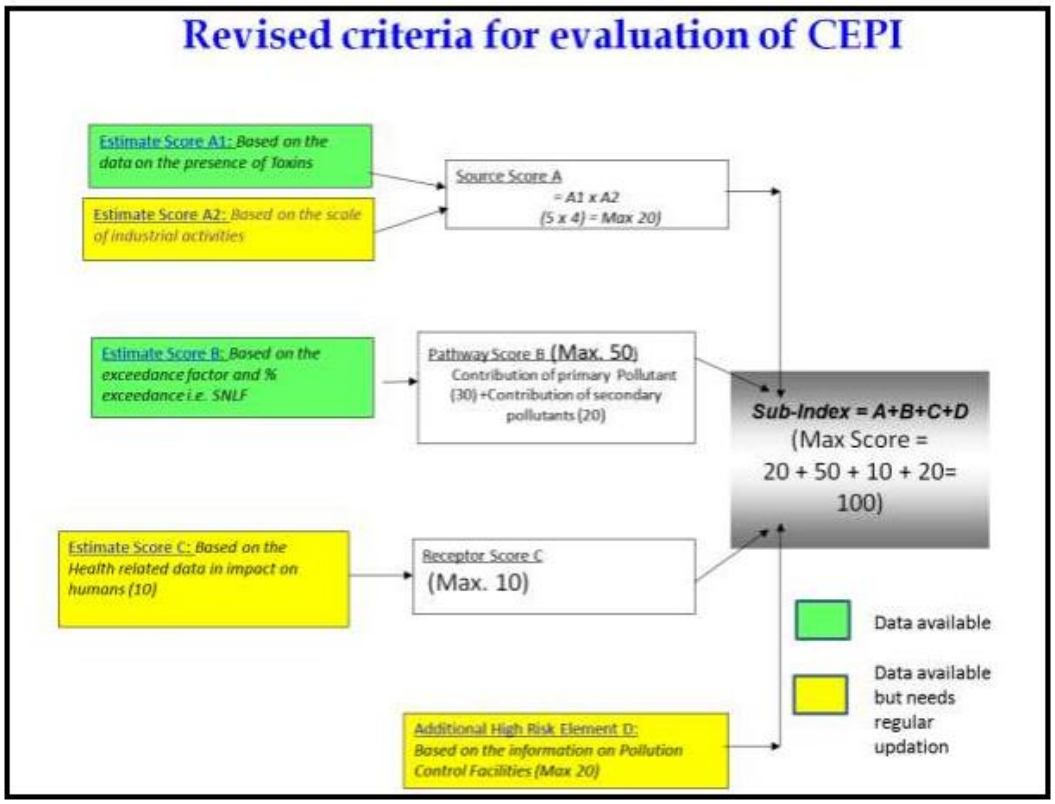
III. Health component was also retained in the revised concept in line with the suggestions of Secretary, MoEFCC during the meeting held in MoEF.

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.

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 February, 2019 prepared by MPCB, CEPI is calculated considering all these revised standards' limiting values, list of parameters and complete scope of monitoring.

5.1 Comparison of CEPI scores:

The result shows that CEPI score of present report is 42.28. The present study is the compilation of post monsoon season, which also regulates the score value. This time locations under study were different from past studies. Hence, comparative results cannot be illustrated and discussed. But the overall CEPI is observed as 42.28 in Chembur city, which falls below the category of severely polluted areas, according to the revised CEPI guidelines. Hence, it can be concluded that the industries are following environmental rules and regulations laid by MoEF and MPCB to control the pollution and to keep the environment clean and green.

Detailed and Aggregated CEPI score of present report is being compared with the previous year's studies in the tables given below:

Air

	A1	**A2**	**A**	**B1**	**B2**	**B3**	**B**	**C1**	**C2**	**C3**	**C**	**D**	**CEPI**
CEPI score February 2019	2	4	8	-	-	-	17.5	-	-	-	0	10	**35.5**
CEPI score June 2018	4.1	2.84	11.6	-	-	-	9.8	-	-	-	5	10	**36**
CEPI score February 2018	3	4.4	13.2	-	-	-	10.6	-	-	-	5	10	**38.8**
CEPI score June 2017	3	3.3	9.9	-	-	-	9	-	-	-	5	10	**33.9**
CEPI score February 2017	3	5	15	5	0	0	5	5	5	0	25	10	**55**
CPCB Report 2009	5.75	5	28.75	6	0	0	6	5	3	0	15	10	**59.75**

Water:

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
CEPI score February 2019	1.25	4	5	-	-	-	9.75	-	-	-	0	10	**24.75**
CEPI score June 2018	2.4	4.2	10.08	-	-	-	14.8	-	-	-	5	10	**39.88**
CEPI score February 2018	2	2.6	5.2	-	-	-	7.1	-	-	-	10	10	**32.3**
CEPI score June 2017	2.6	4.1	10.6	-	-	-	8	-	-	-	10	10	**38.66**
CEPI score February 2017	2	3.8	7.6	5	0	3	8	5	3	0	15	10	**40.6**
CPCB Report 2009	3	5	15	7.75	1.5	1.5	10.75	5	2	5	15	10	**50.75**

Land:

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
CEPI score February 2019	1	4	4	-	-	-	28.5	-	-	-	0	10	**42.5**
CEPI score June 2018	2.5	1.7	4.25	-	-	-	11	-	-	-	5	10	**30.25**
CEPI score February 2018	2.3	1.4	3.22	-	-	-	8.5	-	-	-	10	10	**31.72**
CEPI score June 2017	3.8	3.1	6.2	-	-	-	9	-	-	-	10	10	**40.78**

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
CEPI score February 2017	3	4.3	12.9	5	3	3	11	4	2	3	11	10	**44.9**
CPCB Report 2009	3	5	15	3	1.5	1.5	6	5	2	5	15	10	**46.00**

Aggregated CEPI:

	Air Index	Water Index	Land Index	CEPI
CEPI score February 2019	35.5	24.75	42.5	**42.28**
CEPI score June 2018	36	39.88	30.25	**44.1**
CEPI score February 2018	38.8	32.3	31.72	**45.07**
CEPI score June 2017	33.9	38.66	34.2	**44.3**
CEPI score February 2017	55	40.6	44.9	**63.2**
CPCB Report 2009	59.75	50.75	46.00	**69.19**

6. Conclusion

Chembur has pollution problems and was ranked 46th in a list of the most polluted industrial clusters in India. After the implementation of short term and long term action by Maharashtra Pollution Control Board, there has been a tremendous decrease in the levels of pollution generated by various industries.

We have taken samples of 6 stacks from various industries around the region to carry out the study. It was observed that the results obtained were well within the limits prescribed to specific industry by the Pollution control board. The refinery plants, chemical industry and power plant which were monitored also have implemented Environmental protection measures as suggested by statutory bodies like CPCB and State PCBs and complied with standard limits and regulations.

Six ambient air samples were also collected in checking the ambient air quality of the region. PM_{10}, $PM_{2.5}$, Carbon Monoxide and Benzene were found to have exceeded the limit as per NAAQS in some locations monitored. Automobile exhaust accounts for the concentration of $PM_{2.5}$ and PM_{10} in the area. The Concentration of Benzene is also high due to the presence of refinery plant and Power plant.

The waste water samples were collected from the surface water in the region. Only the concentration of Nitrate Nitrogen and Total Coliform was found to be beyond the limit in

some of the samples identified. We can correct this by taking better measures in the treatment plant so that the outlet water is in the prescribed limit for disposal.

In the ground water samples collected, almost all parameter are found to well within the standard limit as per ISO 10500:2012 Drinking water specifications. The ground water collected is from Borewell and is not used for drinking purpose.

The overall pollution load in the region is reduced and continuous efforts have been inputted by the Regional pollution control board and state pollution control board in brining the pollution lesser.

	A1	**A2**	**A**	**B**	**C**	**D**	**CEPI**
Air Index	2	4	8	17.5	0	10	35.5
Water Index	1.25	4	5	9.75	0	10	24.75
Land Index	1	4	4	28.5	0	10	42.5
						Aggregated CEPI	**42.28**

7. Efforts taken for reduction in pollution

The regional office of Maharashtra pollution control board has taken various initiatives in reducing the CEPI Score of 69.19 of 2009 to 42.28 of February 2019. Below mentioned are some of the efforts:

- Regional office of MPCB has carried out strict inspection and surveillance of major industries & identifies non-complying units.
- Non Complied identified industries shall upgrade their APC & Shall ensure that the industries upgrade their APC failing which action to be initiated against industries.

Find below measures taken by major industries in the area as per the directions provided by MPCB:

1. **HPCL**
   - Provided 2 Nos. of ETP to treat trade effluent & floor wash and tank drains.
   - Mechanical (API) separators and Skim pond to handle cooling water discharge to sea.
   - Two train of Su CO-Boiler for FCCU off gases
   - Utilization of pipelines for transportation of products
   - Installed De-sulphurization facilities for HSD
   - Mechanical Oil Recovery & Bio-Remediation treatment of Oily Sludge
   - Green Fuel Emission Control Projects (including FGD for FCCU off gases)
2. **BPCL**
   - Two Sulphur recovery units.
   - Diesel Hydrodesulphurization facilities for production of low Sulphur diesel.
   - Provision of 3 Nos. high efficiency Boilers in place of old vintage boilers
   - Use of De-SOx additive in regenerator of FCCU
   - Installation of Benzene vapour recovery scheme at Trombay Dispatch Unit
   - Production of Euro III Grade products
   - Mechanical Oil Recovery & Bio-Remediation treatment of Oily Sludge
3. **Tata Power**
   - Industry has provided Electrostatic Precipitator & Flue Gas Desulphurization units at Unit No. 5 to control particulate emission & SO2 emission levels. They have provided ETP at DM Plant.
   - Installed FGD for Unit 5 and Unit 8
   - ESP for Unit 5 and unit 8
   - Low NOx Burner For unit no 7
   - Installed two STP (Sewage Treatment Plant)
   - Installed state of art, Screw unloader at coal yard for coal unloading.
   - Pipe Conveyer for coal movement for unit 5 and unit 8 to reduce the fugitive emission.
   - Using imported low ash low Sulphur coal for unit 5 and unit 8
   - Bioremediation of Oily sludge.
   - Installed CAAQMS station at two different locations

- Installed Aerators for reducing the condenser outlet temperature
- Cooling water system for reduction of temperature of discharge water
- 100% ash utilization
- Adequate green cover development in the plant area
- Brick making activity out of bottom ash

4. RCF

- Hot flare stack to eliminate the chances of ammonia emission to atmosphere.
- De-dusting system on the top of the Prilling Tower to reduces dust emission problem. Dust emission is 25-30 mg/Nm3
- Hydrolyser system for recovery of ammonia from waste water stream.
- Installation of New LP/Waste water vent gas scrubber for recovering ammonia from the LP/Waste water vent gases.
- Exporting of MP section Vent gases to Steam Generation Plant thus reducing fuel consumption in Steam Generation Plant.
- Installation of Fume scrubbers to for reaction section.
- Addition of urea solution to reactor to reduce NOx emission.
- Installation of Spray scrubbers & Ventury cyclones for control of Spherodizer dust.
- Dust cyclones, Bag filters for dust control.
- Adoption of granulation technology with high efficiency cyclone, ventury scrubbers and Tail Gas Scrubbers to reduce dust nuisance.
- Addition of urea solution to reactor to reduce NOx emission.
- Scrubbers, bag filters, cyclones provided as required.

5. Sea Lord Containers Ltd.

- M/s. Sea Lord Containers Ltd & M/s. Aegis Logistics Ltd are located in Mahul, Ambapada, Chembur area which handling chemicals & Petrochemicals in Tank Forms.
- MPC Board has received frequent complaints from residents of Village Mahul, regarding the smell nuisance and air pollution due to tankage and allied operations of M/s. Sea Lord Containers Ltd, & M/s. Aegis Logistics Ltd.
- The residents have filed an application no. 40 (WZ) of 2014 in National Green Tribunal, Western Zone Bench, Pune on the above issue principally alleging odour nuisance due to the tankages and allied operations of M/s. Sea Lord Containers Ltd.
- In order to address the issues raised in the proper perspective and in view of need for specialized expertise, Maharashtra Pollution Control Board constituted a Committee comprising experts in the field such as Petroleum and Explosive Safety Organization (PESO), Directorate of Industrial Safety and Health (DISH) and technical experts in the field to study the matter in-depth and give their recommendations on the issues being raised

8. Photographs

Ambient Air Monitoring at Tata Power
Ambient Air Monitoring at RCF

Ambient Air Monitoring at HPCL

Freeway Mysore colony nalah

Mazgaon dock nalah

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: Chembur, November 2010, MPCB
4) Final Document on Revised CEPI Version – 2016, CPCB No.B-29012/ ESS(CPA)/ 2015-16
5) Standard Methods for the Examination of Water and Waste Water, American Public Health Association, 22nd Edition, 2012.
6) IS 3025 (various parts)
7) www.mpcb.gov.in
8) www.cpcb.gov.in

10. Annexure

Annexure I Health related data in impact on humans

C: Receptor

Component C (Impact on Human Health) 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

ANNEXURE B

INFORMATION ON HEALTH STATISTICS IN PIA

1. Name of the Polluted Industrial Area (PIA): –
2. Name of the major health centre/ organization: SURANA SETHIA HOSPITAL & RC.
3. Name and designation of the contact person: DR. DIPEN DEOLE.
4. Address: SUMAN NAGAR, SION TROMBAY HIGHWAY, CHEMBUR.
5. Year of Establishment: 2007

Sl No.	Diseases	No. of patients reported for the years				
		2018-2017	2017-2016	2016-2015	2015-2014	2014-2013
	Air Borne Diseases					
1.	Asthma	82	95	92	73	
2.	Acute Respiratory Infection	62	93	93	97	
3.	Bronchitis	75	85	102	85	
4.	Cancer	21	18	10	10	
	Water Borne Diseases					
5.	Gastroenteritis	87	92	96	91	
6.	Diarrhea	73	102	93	85	
7.	Renal diseases	93	95	87	92	
8.	Cancer					

DISCARDED DATA

SURANA SETHIA HOSPITAL & RESEARCH CENTRE Chembur Mumbai - 71.

Signature of the Hospital Head/ Superintend

ANNEXURE B

INFORMATION ON HEALTH STATISTICS IN PIA

1. Name of the Polluted Industrial Area (PIA):
2. Name of the major health centre/ organisation: Sai Hospital
3. Name and designation of the contact person: Dr Abd sayyed
4. Address: Chemikon nagar Ambadi Pradeshan Chembur
5. Year of Establishment:

Sl. No.	Diseases	No. of patients reported for the years				
		2016-2017	2017-2018	2018-2019	2019-2014	2014-2013
	Air Borne Diseases	—	—	—	—	—
2.	Asthma	40	41	45	50	36
3.	Acute Respiratory Infection	—				
4.	Bronchitis	—				
5.	Cancer	35	28	20	19	15
	Water Borne Diseases	—				
6.	Gastroenteritis	15	20	18	12	14
7.	Diarrhoea	—	—	—		
8.	Renal diseases	—	—	—		
9.	Cancer	—	—	—		

Signature of the Hospital Head/ Superintendent

ANNEXURE B

INFORMATION ON HEALTH STATISTICS IN PIA

1. Name of the Polluted Industrial Area (PIA): Chembur
2. Name of the major health centre/ organization: Mangal Anand Hospital
3. Name and designation of the contact person: Dr. Mangal L. Parihar
4. Address: MANGAL ANAND HOSPITAL 48, Swastik Park, Chembur Mumbai – 400 071.
5. Year of Establishment: 8-6-1982

Sl No.	Diseases	No. of patients reported for the years				
		2018-2017	2017-2016	2016-2015	2015-2014	2014-2013
	Air Borne Diseases			1	–	3
1.	Asthma	2	5	1	2	2
2.	Acute Respiratory Infection	1	3	1	4	4
3.	Bronchitis	–	–	–	1	
4.	Cancer	–	–	–	–	–
	Water Borne Diseases	–	–	–	–	–
5.	Gastroenteritis	4	4	6	7	12
6.	Diarrhea	–	–	–	1	–
7.	Renal diseases		1	=	2	1
8.	Cancer					

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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 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	5.0 mg/Nm^3 0.02 kg/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	4.0 µg/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

Sr.	Parameters	Method References	Techniques	Detection Limit
11.	Arsenic (As)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 47	AAS Method	0.3 ng/m^3
12.	Nickel (Ni)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 47	AAS Method	3.0 ng/m^3

Annexure IV: Water/Wastewater Sampling and Analysis Methodology

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

Sr.	Parameters	Methods References	Techniques	Detection Limit
14.	Nitrate-Nitrogen	APHA,22nd Ed., 2012, 4500-NO_3, B-4-122	UV Spectrophotometer Screening Method	0.2 mg/L
15.	(NO_2 + NO_3)-Nitrogen	APHA, 22nd Ed., 2012, 4500-NO_2-B, 4-120 APHA, 22nd Ed., 2012, 4500-NO_3, B-4-122	Colorimetric Method V Spectrophotometer Screening Method	0.2 mg/L
16.	Free Ammonia	APHA, 22nd Ed., 2012, 4500 NH_3, F, 4 -115	Colorimetric Method	0.006 mg/L
17.	Total Residual Chlorine	IS 3025 (Part 26): 1986, Reaffirmed 2009, Ed. 2.1 (2004-02)	Iodometric Method	0.1 mg/L
18.	Cyanide (CN)	APHA, 22nd Ed., 2012,4500-CN, C & E, 4-41 & 4-43	Colorimetric Method	0.001 mg/L
19.	Fluoride (F)	APHA, 22nd Ed., 2012, 4500-F, D, 4-87	SPADNS Method	0.05 mg/L
20.	Sulphide (S^{2-})	APHA, 22nd Ed., 2012, 4500 –S^2, C-4-175, F-4-178	Iodometric Method	0.08 mg/L
21.	Dissolved Phosphate (P)	APHA,22nd Ed., 2012, 4500 P,E, 4-155	Ascorbic Acid Method	0.03 mg/L
22.	Sodium Absorption Ratio	IS11624: 1986, Reaffirmed 2006	By Calculation	0.3
23.	Total Phosphorous (P)	APHA,22nd Ed., 2012, 4500 P,E, 4-155	Ascorbic Acid Method	0.03 mg/L
24.	Total Kjeldahl Nitrogen	APHA, 22nd Ed., 2012, 4500 NH_3, B & C, 4 -110, 4-112	Titrimetric Method	0.1 mg/L
25.	Total Ammonia (NH_4 +NH_3)-Nitrogen	APHA, 22nd Ed., 2012, 4500 NH_3, F, 4 - 115	Colorimetric Method	0.001 mg/L
26.	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
27.	Surface Active Agents	APHA, 22nd Ed., 2012, 5540-B & C, 5-50	Methylene Blue Extraction Method	0.1 mg/L
28.	Organo Chlorine Pesticides	APHA, 22nd Ed., 2012, 6410B, 6-74	GC MS-MS Method	0.01 µg/L
29.	Polynuclear aromatic hydrocarbons (PAH)	APHA, 22nd Ed., 2012, 6410B, 6-74	GC MS-MS Method	0.01 µg/L
30.	Polychlorinated Biphenyls (PCB)	APHA, 22nd Ed., 2012, 6410B, 6-74	GC MS-MS Method	0.01 µg/L
31.	Zinc (Zn)	IS 3025 (Part 2): 2004	ICP Method	0.1 mg/L
32.	Nickel (Ni)	IS 3025 (Part 2): 2004	ICP Method	0.05 mg/L
33.	Copper (Cu)	IS 3025 (Part 2): 2004	ICP Method	0.03 mg/L
34.	Hexavalent Chromium (Cr^{6+})	APHA, 22ndEd., 2012, 3500-Cr, B, 3-69	Colorimetric Method	0.02 mg/L
35.	Total Chromium (Cr)	IS 3025 (Part 2): 2004	ICP Method	0.02 mg/L
36.	Total Arsenic (As)	IS 3025 (Part 2): 2004	ICP Method	0.005 mg/L
37.	Lead (Pb)	IS 3025 (Part 2): 2004	ICP Method	0.008 mg/L
38.	Cadmium (Cd)	IS 3025 (Part 2): 2004	ICP Method	0.002 mg/L
39.	Mercury (Hg)	IS 3025 (Part 2): 2004	ICP Method	0.0008 mg/L
40.	Manganese (Mn)	IS 3025 (Part 2): 2004	ICP Method	0.02 mg/L
41.	Iron (Fe)	IS 3025 (Part 2): 2004	ICP Method	0.06 mg/L
42.	Vanadium (V)	IS 3025 (Part 2): 2004	ICP Method	0.05 mg/L

Sr.	Parameters	Methods References	Techniques	Detection Limit
43.	Selenium (Se)	IS 3025 (Part 2): 2004	ICP Method	0.005 mg/L
44.	Boron (B)	IS 3025 (Part 2): 2004	ICP Method	0.1 mg/L
45.	Total Coliforms	APHA, 22nd Ed., 2012, 9221-B, 9-66	Multiple tube fermentation technique (MPN/100ml)	1.1 MPN/100ml
46.	Faecal Coliforms	APHA, 22nd Ed., 2012, 9221-E, 9-74	Multiple tube fermentation technique (MPN/100ml)	1.1 MPN/100ml
47.	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/m³	Annual *	50	20	– Improved West and Gaeke – Ultraviolet fluorescence
		24 hours **	80	80	
2	Nitrogen Dioxide (NO_2) µg/m³	Annual *	40	30	– Modified Jacob & Hochheiser (Na-Arsenite) – Chemilminescence
		24 hours **	80	80	
3	Particulate Matter (size less than 10 µm) or PM_{10} µg/m³	Annual *	60	60	– Gravimetric – TOEM – Beta attenuation
		24 hours **	100	100	
4	Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$ µg/m³	Annual *	40	40	– Gravimetric – TOEM – Beta attenuation
		24 hours **	60	60	
5	Ozone (O_3) µg/m³	8 hours **	100	100	– UV photometric – Chemiluminescence – Chemical Method
		1 hour **	180	180	
6	Lead (Pb) µg/m³	Annual *	0.50	0.50	– AAS/ICP method after sampling on EPM 2000 or equivalent filter paper – EDXRF using Teflon filter
		24 hours **	1.0	1.0	
7	Carbon Monoxide (CO) mg/m³	8 hours **	02	02	– Non Dispersive Infra Red (NDIR) spectroscopy
		1 hour **	04	04	
8	Ammonia (NH_3) µg/m³	Annual *	100	100	– Chemiluminescence – Indophenol blue method
		24 hours **	400	400	
9	Benzene (C_6H_6) µg/m³	Annual *	05	05	– Gas Chromatography based continuous analyzer – Adsorption and Desorption followed by GC analysis
10	Benzo (a) Pyrene (BaP) – particulate phase only, ng/m³	Annual *	01	01	– Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As) ng/m³	Annual *	06	06	– AAS/ICP method after sampling on EPM 2000 or equivalent filter paper.
12	Nickel (Ni) ng/m³	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/m³: micro-gram/m³ i.e. 10^{-6}gm/m³ ng/m³ : nano-gram/m³ i.e. 10^{-9}gm/m³

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	a) For process waste water - 100 b) 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			a. Floatable solids, Max 3 mm b. 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

Sr.	Parameter	Standards			
		Inland surface Water	**Public Sewers**	**Land for Irrigation**	**Marine Coastal Areas**
7.	Oil and Grease mg/L, Max	10	20	10	20
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/L, 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
34.	Phenolic compounds (as C_6H_5OH), mg/L, Max.	1.0	5.0	--	5.0

Sr.	Parameter	Standards			
		Inland surface Water	**Public Sewers**	**Land for Irrigation**	**Marine Coastal Areas**
35.	Radioactive materials:				
	a. Alpha emitters MC/ml., Max.	10^{-7}	10^{-7}	10^{-8}	10^{-7}
	b. 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
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

Sr.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
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 (as Cd)	mg/L	Max 0.003	No relaxation
32.	Cyanide (as CN)	mg/L	Max 0.05	No relaxation
33.	Lead (as Pb)	mg/L	Max 0.01	No relaxation
34.	Mercury (as Hg)	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
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

Sr.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
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
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

Sr.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
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			
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 ➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 6 mg/L or more, and ➢ Biochemical Oxygen Demand 2 mg/L or less
Outdoor bathing (organized)	B	➢ Total coliform organisms (MPN/100 ml) shall be 500 or less ➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 5 mg/L or more, and ➢ 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 ➢ pH between 6 and 9 ➢ Dissolved Oxygen 4 mg/L or more, and ➢ Biochemical Oxygen Demand 3 mg/L or less
Propagation of wildlife and fisheries	D	➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 4 mg/L or more, and ➢ Free ammonia (as N) 1.2 mg/L or less
Irrigation, industrial cooling, and controlled disposal	E	➢ pH between 6.0 and 8.5 ➢ Electrical conductivity less than 2250 micro mhos/cm, ➢ Sodium Absorption Ratio less than 26, ➢ 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, mg/l	<25	<50	<100

Sr.	Parameters	Requirement for Waters of Class		
		A Excellent	B-Desirable	C-Acceptable
(vii)	Fecal 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	<2 µg/l	<5 µg/l	<10 µg/l
(v)	Surface Active Agents	<20 µg/l	<100 µg/l	<200 µg/l
(vi)	Organo Chlorine Pesticides	<0.05 µg/l	<0.1 µg/l	<0.2 µg/l
(vii)	PAH	<0.05 µg/l	<0.1 µg/l	<0.2 µg/l
(viii)	PCB and PCT	<0.01 µg/l	<0.01 µg/l	<0.02 µg/l
(ix)	Zinc	<100 µg/l	<200 µg/l	<300 µg/l
(x)	Nickel	<50 µg/l	<100 µg/l	<200 µg/l
(xi)	Copper	<20 µg/l	<50 µg/l	<100 µg/l
(xii)	Chromium (Total)	<20 µg/l	<50 µg/l	<100 µg/l
(xiii)	Arsenic (Total)	<20 µg/l	<50 µg/l	<100 µg/l

Sr.	Parameters	Requirement for Waters of Class		
		A- Excellent	B-Desirable	C-Acceptable
(xiv)	Lead	<20 µg/l	<50 µg/l	<100 µg/l
(xv)	Cadmium	<1.0 µg/l	<2.5 µg/l	<5.0 µg/l
(xvi)	Mercury	<0.2 µg/l	<0.5 µg/l	<1.0 µg/l