# ❖ Highlights 2000


## WATER QUALITY

Water quality management demands the information with respect to the nature and extent of existing water quality. The Central Pollution Control Board has been monitoring quality of water bodies in collaboration with concerned State Pollution Control Boards at 507 locations. Out of 507 locations, 414 monitoring locations are on the rivers, 38 locations on lakes, 25 groundwater locations while 30 stations are situated on other water bodies like canals, creeks and drains. So far, 430 locations are covered under the Monitoring of Indian National Aquatic Resources (MINARS) programme, 50 stations under the Global Environmental Monitoring Systems (GEMS) programme and 27 locations are under the Yamuna Action Plan (YAP) programme. The monitoring at 371 locations is done at monthly interval while the monitoring frequency at 136 stations is quarterly. The collected water samples are analysed for 22 physico-chemical parameters.

The monitoring data of surface water resources reveal that the major rivers of the country have retained pristine quality of water in their upper stretches. As the rivers enter the plains, they start getting exploited for irrigation and drinking and used as recipient of industrial and domestic wastewater. This has rendered the rivers polluted. The presence of organics and bacterial contamination are the critical pollution factors in these water bodies. The situation is mainly responsible for water borne diseases.

On the basis of water quality monitoring data, the Central Pollution Control Board has identified surface water in terms of riverine length having different levels of pollution. The water quality in rivers with respect to BOD have been observed as follows:

| Sl. No. | Water Quality Status | Riverine length (Kms) | Percentage Riverine length |
|---|---|---|---|
| 1. | Severely polluted | 6,086 | 14 |
| 2. | Moderately polluted | 8,691 | 19 |
| 3. | Relatively clean | 30,242 | 67 |

**Review of Water Quality Monitoring Programme**

The present water quality monitoring network, although quite extensive is not adequate to cover all the variations in the quality. Moreover, the nature and extent of pollution has been changing with the rapid urbanisation and industrialisation. Thus, the need to review, rationalise and optimise the monitoring network has been realized. Accordingly, the review exercise has been undertaken for:

- Optimization of monitoring programme; and
- Development of guidelines for water quality monitoring.

As an outcome of the review exercise, the Central Pollution Control Board has come to the conclusion that the existing water quality network is to be strengthened in respect of coverage of larger area as well as inclusion of more parameters especially micropollutants, wherever required. It was also concluded that the water bodies having stable water quality need to be monitored with lesser frequencies. The resources and effort thus, saved can be utilised for augmenting the monitoring network.

**Water Quality Status of Chennai Water Ways**

The waterways in the cities constitute an important environmental component for assimilation of wastewater, recharge of groundwater aquifers and also for maintaining the aesthetic quality. Chennai City is traversed by four major waterways namely River Cooum, River Adyar, Buckingham Canal and Otteri Nullah. The Water channels/drains such as Mambalam drain, Captain Cotton Canal, Nandanam drain, Arumbakkam drain, Irugambakkam drain and Kodungaiyur drain also traverses the city. In the earlier days, the Buckingham Canal served as a useful mode for inter-state transport.

A project for environmental improvement of waterways in Chennai, which is first of its kind, was launched to rejuvenate the important watercourses in the city, which will have significant impacts on the well being of the city and its populace. It is a collaborative initiative of the Chennai Metropolitan Water Supply and Sewerage Board along with Tamil Nadu State Pollution Control Board and the Central Pollution Control Board supported by the National River Conservation Directorate, Ministry of Environment & Forests, Government of India.

The waterways of Chennai are not perennial and these receive flood discharge only during monsoon season. During other months, these are used as carriers of wastewater. Thus, the waterways function as elongated lagoons for wide range of domestic, commercial and industrial wastes/effluents. The uncollected sewage from unorganised sector, sewage from treatment plants, effluent discharged from commercial establishments and wastewater from drainage system finally reach the waterways of Chennai City.

Several outfalls from industries, commercial institutions, treated/partially treated sewage from STPs, discharge from pumping stations and drains from the slums, discharge wastewater into respective waterways in their basin. This wastewater discharge contributes contaminated/polluted water to the waterways and produces insanitary condition. The identified outfalls in various waterways are as follows:

**Source-wise details of Wastewater Outfalls in Chennai City waterways**

| Sl.No. | Outfalls source | Number of outfalls in waterways |
|---|---|---|

| | | River Adyar | | River Cooum | | Buckingham Canal | | Otteri Nullah | |
|---|---|---|---|---|---|---|---|---|---|
| | | **1994** | **1999** | **1994** | **1999** | **1994** | **1999** | **1994** | **1999** |
| 1. | Industries | 20 | 11 | 18 | 1 | 14 | 13 | 13 | 4 |
| 2. | Commercial Institutions | 38 | 38 | 18 | 11 | 21 | 21 | 3 | 3 |
| 3. | Sewage Treatment Plant | 1 | 1 | 1 | 1 | 1 | 2 | -- | 1 |
| 4. | Pumping Stations | 4 | 1 | 2 | -- | 9 | 4 | 2 | 1 |
| 5. | Sewer/Storm water Drain | 148 | 147 | 281 | 276 | 63 | 64 | 43 | 43 |
| 6. | Slums | 17 | 17 | 24 | 24 | 20 | 19 | 5 | 5 |
| **Total** | | 228 | 215 | 344 | 313 | 128 | 123 | 66 | 57 |

The number of outfalls discharging effluents into city waterways has been reduced to 708 during 1999, as compared to 766 in the year 1994. As per survey conducted in March 1994, the total number of industrial outfalls was 65, which has been subsequently reduced to 29 outfalls into various waterways of the city. These outfalls contribute total flow of 12330.30 KLD to the waterways. The Sewage Treatment Plants provided by the Chennai Metropolitan Water Supply and Sewerage Board takes care of only one third of the total sewage generation, besides the fact that the STPs have been designed during 1970s and does not cover the extensive growth of the city thereafter.

**Bio-monitoring of Aquatic Resources**

Bio-monitoring of water bodies has been undertaken in the problem areas of Singrauli, Vapi, Ankleshawar, Pali, Jodhpur, Angul-Talcher and Najafgarh Drain basin in Delhi to assess the water quality.

In addition, bio-monitoring of national aquatic systems was initiated in 13 States with association of respective State Pollution Control Boards.

Monitoring of biological parameters were also conducted at three lakes, Ulsoor, Sankey and Yelemallappa; one reservoir, Thippagondanahalli (T.G.Halli), which is a drinking water source; and two minor rivers, Arkavathi and Kumudavathi in Bangalore.

**Monitoring of Haldi and Roopnarayan Rivers in West Bengal**

Studies on the rivers Haldi and Roopnarayan in West Bengal were conducted to identify the status of water quality.

A comprehensive report on the status of water quality has been prepared. The water quality data are summarised below:

**Water Quality of Haldi River**

| Parameters | Haldi Mouth | Upstream Township | Matingini Setu | Moina |
|---|---|---|---|---|
| pH | 7.96-8.08 | 7.9-8.05 | 7.7-8.01 | 7.91-8.10 |
| TDS (mg/l) | 6724-18096 | 7668-18730 | 5446-12504 | 858-11966 |
| Chloride (mg/l) | 2755-8700 | 2745-6100 | 2639-6000 | 245-5500 |
| Total Hardness (mg/l) | 913-2884 | 981-1836 | 446-2076 | 125-1817 |
| DO (mg/l) | 6.9-7.8 | 7.2-8.1 | 6.3-7.9 | 6.8-7.6 |
| BOD (mg/l) | 1-2 | 1.3-1.4 | 1-2.1 | 1-2.0 |
| Total Coliforms (Nos./100 ml) | 32400-127200 | 24000-60000 | 14000-33200 | 3300-73600 |
| Faecal Coliforms (Nos./100 ml) | 32400-127200 | 24000-60000 | 14000-33200 | 3300-73600 |

**Water Quality of Roopnarayan River**

| Parameters | Mouth | Tamluk | KTPS | Kolaghat | Ghatal |
|---|---|---|---|---|---|
| pH | 7.40-7.95 | 7.10-8.05 | 7.40-8.02 | 7.40-7.79 | 7.03-7.42 |
| TDS (mg/l) | 335-610 | 283-1210 | 195-1178 | 186-1088 | 134-242 |
| Chlorides (mg/l) | 83-225 | 67-502 | 51-492 | 40-454 | 28-36 |
| Total Hardness (mg/l) | 146-201 | 127-326 | 107-317 | 95-288 | 67-87 |
| DO (mg/l) | 5.7-6.8 | 5.7-6.9 | 5.9-7.1 | 5.7-7.0 | 5.9-7.6 |
| BOD (mg/l) | 1.0-2.0 | 1-1.4 | 1-1.7 | 1.3-2.0 | 1-1.7 |
| Total Colifirms (Nos./100 ml) | 4600-27400 | 4200-208000 | 7600-60800 | 8800-22200 | 6800-109200 |
| FC (CFU/100 ml) | 1600-24000 | 1800-76800 | 4000-30400 | 5600-10200 | 4900-6800 |

**Non-point Sources of Pollution**

The Central Pollution Control Board has been regularly assessing point sources of pollution. However, similar assessment needs to be undertaken for non-point sources, as their magnitude is quite significant. Due to the fast growth of urban population and inadequate arrangements for collection and disposal of liquid and solid waste generated, large application of chemicals in agriculture, fast industrialization results in indiscriminate disposal of wastes. All these activities contribute the non-point pollution into both surface run-off and groundwater. CPCB in collaboration with Punjab Pollution Control Board has taken up a pilot study to assess non-point sources of pollution in Ludhiana city.

It was revealed that indiscriminate disposal of waste is the major source of non-point source of pollution. Increased application of agro-chemicals, both fertilizers and pesticides, are also important non-point sources of pollution. Increased irrigation also results in gradual building up of salts in the agriculture, which increase the salinity in groundwater and ultimately surface water. There is an urgent need to frame a policy on prevention and control of non-point sources of pollution.

**Revised Water Quality Criteria**

The Water (Prevention and Control of Pollution) Act envisaged restoration and maintenance of "wholesomeness" of aquatic resources. The Central Pollution Control Board had earlier defined the "wholesomeness" of water in terms of selected water quality criteria parameters to protect different human uses of water. Over the years, there has been increase in diversity of pollution problems posing technical difficulties in implementing these criteria. To review the water quality criteria, CPCB set up an Expert Group. Based on deliberations of and interactions with the State Pollution Control Board, the following decisions have been taken:

- A set of water quality criteria developed as basic water quality criteria applicable to all water bodies in the country.
- Existing use based water quality criteria are retained but elaborated to include more parameters.
- A separate set of water quality criteria designed for groundwater in the country.
- For involving larger groups of people in water quality monitoring, a set of simple parameters have been identified
- Scientific rationale is incorporated to avoid difficulties in implementation.
- Responsibilities of concerned agencies have been identified for water quality management.

**Pollution Assessment - River Kosi**

A study was undertaken with the objective to assess the extent of pollution and monitoring of the river, starting from the origin till its confluence with River Ramganga to know the sources responsible for the same. The river originates from village Budha Peenath, Kausani of Distt. Almora (U.P.) and up to Ramnagar , Distt. Nainital. The river is not subjected to any significant source of pollution and the quality of river water meets the criteria designated for `A` class use. At Ramnanagar the major portion of city sewage is discharged into the river, the quality afterwards deteriorates slightly. After Ramnagar, the river flows through the outskirts of the city - Kashipur and the river becomes highly polluted due to huge and contaminated discharge from several highly polluting industries including Paper Mills, Sugar and Distillery. The river water becomes dark coloured. Here the quality of river water matches with the criteria for `D` class use of water. Afterwards the river is not subjected to any significant source of pollution. The total length of the river is around 250 kms. The water quality profile of the river water may be categorised as follows-

-Origin to u/s of Ramnagar - `A` Class

-D/s of Ramnagar to u/s of Kashipur - `B` Class

-D/s of Kashipur till confluence - `D` Class

with River Ramganga

(A class - drinking water source without conventional treatment but after disinfection, B class - outdoor bathing organised, C class - drinking water source with conventional treatment followed by disinfection, D class - propagation of wildlife, fisheries and E class - irrigation, industrial cooling, controlled waste disposal)

There is a need to treat the industrial effluents upto desired level by the concerned industries and also the treatment / diversion of sewage at Ramnagar. The release of discharges from the barrages at Ramnagar and Lalpur are to be maintained as per norms.

**Important activities in water quality monitoring and pollution control**

- Revised guidelines for water quality criteria/standards formulated
- Report on "Brahmaputra basin" prepared and printed
- Report on "Assessment of Environmental Quality of River in Eastern Region" prepared
- Regular AQC exercises carried out for 20 parameters covering 101 laboratories, which include laboratories participating in water quality monitoring programme of CPCB and EPA recognised labs

- A study on development of PCB analysis methodology for water and sediments initiated
- Water Quality monitoring of river Yamuna at 15 locations from Hathnikund to Chambal river confluence and monitoring of 12 major drains joining Yamuna was continued. The samples are analysed for physico-chemical parameters, pesticides and heavy metals
- Performance study of four sewage treatment plants - Sen Nursing Home, Delhi; Faridabad; Ballabhgarh and Gurgaon was conducted

**Performance of STPs Under GAP-I and their Impact on River Water Quality**

Intensive performance monitoring of all the STPs commissioned under Ganga Action Plan Phase-I in the state of Uttar Pradesh and their overall impact on water quality of the river(s) is being carried out at frequency of at least once in three months. In all 12 STPs namely Haridwar (18 MLD), Rishikesh/Lakkerghat (6 MLD), Swargasram (0.32 MLD), Fatehgarh (2.7 MLD), Kanpur (5 MLD, 36 MLD & 130 MLD), Varanasi (BHU-8 MLD, DLW -12 MLD and Dinapur- 80 MLD), Mirzapur (14 MLD) & Allahabad (60 MLD) and the quality of River Ganga before and after confluence of the sewage were monitored.

**The salient findings are as follows:**

- High coliform content observed in untreated and treated wastewater
- Due to interrupted power supply/regular load shedding and lack of DG sets, untreated wastewater from pumping stations directly discharged to the river.
- Water quality of river does not conform to 'C' category of Designated Best Use classification

**Impact Assessment of Immersion of Ganesha Idols in Bangalore**

As a part of final ritual of Ganesh Chaturthi celebrations, the clay idols of Ganesha, along with flowers, banana leaves, coconuts etc. are immersed in various water bodies, resulting in alarming increase in pollution levels in the water bodies. In Bangalore, the idols are immersed in lakes, subsequently endangering the aquatic flora & fauna. It was observed that a total of 3051 idols in Sankey Tank, 3890 in Ulsoor Lake, 642 in Lalbagh Lake and 962 idols in Yediyur Lake were immersed.

The analytical results of the water samples indicate that pH varied between 7.3 to 7.6 in the lakes. There was a substantial increase in total dissolved solids and during the immersion the iron content increased manifold in all the lakes. Traces of copper, chromium and zinc were also found in water samples after the immersion.

# AMBIENT AIR QUALITY

## Ambient Air Quality in Delhi

Ambient air quality monitoring conducted at different locations for a period of 24 hours in Delhi revealed that suspended particulate matter (SPM), respirable particulate matter (RSPM) and carbon monoxide are in high concentrations at all the monitoring stations. Sulphur dioxide has been recorded within prescribed limit at all the locations while Nitrogen dioxide was within limit at ITO, S.P.Marg, R.K.Puram Crossing, Dr. Jakir Hussain Marg, Windsor Place, Pusa Road, Janpath, Rashtrapati Bhawan, Ridge Area, Badli Industrial Area and Shahjada Bagh. The values of nitrogen dioxide exceeded at Connaught Place and Race Course. Air pollutants were found to increase between 8 AM to 11 AM and 4 PM to 9 PM. Ambient noise level was also found higher than the prescribed limit at all the locations during peak traffic hours.

## Benzene Monitoring (By Passive Sampling Method) in Delhi and Kanpur

CPCB has been monitoring benzene in ambient air at seven locations in Delhi comprising residential, industrial and commercial areas. The monthly average values observed at all the locations vary between 16 to 35 microgrammes per cubic metre. Overall mean benzene concentration for all seven locations has been calculated as 26 microgrammes per cubic metre. This is 1.6 times higher than the United Kingdom's Annual Running Mean Standard of 16 microgrammes per cubic metre.

The monthly average values observed in Kanpur varies between 7 to 41 microgrammes per cubic metre. Overall mean benzene concentration for all five locations in Kanpur was calculated as 22 microgrammes per cubic metre, which is 1.4 times higher than the United Kingdom's Annual Running Mean Standard.

Benzene monitoring was carried out using BTEX Analyzer (Benzene, Toluene, Ethyl benzene, o,m,p-Xylene) at ITO and at CPCB premises. Higher levels were observed at ITO.

## Levels of Benzo(a)Pyrene in Delhi

Measurements for Benzo(a)pyrene in ambient air particulate samples collected at six locations in Delhi indicate that the annual average ranged between 1.0 ng/$m^3$to 5.3 ng/$m^3$ from 1997 to 1999. The recommended standard for concentration of B(a)P in ambient air is 10 ng/$m^3$ . The concentration of B(a)P during winter season was generally higher as compared to monsoon and summer. Low concentration of B(a)P was recorded during summer possibly due to photo-oxidation and meteorological conditions favouring the dispersal of B(a)P. During monsoon, rain and washout are possible reasons for the low B(a)P.

## Ambient Noise Level and Air Pollution during Deepawali

Ambient noise level monitoring was carried out at various locations in Delhi, i.e. Patel Nagar, AIIMS, Connaught Place, India Gate, Lajpat Nagar, Mayur Vihar, New Friends Colony and East Arjun Nagar on occasion of Deepawali festival. The ambient noise levels were above the prescribed limits but were slightly lower at few locations as compared with the previous year's data.

Ambient air quality monitoring was also carried out at ITO intersection, Ashok Vihar, East Patel Nagar and Pusa Road. $SO_2$ levels were higher in the evening on Deepawali day and pre-Deepawali day. NOx and CO levels were observed lower on the Deepawali day as compared with the pre-Deepawali day.

## Monitoring of PM 10 (RSPM) in Kanpur

Ambient air quality monitoring of PM *10* in Kanpur was conducted. Status of PM *10* is being worked out with reference to developing a control strategy for PM *10* under the World Bank Assisted Programme. The monitoring of PM *10* is being conducted with the objective to determine status of PM *10* in ambient air of Kanpur and to assess the content of sulphate in PM *10* . The monitoring was started a 6 locations in Kanpur in July 2000 by CPCB and in September 2000 by the National Environmental Engineering Research Institute (NEERI) at three

locations. The Uttar Pradesh Pollution Control Board is measuring $PM_{10}$ at 3 locations in Kanpur since April 2000. The frequency of monitoring has been maintained twice in a month, and the following parameters were planned for monitoring: RSPM, $SO_2$ and Sulphate. The maximum & minimum concentrations of RSPM & $SO_2$ at different locations monitored are presented below:

| Sl. No | Locations | Monitoring Agency | Average RSPM ( m µ/m $^3$) | | Average SO 2 ( m µ/m $^3$) | |
|---|---|---|---|---|---|---|
| | | | Maximum | Minimum | Maximum | Minimum |
| 1 | Civil Lines | CPCB | 457 429 | 46 73 46 | 20 29 30 29 | 7 3 3 4 3 3 |
| 2 | Gol Chouraha | CPCB | 354 454 | 87 102 37 | 26 28 26 29 | 14 15 14 |
| 3 | Kalyanpur | CPCB | 860 315 | 152 131 | 27 21 19 19 | 17 18 16 |
| 4 | Barra | CPCB | 299 284 | 148 55 86 | | |
| 5 | Ghantaghar | CPCB | 292 283 | 87 | | |
| 6 | Ramadevi | CPCB | 420 369 | | | |
| 7 | Fazalganj | UPPCB | | | | |
| 8 | Kidwai Nagar | UPPCB | | | | |
| 9 | Deputy Ka Parao | UPPCB | | | | |
| 10 | Lajpat Nagar | NEERI | | | | |
| 11 | Bara Chouraha | NEERI | | | | |
| 12 | Agricultural University | NEERI | | | | |

The values of $SO_2$ are within norms but RSPM exceeds far in excess of the prescribed norms.

**Quality Assurance for Air Quality Measurements**

The Central Pollution Control Board has set up a dynamic dilution system (Ring Test Facility) to produce gas mixtures of any desired concentration and composition. The primary objective of developing this system is to conduct quality assurance programme for participating laboratories as well as to calibrate continuous monitoring analyzers. Participation in the quality assurance programme helps the laboratory in achieving compatibility of results and to validate the method being adopted for the measurement. CPCB has been conducting the quality assurance programme for State Pollution Control Boards since 1999. During March 2000, officials from seven State Pollution Control Boards took part in AQC programme for measurement of sulphur dioxide and nitrogen dioxide by wet chemical methods. On analysing the results, it was observed that the performance of 90% of the participating laboratories was satisfactory.

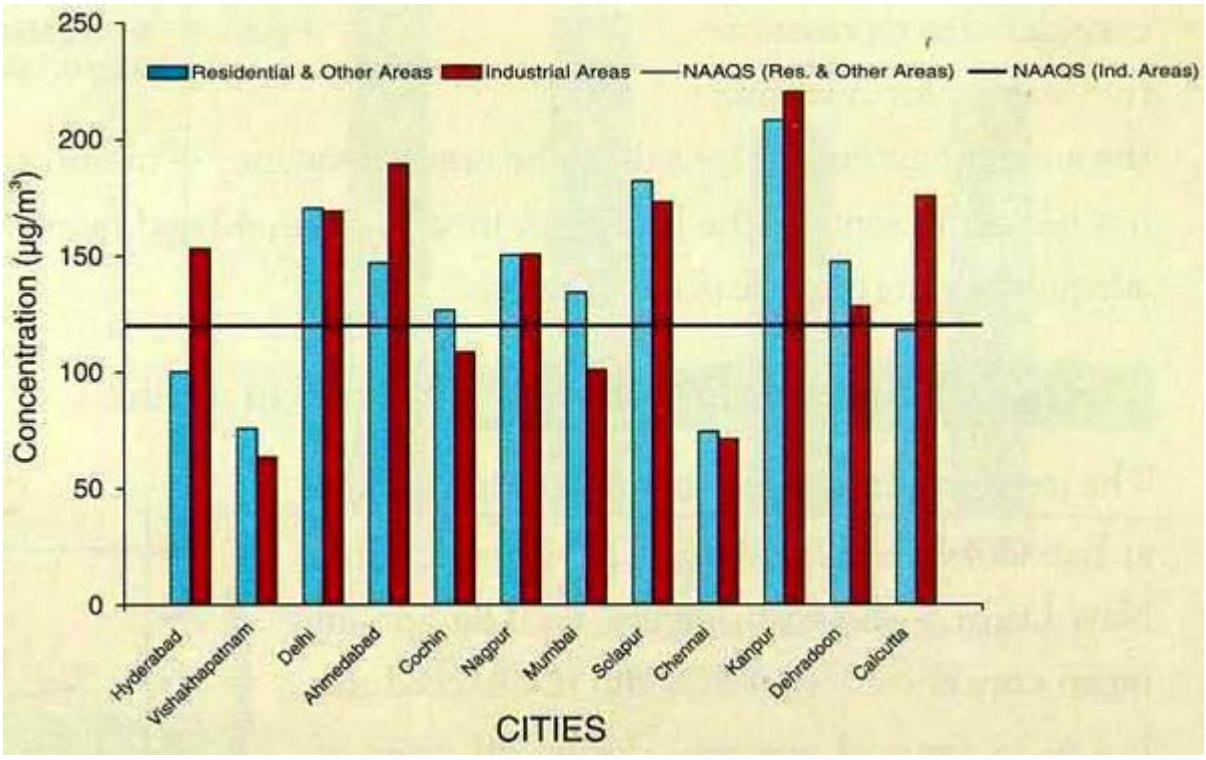



Figure 1: RSPM (Annual Average) in various Cities in India during 1999

**Levels of Respirable Suspended Particulate Matter (RSPM) in Selected Cities**

The RSPM levels in residential and industrial areas in selected cities are presented in Figure 1. RSPM levels exceeded the National Ambient Air Quality Standards (NAAQS) (annual average) in residential areas of all the monitored cities. Also, RSPM levels exceeded the NAAQS (annual average) in industrial areas of all the monitored cities except Visakhapatnam, Cochin, Mumbai and Chennai. The Respirable Suspended Particulate Matter violated 24 hourly average RSPM Standard at all the monitored locations except Industrial estate, Visakhapatnam. The trend in annual concentration of RSPM at BSZ Marg, (ITO Intersection) New Delhi is depicted in Figure 2. RSPM levels exceeded the NAAQS (annual average) during 1998, 1999 and 2000 at BSZ Marg, New Delhi.

Since the target sampling of 24 hours in a day could not be fulfilled at all the locations due to the power failures etc., the values monitored for 16 hours and more are considered as representative values for assessing the ambient air quality for a day. The target frequency of monitoring twice a week, 104 days in a year could not be met in some of the locations, in such cases, 40 and more days of monitoring in a year is considered adequate for the purpose of data analysis.

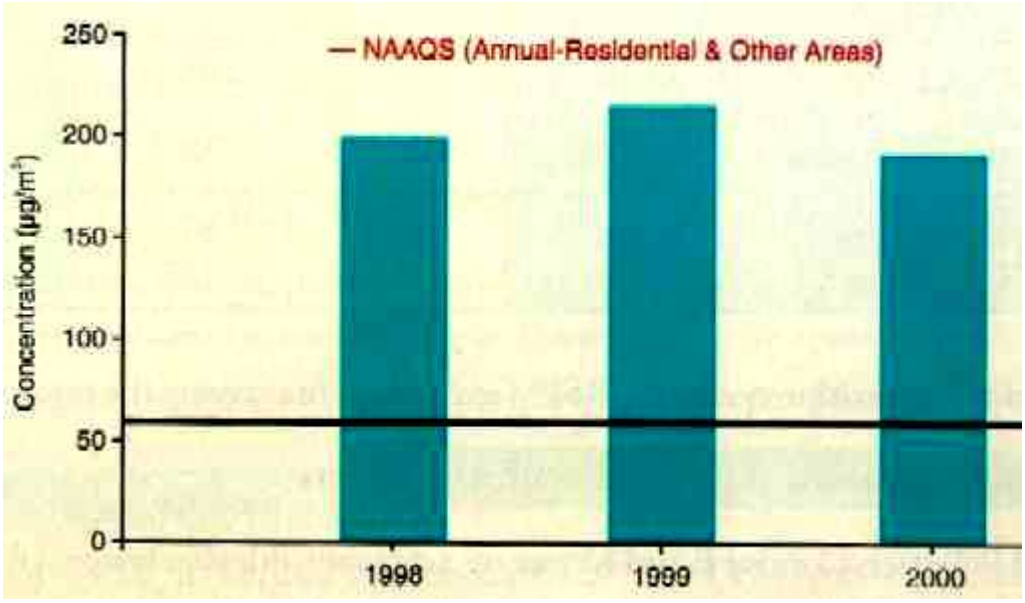



Figure -2 Annual Mean Concentration of RSPM at B.S.Z Marg (ITO Intersection) New Delhi

**Trends of Sulphur Dioxide (SO 2 ) Levels in Delhi**

The trend in annual mean concentration of $SO_2$, at Bahadurshah Zafar Marg. (ITO Intersection), New Delhi is shown in Figure 3. The annual mean concentration of $SO_2$ did not exceed the NAAQS (annual average) during all years of monitoring. Decreasing trend in $SO_2$ levels is observed which is attributable to low sulphur diesel introduced in Delhi.

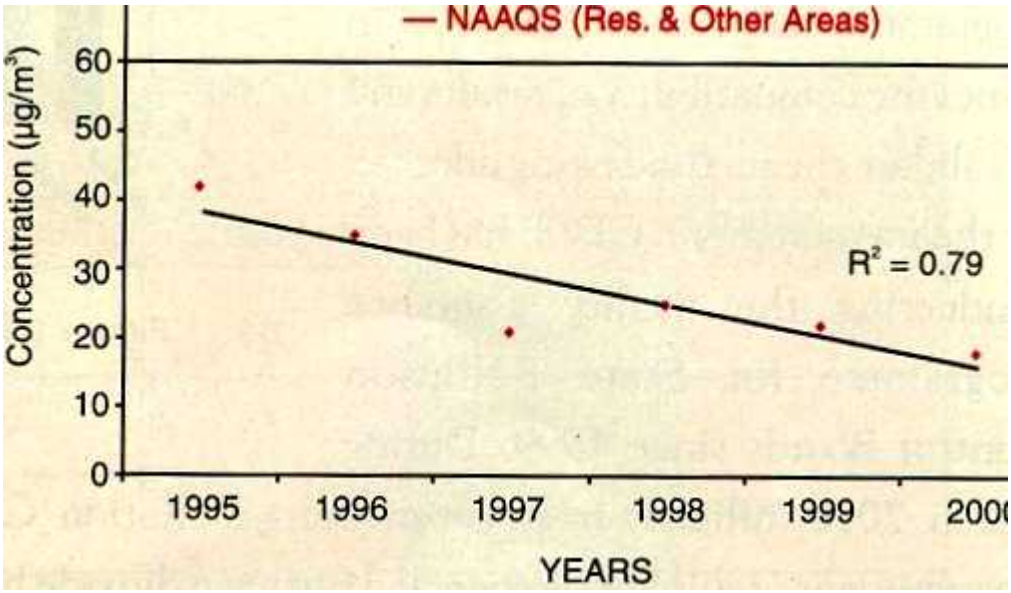



Figure 3: Trend in Annual Average of $SO_2$ at BSZ Marg (ITO Intersection), New Delhi

**Trends in Nitrogen Dioxide ($NO_2$ ) levels in Delhi**

The trend in annual mean concentration of $NO_2$ at BSZ Marg (ITO Intersection), New Delhi is depicted in Figure 4. Decreasing trend in $NO_2$ levels is observed, which might be due to prohibition in plying of more than 15 - year old commercial vehicles in Delhi.

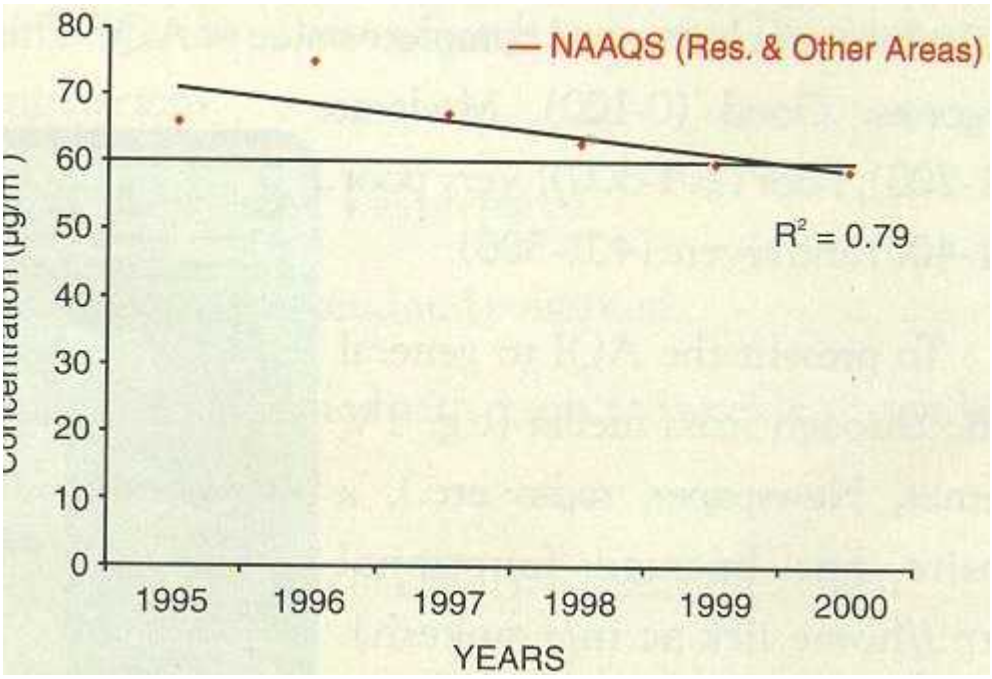



Figure 4: Trend in Annual Average of $NO_2$ at BSZ Marg (ITO) Intersection, New Delhi

**Trends of Suspended Particulate Matter (SPM) in Delhi**

The trend in annual mean concentration of SPM at BSZ Marg (ITO Intersection) is shown in Figure 5. SPM levels exceeded the NAAQS (annual average) during all the years.

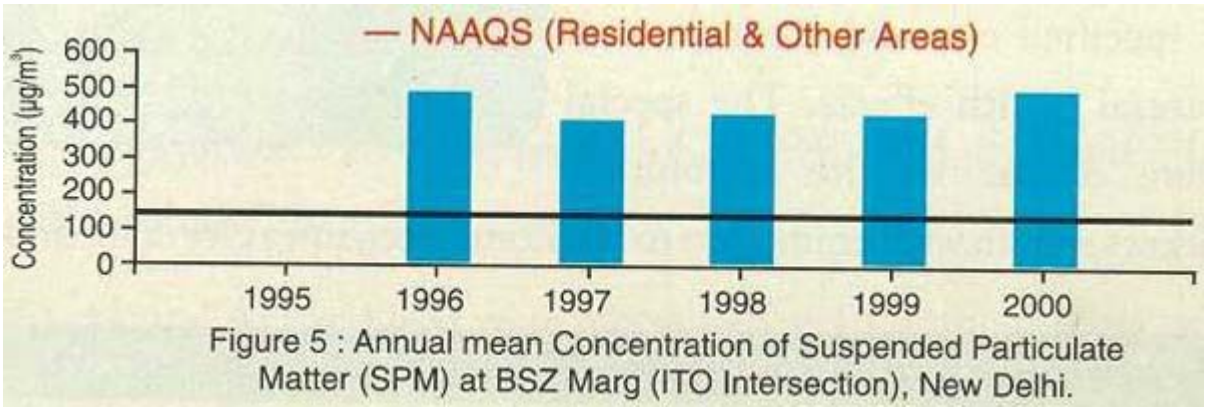



Figure 5 : Annual mean Concentration of Suspended Particulate Matter (SPM) at BSZ Marg (ITO Intersection), New Delhi.

Figure 6: Annual Average Concentration of CO($mg/m^3$) at BSZ Marg (ITO), New Delhi

**Air Quality Index for Public Information**

An Air Quality Index (AQI) has been developed in collaboration with the Indian Institute of Technology, Kanpur based on the dose-response relationship of various pollutants. A minimum number of three pollutant parameters (Suspended Particulate Matter (SPM), Sulphur Dioxide ($SO_2$) and Nitrogen Dioxide ( $NO_2$) are essential to calculate the AQI. Any additional information on other pollutants such as Respirable Particulate Matter (RSPM or $PM_{10}$ ), Carbon Monoxide (CO) and Ozone ($O_3$) are included to calculate conclusive and complete value of AQI. The developed index is classified in five categories: Good (0-100), Moderate (101-200), Poor (201-300), Very poor (301-400) and severe (401-500).

To present the AQI to general public through mass media (e.g. TV, Internet, Newspaper, radio etc.), a website has become functional (http://home.iitk.ac.in/~mukesh). The website is capable of producing online and historical AQI values for any specified city and location with potential health effects. The special feature of the website is multiple

windows system with animation to facilitate inter/intra city comparison of air quality.

**Preparation of Environmental Management Plan for Taj–Trapezium Zone (TTZ)**

To protect the National Heritage site at Agra and its nearby areas, the Ministry of Environment & Forests had formed an Authority for prevention and control of pollution in the zone. Alongwith pollution prevention activities by other organisations, CPCB took up the activity to prepare the Environmental Management Plan for the entire Zone. The work was initiated in September 2000 and is expected to be concluded by March 2002. The assigned activity is in progress with financial assistance from the World Bank.

The work has been divided in two phases viz. City level Planning and Regional Level Planning. In the city level planning, among other activities, the thematic maps in respect of drainage, water resources, road network, tourist places, solid waste, environmental resources maps have been prepared. In case of Regional Planning Forest, Natural drainage, Contour, Tourist site, settlement and heritage site maps etc. have been prepared. For analysis of the data and its digitization, Geographical Information System (GIS) is proposed to be used.

**Air pollution and Human Health**

In collaboration with the All India Institute of Medical Sciences (AIIMS), a project has been initiated on the effect of ambient air quality on human health in Delhi. Preliminary survey indicated that CO levels in blood among smokers, factory workers and petrol pump workers are higher and symptoms related to adverse impact on respiratory, cardio-vascular and nervous system were observed.

**Important Activities in Air Quality Evaluation and Pollution Control**

- Review of the present air quality monitoring network is under progress. There is a proposal to increase the number of monitoring stations.
- Report on "Air Quality Status of the city of Delhi" was prepared.
- Report on "Air Quality Status and Trends in India" was prepared and published
- CPCB Website (http://www.cpcb.nic.in/) regularly updated with respect to weekly air quality data of ITO intersection, Delhi
- Measurement of 15 polyaromatic hydrocarbons in ambient air of Delhi has been undertaken
- Monitoring of ambient ozone at ITO intersection, New Delhi is continued
- Two fixed and one mobile continuous automatic ambient air quality monitoring stations operated in Delhi, where SPM, $SO_2$ , $NO_2$ , NO x , CO are recorded
- Seven stations in Bangalore were monitored for measurement of RSPM, SPM, $SO_2$ and $NO_x$at important traffic intersections of Bangalore City.
- Pollutants like SPM, RSPM, $SO_2$ , $NO_x$, PAH and lead were monitored at 13 traffic intersections in Calcutta.

## VEHICULAR POLLUTION PREVENTION AND CONTROL


Vehicles are the major source of air pollution in the urban areas. During the past few years, various steps have been taken to reduce vehicular emissions and its effect is evident on ambient air quality. Ambient air quality in Delhi with respect to nitrogen dioxide, sulphur dioxide and respirable particulate matter has shown improvement in 2000 as compared to the levels in 1999. Important steps taken during the year 2000 to reduce the vehicular emissions are as follows:

**Vehicle Technology**

- Bharat Stage - I norms (Euro - I norms) are being implemented for all categories of vehicles throughout the country with effect from 1.4.2000.
- Mass emission for CNG vehicles has been notified on 9.2.2000.
- Bharat Stage - II norms (Euro - II) for private non - commercial vehicles notified on 31.1.2000 are being implemented from 1.4.2000 in National Capital Region.
- Post 1990 in-use Auto, taxies and buses are being replaced with CNG driven vehicles from 1.4.2000.
- The ratio of sale of 4-stroke to 2-stroke two-wheelers in 2000 has increased throughout the country.

**Fuel Quality**

***Diesel***

- Diesel with 0.25% sulphur has been introduced throughout the country from 1.1.2000.
- Diesel with 0.05% sulphur has been introduced in National Capital Region for private non-commercial vehicles from 1.4.2000 and in Mumbai for all categories of vehicles from 1.1.2000.

***Gasoline***

- Leaded gasoline phased out throughout the country from 1.2.2000.
- Gasoline with sulphur contents of 0.1% has been introduced throughout the country from 1.4.2000.
- Gasoline with sulphur contents of 0.05% has been introduced in National Capital Region for all categories of petrol vehicles from 1.4.2000 and in Mumbai from 1.10.2000.
- Benzene in gasoline with 3% has been introduced in Metros from 1.4.2000.
- Benzene in gasoline with 1% introduced in NCT - Delhi from 1.11.2000.
- CNG filling station in NCT Delhi has been increased to 60.

**Constitution of Committees**

- Inter-ministerial Task Force to evolve a long-term policy and road map to be followed in vehicular emission standards and Auto fuel quality.
- Expert Committee on Reformulated and low Benzene petrol constituted by committee of Secretaries, Government of India.
- Report of the working group on fuel quality for 2005 has been submitted in December 2000.

## NOISE POLLUTION


- Noise measurement studies for firecrackers completed and noise standards for firecrackers finalised by the 'National Committee on Noise Pollution Control'. The standards have been notified by the Ministry of Environment & Forests.

- Noise measurement studies for portable gensets (upto 2.5 KVA) completed and noise standards for portable gensets finalised by the National Committee on Noise Pollution Control. Standards have been recommended to the Ministry of Environment & Forests for notification.

- Revision of noise standards for vehicles taken up through the National Committee on Noise Pollution Control.

- A study was undertaken to monitor level of noise around Netaji Subhash Chandra Bose International Airport, Kolkata. Perceived noise levels were measured at various locations around the airport.

## HOSPITAL WASTE MANAGEMENT

Stack emission monitoring carried out in the incinerators installed at 32 major hospitals in Delhi. The observations are as follows:

- Emission of particulate matter is being exceeded by more than 5 to 50 times of the permissible limit
- Air pollution control devices have not been installed with incinerators
- A few hospitals are still using single chamber incinerator, while others do not attain prescribed temperature in primary or secondary chambers
- Segregation of bio-medical wastes has not been paid adequate attention by hospitals

Inventory of bio-medical waste in the cities of Vadodara, Nagpur, Wardha and Nasik has been completed. It was observed that except SSG hospital, Vadodara, no other hospital has provided incinerator as per the guidelines. The methods adopted for the disposal of hospital wastes by most of the hospitals were found to be inadequate.

A study was conducted in nine government run hospitals in Kolkata, having bed capacity exceeding 500, to ascertain the status of the biomedical waste management.

**Spore Testing Methodology for Efficiency Testing of Autoclaves**

With the intensive development of health care, there has been mushroom growth of hospitals and nursing homes. Growth has eventually boosted generation of quantum of medical wastes from hospitals and nursing homes. Safe disposal of infectious hospital wastes is a matter of serious concern. The Bio medical Waste (Management and Handling) Rules, 1998 notified by Govt. of India, have stipulated rules for proper collection, storage, transportation, treatment and disposal of bio-medical waste. As per Biomedical Waste Rules, 1998, the hospitals have to install treatment facilities like autoclaves, incinerators etc. for treatment of bio-medical wastes generated from their premises. To ensure safe treatment and disposal of infectious hospital waste, these treatment facilities should operate at designed efficiency level.

A project has been initiated by the Central Pollution Control Board to develop spore testing methodology for efficiency testing of autoclaves used for hospital waste treatment. The major objectives of the project are:

- To standardise the spore testing methodology for assessment of the efficiency of autoclaves used in hospital waste treatment.
- In-situ assessment of the efficiency of autoclaves installed at various hospitals within NCT-Delhi using biological indicator.

Standardisation of spore testing methodology has been undertaken using *Bacillus stereothermophilus* as biological indicator for efficiency testing of autoclaves used for hospital waste treatment. Standardised methodology has been field tested at various autoclaves installed at hospitals within NCT-Delhi for their efficiency testing. The observations and findings of field testing are presented below.

**Efficiency testing/validation of hospital autoclaves in NCT-Delhi by spore testing methodology**

| S. | Autoclave Location | Sampling Month | Location inside Autoclave | Observations | Efficiency/ |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| 1. | Autoclave - I Mangolpuri | July, 1999 | From inner wall towards door, placed spore strips in 6 tubes in bags for efficiency testing. | Turbidity developed in two tubes (5 & 6) | Partially satisfactory/ Unsatisfactory |
| 2. | Autoclave - I Mangolpuri | October, 1999 | Exposed spore strips in 8 tubes in bags inside autoclave | No turbidity developed in any tube. | Satisfactory |
| 3. | Autoclave - II<br><br>Sarita Vihar | February, 2000 | Exposed spore strips in 5 tubes in bags inside autoclave | No turbidity developed in any tube. | Satisfactory |
| 4. | Autoclave - III<br><br>Jehangirpuri | February, 2000 | Exposed spore strips in 5 tubes in bags inside autoclave | No turbidity developed in any tube. | Satisfactory |
| 5. | Autoclave - IV<br><br>Delhi Gate | February, 2000 | Exposed spore strips in 5 tubes in bags inside autoclave | No turbidity developed in any tube. | Satisfactory |

The results indicate that the Bio-medical waste treatment autoclaves installed at the hospitals are satisfactory with respect to sterilization of bio-medical waste undertaken at these autoclaves.

**Bio-Medical Waste Management in Lucknow**

In Lucknow city, there are total 25 Govt. hospitals, 125 registered Private nursing homes, 75 un-registered Private Nursing homes, about 500 Private Clinics and 250 Pathological Laboratories spread all over the city. There are also 243 Govt. Dispensaries and private clinics that are running in rural areas. In general, average per bed bio-medical waste generation in Lucknow ranges between 240 - 824 gm/bed/day. The maximum bio-medical waste generation was estimated to be 3.7 MT/ day. The salient findings of a study undertaken by CPCB are:

- None of hospitals are following any waste management scheme;
- Incinerator at SGPGI was found in operational condition, while other incinerators are completely non-functional;
- Municipal Corporation has installed an incinerator of capacity 75 Kg/hr to treat medical waste being generated from various hospitals but it remains non-functional; and
- Bio- medical waste is being mixed with other non- infectious or domestic solid waste

**Workshop on Bio-Medical Waste Management**

A joint workshop was organised with the UP Pollution Control Board on December 02, 2000 at Lucknow. The Workshop was attended by representatives of Nagar Nigam from all major and a few minor towns, representatives from IMA, Nursing Home Associations, major hospitals, medical and management experts across the entire state of UP. The major recommendations of the workshop are given below:

- To organise follow-up meetings at regional levels by all regional offices of UPPCB in association with CPCB and prepare a definite action plan preferably in phases;
- To organise training at regional levels for doctors/nurses/ safaiwalas engaged in generation/segregation and management of bio- medical waste;
- CPCB and concerned regional offices of UPPCB will pursue with Nagar Nigam/ Nagar Palikas and Medical Association including concerned agencies to ensure development and management of facilities; and

awareness programme with various organisation for speedy implementation of the rules.

## MUNICIPAL SOLID WASTE

In response to a writ petition filed in the Hon'ble Supreme Court of India, the Central Pollution Control

Board prepared status report of solid waste management in Bangalore and Chennai. Based on the recommendations, Bangalore Mahanagar Palike has constituted two Committees for supervision of overall management of solid waste management in Bangalore city. The Central Pollution Control Board commissioned NEERI for the work related with EIA studies of the proposed landfill sites at Kannehalli, Segahalli and Medi Agrahara. Two rounds of the field investigations have been completed by NEERI.

## ZONING ATLAS PROGRAMME


The nation-wide environmental planning and mapping programme on "Zoning Atlas" is being executed under the World Bank funded 'Environment Management Capacity Building Project', by the Central and State Pollution Control Boards and other executing agencies. The programme that covers various spatial environmental planning activities has been conceived as a tool for the protection of the environmental resources and for achieving developmental targets in an environmentally sound manner. Following are the significant achievements of the programme during the year 2000:

**Zoning Atlas for Siting of Industries**

The study on Zoning Atlas for siting of industries taken up District-wise, zones and classifies the environment and presents the pollution receiving potential of various sites/zones in the district and identifies the possible alternate sites for industries, through easy-to-read maps (1:250,000 scale). The work had been covered in the previous years for 60 Districts. The work during the current year has been taken up for the 50 Districts in 15 States.

Atlases have been published for the Districts of East Singhbhum and West Singhbhum (Bihar), Panchmahals (Gujarat), Solan (Himachal Pradesh), Mysore (Karnataka), Palakkad (Kerala), Chhindwara (Madhya Pradesh), Imphal, Thoubal and Bishnupur (Manipur), Sundargarh (Orissa), Udaipur and Rajasmund (Rajasthan), Ghaziabad (Uttar Pradesh) and Bankura (West Bengal).

**Industrial Estate Planning**

In continuation of the Zoning Atlas studies, the Industrial Estate Planning studies have been taken up at micro-level (1:50,000 and lower) to identify environmentally acceptable sites for industrial estates, to suggest wastewater disposal points and to provide suggestions on control of surrounding land uses. The studies will be helpful to the industrial development corporations and the industries departments in properly locating the industrial estates and in providing the needed pollution abatement infrastructure.

Studies have been taken up for sites in the Districts of East Godavari (Andhra Pradesh), East Singhbhum (Bihar), Amreli (Gujarat), Solan (Himachal Pradesh), Mysore (Karnataka), Palakkad (Kerala), Sagar (Madhya Pradesh), Imphal (Manipur), Ri-Bhoi (Meghalaya), Undivided Cuttack (Orissa), Ludhiana (Punjab), Alwar (Rajasthan), North Tripura (Tripiura), Bulandshahr (Uttar Pradesh) and Bankura (West Bengal).

The draft reports are ready for the sites in Bulandshahar, Ludhiana, Sagar, East Godavari and Ri-Bhoi. The studies for the other sites are in advanced stage.

**Mapping of Environmentally Sensitive Zones and Industrial Sites (ESZIS) - State-wise**

The activity on Mapping of Environmentally Sensitive Zones and Industrial Sites aims at presenting the information on environmentally sensitive zones viz. National Parks, Reserve Forests, Protected Forests etc. and industrial sites, state-wise, in the form of maps

Work has so far been completed for the States of Bihar, Meghalaya, Kerala, Goa, AP, Orissa and it is in progress for the States of Gujarat, Karnataka, Assam, Jammu & Kashmir, Madhya Pradesh, Rajasthan, Punjab, Uttar Pradesh, West Bengal, Tamil Nadu, Manipur and Maharashtra.

**Environmental Management Plans for Urban Areas, Mining Areas, Environmentally Fragile Areas, Tourism Areas etc.**

These studies are targeted for improving environmental quality through appropriate land use planning and development. As a pilot study, the Central Pollution Control Board took up Kanpur Urban Area and provided planning solutions for improving the environmental quality.

The Kanpur Development Authority used the pilot study report "Environmental Management Plan for Kanpur

Urban Area" and has incorporated it in their short and long term developmental plans and a number of measures for improvement of environment are under implementation at Kanpur. The experience from the Kanpur study have helped in conceiving the "ECOCITY" concept that the Ministry of Environment & Forests, Government of India is now contemplating implementation in the large metropolitan cities.

Encouraged by the response on Kanpur study, the following studies have been taken up during the year 2000:

1. Environmental Management Plan for Taj Trapezium Zone
2. Environmental Management Plans for Mining Areas of Dhanbad
3. Environmental Considerations for Land Use Planning in Vasai Virar Sub-region, District Thane, Maharashtra
4. Siting of New Township for the Proposed and Existing Industrial Estates in Vidharba Region – based on environmental considerations
5. Environmentally Sound Development Concept for Tourist Destinations - Bakel Fort of Kannur District (Kerala)
6. Environmental Status Mapping for Cauvery River Basin

The above studies are expected to be completed by the end of 2001.

**Regional Planning**

In continuation of the District-wise Zoning Atlas studies, pilot studies on regional planning had been taken up for Jalpaiguri district of West Bengal and for the entire state of Tripura. These studies are targeted for demonstrating the utility of environmental planning tool for achieving overall development of the district/region in a sustainable manner. The studies are in progress.

**Environmental Atlas of India**

The Environmental Atlas of India is a compilation of various environmentally related information presented in the form of maps and text including statistical data. The information on maps is being presented in 1:12 mi and 1:2 mi scales. The Atlas has information on the land, climate, natural hazards, population, major sources of pollution, environmental quality, environmentally sensitive areas and pollution control. The Atlas is expected to be released during 2001.

**Human Resource Development**

The Centre for Spatial Environmental Planning has been created at the Central Pollution Control Board for intensifying the Zoning Atlas activities. The Centre was inaugurated by Shri T.R. Baalu, Hon'ble Minister for Environment & Forests on December 12, 2000. Similar Centres are also planned for Tripura Pollution Control Board, Agartala, Kerala State Pollution Control Board, Thiruvananthapuram, West Bengal State Council of Science & Technology, Calcutta and Environmental Protection Training Research Institute, Hyderabad. In the other States, staffs to undertake spatial environmental planning tasks are being strengthened.

Training/awareness programmes on the need for planning and incorporation of environmental aspects into developmental activities and on usage of Zoning Atlas outputs were held in Panchamahals (Gujarat), Patna (Bihar), Mysore, Hassan, Bangalore (Karnataka), Bhopal (Madhya Pradesh), Agartala (Tripura), Bhubaneshwar (Orissa) and Jalpaiguri (West Bengal).

A two - week executive information visit on ‘Environmental Management and Land Based Natural Resource Planning in Germany' was organised for the senior level officers from the pollution control boards and other environmental administration during January 2000.

Training-cum-Exposure in Germany for the Senior Officers from Environmental Administration

Considering the progress of the Zoning Atlas programme so far and the usage of the planning tools, a detailed training need assessment has been carried out and a comprehensive human resource development programme has been developed. Under the programme, it is proposed to establish a network of institutions called "SEP-NET" (Spatial Environmental Planning Network) for developing capacities in the field of spatial environmental planning and executing various training programmes catering to the regional needs. The concept document and the training plan have been prepared and the programme is expected to take-off during 1 st quarter of year 2001-02.

**Infrastructure Development**

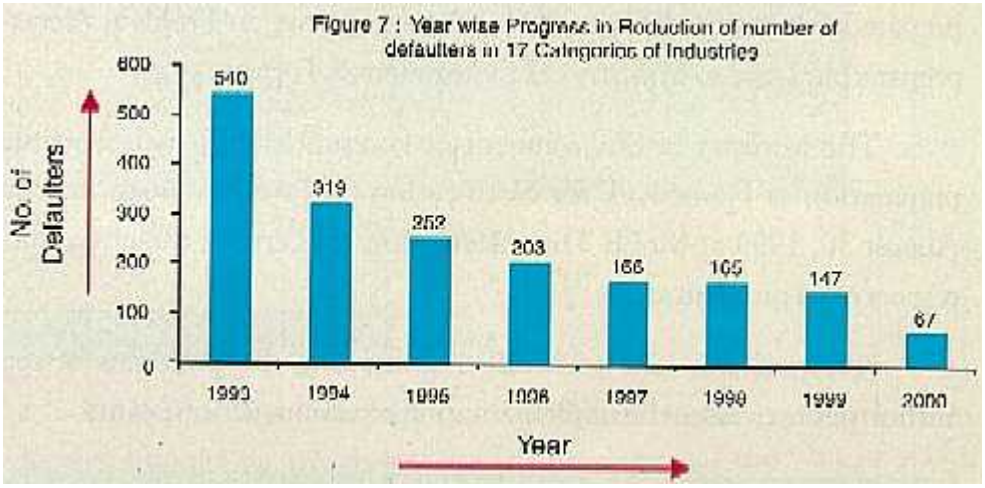
Spatial environmental planning requires GIS tools and other supporting infrastructure for mapping and disseminating the results. The infrastructure including GIS hardware and software, audio-visual equipment and cartographic equipment have been installed at CPCB and are being installed at various organisations participating in the programme.

## INDUSTRIAL POLLUTION CONTROL

### 17 Categories of Highly Polluting Industries

The implementation of the action plan for pollution control in 1551 medium and large scale units identified under 17 highly polluting industrial sectors was continued. The follow-up of the action taken against the defaulting industries under Section 5 of The E (P) Act, 1986 was further intensified and as a result the number of defaulting industries has been reduced from 147 in March, 1999 to 67 in March, 2000. The number of complying industries has increased from 1284 to 1320.

The year-wise progress made in the implementation of the programme since 1993, is presented in following Table. The year wise reduction in the number of defaulters is depicted in Fig.7.




### Year-wise progress in Implementation of the Programme

| Status | Closed Industries | Complying | Defaulters Industries |
|---|---|---|---|
| March 31, 1993 | 51 | 960 | 540 |
| March 31, 1994 | 74 | 1154 | 319 |
| March 31, 1995 | 121 | 1178 | 252 |
| March 31, 1996 | 111 | 1237 | 203 |
| March 31, 1997 | 125 | 1260 | 166 |
| March 31, 1998 | 125 | 1261 | 165 |
| March 31, 1999 | 135 | 1269 | 147 |
| March 31, 2000 | 164 | 1320 | 67 |

**Problem Areas**

Twenty four problem areas have been identified in the country for pollution control through concerted efforts involving all the concerned agencies/ industries. Action plans have been prepared and being implemented in respect of all these 24 areas and presently in various stages of implementation.

The last one finalised among these is the Action Plan for Durgapur. All the 24 units located in the area of Durgapur were issued notices under Section 5 of the E (P) Act, 1986 and the action Plan was prepared on the basis of the responses of the notices. The pollution control status in each of these units has also been prepared. A compilation on "The Action Points on Problem Areas" in respect of all the 24 areas was prepared and sent to Ministry of Environment & Forests.

The Ministry of Environment & Forests (MoEF) had constituted a Committee in May, 1999 for preparation of Framework for Notification on Problem areas. First meeting of the Committee held on August 30, 1999 at MoEF. The information concerning the environmental quality has been collected in respect of 24 problem areas.

A report was sent to MoEF highlighting the problems of specific areas and for setting special authorities to oversee the implementation of various action points.

**Industrial Pollution Control along the River Ganga (GAP Phase-I)**

The follow-up programmes in respect of the 68 industries identified under Ganga Action Plan (GAP) Phase-I were initiated by CPCB soon after the introduction of GAP in 1985. The pollution control status of these 68 industries as on March 31, 2000 is provided below.

**Summary status of the 68 industries identified under the Ganga Action Plan (Phase-I) (As on March 31, 2000)**

| S. No. | Status | Number of Industries | | | Total |
|---|---|---|---|---|---|
| | | Uttar Pradesh | Bihar | West Bengal | |
| 1. | Effluent Treatment Plant Installed | 20 | 04 | 20 | 44 |
| 2. | Industries Closed | 14 | 01 | 09 | 24 |
| **Total** | | **34** | **05** | **29** | **68** |

The industrial pollution control programme along the River Ganga got further intensified with the launching of the Central Action Plan in August, 1997, for control of industrial discharges along the rivers and lakes in the country. This programme resulted into identification of 119 more industries along the river Ganga that requires priority attention for the control of their effluent discharges. The pollution control status of these 119 industries as on March 31, 2000 is provided below.

**Overall Pollution Control Progress of the Industries along the River Ganga**

| S. No. | State | Total Units | No. of Units which have installed ETP | | No. of Units Closed | | No. of Units Defaulting | |
|---|---|---|---|---|---|---|---|---|
| | | | 1997 | 2000 | 1997 | 2000 | 1997 | 2000 |
| 1. | Uttar Pradesh | 83 | 18 | 59 | 04 | 24 | 61 | 00 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2. | Bihar | 03 | 02 | 03 | 00 | 00 | 01 | 00 |
| 3. | West Bengal | 33 | 16 | 29 | 00 | 03 | 17 | 01 |
| **Total** | | 119 | 36 | 91 | 04 | 27 | 79 | 01* |

* M/s. B&M Chemicals Ltd., 24 Parganas (N), West Bengal

**Industrial Pollution Control Along the Rivers and Lakes**

851 defaulting Grossly Polluting Industries located along the rivers and lakes in the country have been identified for priority actions under this programme, which was started during August 1997. The follow-ups for the implementation of the programme (including the review meetings held with the State Boards of Uttar Pradesh, Andhra Pradesh and Tamil Nadu), was intensified. This has resulted in reduction in the number of defaulting industries from 514 in March, 1999 to 22 in December, 2000. The State wise status of the 851 industries as on December 31, 2000 is presented below.

**Summary status of pollution control in grossly polluting industries discharging their effluents into rivers and lakes (As on December 31, 2000)**

| **S. No.** | **State/UT** | **No. of defaulters as in August' 97** | **No. of Industries Closed** | **No. of Industries which have provided requisite treatment/disposal facilities after issuance of directions** | **No. of defaulters** |
|---|---|---|---|---|---|
| 1. | Andhra Pradesh | 60 | 17 | 37 | 06 |
| 2. | Arunachal Pradesh | 00 | 00 | 00 | 00 |
| 3. | Assam | 07 | 05 | 00 | 02 |
| 4. | Bihar | 14 | 04 | 10 | 00 |
| 5. | Goa | 00 | 00 | 00 | 00 |
| 6. | Gujarat | 17 | 03 | 14 | 00 |
| 7. | Haryana | 21 | 08 | 12 | 01 |
| 8. | Himachal Pradesh | 00 | 00 | 00 | 00 |
| 9. | Jammu & Kashmir | 00 | 00 | 00 | 00 |
| 10. | Karnataka | 20 | 02 | 17 | 01 |
| 11. | Kerala | 36 | 04 | 32 | 00 |
| 12. | Madhya Pradesh | 02 | 01 | 00 | 01 |
| 13. | Maharashtra | 06 | 03 | 03 | 00 |
| 14. | Manipur | 00 | 00 | 00 | 00 |
| 15. | Meghalaya | 00 | 00 | 00 | 00 |

| | | | | | |
|---|---|---|---|---|---|
| 16. | Mizoram | 00 | 00 | 00 | 00 |
| 17. | Nagaland | 00 | 00 | 00 | 00 |
| 18. | Orissa | 09 | 01 | 04 | 04 |
| 19. | Pondicherry | 04 | 00 | 04 | 00 |
| 20. | Punjab | 18 | 01 | 16 | 01 |
| 21. | Rajasthan | 00 | 00 | 00 | 00 |
| 22. | Sikkim | 00 | 00 | 00 | 00 |
| 23. | Tamil Nadu | 366 | 118 | 248 | 00 |
| 24. | Tripura | 00 | 00 | 00 | 00 |
| 25. | UT-Andaman & Nicobar | 00 | 00 | 00 | 00 |
| 26. | UT-Chandigarh | 00 | 00 | 00 | 00 |
| 27. | UT-Daman & Diu, Dadra & Nagar Haveli | 00 | 00 | 00 | 00 |
| 28. | Delhi | *CSP | - | - | - |
| 29. | UT-Lakshadeep | 00 | 00 | 00 | 00 |
| 30. | Uttar Pradesh | 241 | 59 | 176 | 06 |
| 31. | West Bengal | 30 | 07 | 23 | 00 |
| **Total** | | **851** | **233** | **596** | **22** |

* CSP: Covered under the separate plan involving shifting, relocation etc. of the units as per the orders of Hon'ble Supreme Court.

**Pollution Control Status in Foundries**

A report on performance study of cupola and pollution control devices in foundries located at Howrah has been prepared. The report reveals that most of the foundries could not meet the standards. Adoption of divided blast in place of single blast improved the thermal efficiency of cupola to large extent but other parameters like shaft height, cupola diameter, blast volume etc. were not properly optimised in most of the foundries. As a result, level of pollution could not be minimized through in-plant pollution control. It was observed that improvement in cupola design considering most of the parameter, made the cupola most efficient as reflected from metal coke ratio (12:1). The pollution control devices fitted with cupola is not properly maintained which in turn, reduces the effectiveness of these devices. Some of them were not found very effective. During investigation, it was revealed that most of the foundries were running without putting much effort to charge the raw materials, flux, coke and air for complete combustion and energy utilisation.

**Pollution Control Status in Galvanizing units and Re-rolling mills**

In Howrah and Kolkata the galvanizing units operate in thickly populated areas. The number of units in different clusters produces huge quantity of obnoxious fumes, without any pollution control devices, causing severe pollution in surrounding areas. CPCB has taken up a project to assess the quantity of fumes generated in these

units as well as to characterize the wastewater discharged through drains. In same manner, quantification of pollution load in re-rolling mills has been carried out. Though, these units are in small scale sector but quantity of pollutants generated by these is significant.

**Pollution Control Status in Coal Washeries**

Four coal washeries in Bihar were selected for in-depth study to ascertain the effectiveness of common coal washing processes like jig, heavy media bath, heavy media cyclone, froth floatation and hydroclone in these washeries in terms of recovery of washed coal. The products of coal washeries in the form of washed coal, middling coal and reject coal were quantified to assess the quantity of fine coal ultimately discharged with the effluent. The treatment efficiency of settling tank was evaluated to justify the claim of zero discharge.

**Pollution Potential of Mines**

To study the pollution potential of various mines, chromite mines in Sukinda Valley, Orissa, were inspected and monitored. It was observed that huge volume of water containing chromium in hexavalent form in the range of 0.02-4.0 mg/l is discharged to adjacent water bodies. The overburden is dumped by the side of quarries and their slopes are exposed to sun, wind and rain. As a result, soluble metals are leached out and ultimately reached to the water bodies. Treatment facility available is very limited.

Coal mines in Talcher area were also inspected and monitored. Most of the mines are open-cast. Impact of mining on environment was assessed. Surface miners are being used in Kalinga open cast mine and appear to be environment friendly for primary rock excavation.

**Environmental Management in Thermal Power Plants of West Bengal**

The State of West Bengal has 15 Thermal Power Plants (TPPs) among which the inspection has been underwater at TPPs having power generation capacity more than 100 MW. All the units are located near the banks of the rivers. These rivers serve both as a source of water supply and also the recipient of effluent from the industry. All the units inspected were coal fired using coal with an average ash content of 30-40 per cent. Almost all the plants have installed electrostatic precipitators for air pollution control, but their performance varies due to poor maintenance, faulty repair work or non-operation of some passes. Control of fugitive emission at the coal handling areas and ash-handling areas are poor. Some plants are enhancing ash pond capacities by raising dykes. Ash utilisation needs to be boosted since users are still wary of the strength of ash bricks versus clay bricks.

**Performance Study of Coke Oven By-product Plant**

In an integrated steel industry, wastewater generated from Coke Oven By-product Plant (COBP) considered to be major polluting stream containing toxic chemicals like phenol, cyanide and ammonia. In recent times COBP effluent is treated by biochemical oxidation of cyanide, ammonia and phenol at separate effluent treatment plants, commonly known as bio-chemical oxidation & dephenolisation plants (BOD plants). The treated effluent from BOD plant is recycled for use in quenching hot coke in coke-ovens, however, excess treated water has to be discharged into common outlet drain of steel plant. Almost all the integrated iron and steel industry have installed BOD plants. Wastewater reduction in COBP involves reduction of pollution load in process wastewater and proper operation of BOD plant. A detailed study was conducted to evaluate the performance of BOD plants. The performance of BOD plant depends on proper design, inlet concentration, type of treatment units, operation and maintenance and trained manpower. The experience of the steel industry indicates that it is difficult to meet stipulated norms for cyanide and ammonia.

**Lead Smelting Units in and around Kolkata**

Many secondary lead smelting units are operating in the country to recover and re-use lead from waste scrap. However, the process of secondary lead smelting itself generates lead bearing solid waste from which further recovery is not economical. It also generates lead-bearing emissions. Kolkata is one of the oldest and major manufacturing centres of unorganised automobile battery. Lead from lead plates in battery manufacturing units were sourced mainly from secondary lead smelting units located in various clusters in and around Kolkata. The study was aimed to ascertain the present pollution potential of these units. The overall findings of the study are:

- All the units have installed adequate emission control facilities;
- The pollution control equipments are also economical, as further recovery of lead is possible from the dust arrested in these equipments; and
- Most of the units are able to meet the standards as prescribed by the West Bengal Pollution Control

Board.

Non-recyclable slag is the solid waste from secondary lead smelters. This waste is hazardous in nature and poses major problem at present due to non-availability of safe and notified hazardous waste disposal site. Presently, all the industries are collecting these wastes in a secure dump yard within the premises, from where the possibility of mishandling and disposing of solid waste to low lying area is very high.

**Prevention and Control of Pollution in Tanneries**

Tanneries occupy an important place in an overall industrial scenario in Uttar Pradesh. In Kanpur and nearby city of Unnao, there are more than 400 tanneries operating on different scales of production. The tannery cluster in Jajmau at Kanpur comprises of 354 tannery units, which are engaged in chrome and vegetable tanning operations. Highly polluted wastewater (approx. 9 MLD) is generated from this cluster. Although Common Effluent Treatment Plant (CETP) has been established for treatment of wastewater from tanneries, because of poor CETP performance there are reports of groundwater contamination in areas where the treated wastewater is utilised for irrigation is adversely affected on account of high content of chromium in the wastewater. In order to address the problem of chromium contamination following steps are identified which are in different stages of execution: Identification and categorization of tanneries to enforce the measures to recover chrome from their wastewater, commensurate with their economies of scale;

- Interaction with Uttar Pradesh Pollution Control Board to issue notices to all the tanneries processing 50 hides per day or more to establish individual Chrome Recovery Units (CRU). Accordingly 117 notices were issued to various tanneries unit;
- As a result of continuous follow up, 16 CRUs are established so far rising from initially 6 CRUsand 20 others are in different stages of construction. The other tannery units of the area are actively being pursued and there are active consideration to initiate legal action against defaulters units; and
- For smaller tanneries (processing less than 50 hides), efforts are being made to establish a common CRU in Kanpur. The matter has already been discussed with experts from Central Leather Research Institute, which has been assigned the task of preparation of feasibility report for the common CRU. CLRI will shortly commence the study, meanwhile interaction are on to mobilise financial resources through concerned departments.

**Mercury Balance in Coal based Thermal Power Plants**

The presence of mercury in the environment in Singrauli coal belt of Uttar Pradesh is of concern. Therefore, CPCB took up a study to investigate the mercury balance in the area to ascertain the route of mercury emissions from various sources including several thermal power plants in the area. The study was done in three thermal power plants viz: Anpara (Renusagar), Shaktinagar and Rihandnagar. The mercury matrix studied included ambient air quality, stack emissions, bottom-ash and coal feed-stock. The findings of the study are outlined below: Coal samples collected from stockyards of different thermal power plants indicated that mercury content in coal varies significantly from plant to plant

- Comparing the relative percentage in particulate and gaseous state of mercury emissions, it was observed that mercury is predominantly present in gaseous state
- After analysing different monitored sources of emissions, it has been derived that highest contribution of mercury is through the stack emissions
- Size of (pulverised) coal particles constitute an important factor to decide the state of mercury (gaseous / particulate)
- With increase in size of coal particles, the percentage of particulate mercury increases in comparison to gaseous state mercury.

**CETP Tarapur, Maharastra**

The industrial area of Tarapur, Maharastra, has been identified among the 24 problem areas in the country by CPCB. One of the major action point in the time-targetted action plan was augmentation of existing CETP to accommodate all the small scale units. The Tarapur Industries Association has completed the task and enhanced the capacity of CETP, which is approx. 1000 m 3 /day. The average effluent receiving from 207 member industries is approx. 1005 m 3 /day. The treated effluent is finally disposed into the sea through closed pipeline. The analysis study reveals that CETP is not working efficiently to treat the effluent at desired level. The major parameters like BOD, COD, chloride, TKN and nitrate were found to be very high against the prescribed standards. This is mainly due to the non-compliance of inlet norms of CETP by the individual units.

**Pollution Potential in Petro-chemical Industries**

To assess the pollution potential of petro-chemical industries, M/s IPCL, Nagothane and M/s Reliance Petrochemical Industries, Hazira were taken up during the year. IPCL, Nagothane is using lean gas at cracker unit for the production of various petrochemical products, emitting negligible emissions of SO 2 and other air pollutants. However, handling of solid waste by IPCL was observed inadequate, as no proper place for solid waste disposal has been developed.

There was no significant problem in the effluent treatment plant provided by Reliance Petrochemicals, Hazira, but air pollution control devices were not working satisfactorily. Benzene vapour to the extent of 100 ppm has been observed in emissions from the stack attached with benzene recovery system. Further, significant amount of hydrocarbon was measured at various stacks attached with the process.

**Guidelines for Control of Pollution from Distilleries**

The salient features of the guidelines as reviewed by CPCB are as follows:

***A. Methods of Treatment***

The distilleries may adopt any or combination of the following measures:

- Composting of spentwash with pressmud/baggasse/agro-residues by primary treatment (anaerobic digestion with methane recovery) and necessary measures to prevent contamination of groundwater due to leachates.,
- Concentration and Incineration of spentwash.
- Primary and Secondary Treatment and utilisation of treated effluent for irrigation to meet the norms of 500 mg/l of BOD and 2100 mg/l of TDS for use of treated effluents in irrigation as per protocol developed by IARI. Since inorganic constituents of wastewater are of primary concern for land application of the wastewater. It is suggested that the wastewater with TDS limit of 2000 mg/l may be stored in lined storage tanks, during the period when it is not used for irrigation.
- Primary and secondary treatment followed by either dilution with process water and tertiary treatment or mixing the treated effluent with the sewage for terminal treatment in the Municipal Sewage Treatment Plants.
- Any other method to ensure compliance of prescribed norms.

***B. Operation and Maintenance of ETPs***

- Performance assessment studies are to be carried out in each distillery to evaluate the energy requirement and efficiency of individual units of the ETPs vis-a-vis design parameters. Performance of the ETP's is to be periodically checked on the basis of records of energy consumption through dedicated energy meters provided for ETPs and operating parameters including MLSS & DO in aeration Tanks.

***C. Discharge of Effluent***

- Discharge of effluent directly or indirectly through the drains into the drinking/bathing water courses should be avoided because of offensive colour of the effluent, even in case the treated effluent meets the BOD norms of 30 mg/l. Where even it is unavoidable, distilleries must ensure colour removal from the effluent besides conforming to the prescribed BOD limits depending upon the conditions.
- The studies pertaining to composting of distillery waste was carried out at M/s Shakti Distillery, Erode, Tamil Nadu and M/s Gemini Distilleries, Nanjangudu, Karnataka.

**Project on Distillery Unit Compost**

A project on distillery units compost was initiated and seven distillery units were inspected to collect the information. The study reveals that bio-methanation reduces the BOD and COD load by about 60% and 90% respectively and use of generated methane gas reduces the consumption of fuel by 65%. Thus, disposal of "spent wash" from distillery by making the "compost" is one of the most viable options. The ground water analysis results show that manufacturing and application of compost does not cause any significant ground water pollution as on date. On the other hand, the yield of sugar cane and quality of sugar is reported to have increased by 8-10% due to the use of compost made out of spent wash and press mud. Also, the study reveals that COD concentration of spent wash is also influenced by the temperature maintained in the distillation column. However, a thorough study

is required to examine the long-term impact of distillery unit compost application on soils.

## ENVIRONMENTAL STANDARDS

**Development of Toxicity Based Standards**

A two - year project has been initiated by the Central Pollution Control Board involving three other laboratories i.e. Gujarat Pollution Control Board, Gandhinagar, National Institute of Occupational Health (NIOH), Ahmedabad and National Environmental Engineering Research Institute, Nagpur, to develop toxicity based Minimum National Standards (MINAS) for dye and dye intermediate industries. The project has been completed in the year 1999-2000. In order to develop and finalize the standards, the standardized test method was adopted, which is based on dimensionless toxicity factor. The method was also adopted as a Standard method by the Bureau of Indian Standards (BIS) in its meeting held during November, 1999.

Studies have been undertaken at selected group of Effluent Treatment Plants (ETP) of Dye & Dye intermediate industries. Thirteen ETPs including one CETP were selected to provide proper representation of all the seven categories of Dye & dye intermediate industries. The selected ETPs are located in the state of Gujarat (Vapi, Valsad and Ahmedabad) and Maharashtra (Thane, New Mumbai and Roha).

The monitoring of treated & untreated samples from 13 treatment plants were jointly carried out by all the participating laboratories thrice. The summary of the observations made on the basis of the results obtained is presented in following table.

**Toxicity Factor (T F in Effluents of Dye & Dye Intermediate Industries)**

| Category of Industry | No. of Treatment Plant studied | Range of Toxicity Factor (T F ) | | Range of toxicity reduction in % |
|---|---|---|---|---|
| | | Before treatment | After treatment | |
| Small scale | 3 | 8 - 250 | 1 - 2 | 75 - 99 |
| Large/ Medium scale | 9 | 8 - 250 | 1 - 4 | 50 – 99 |
| Combined Effluent Treatment | 1 | 32 | 4 | 87.5 |

Based on the observations of the study, it is recommended that toxicity factor in dye and dye intermediate industries may be considered as 4.0 for Minimum National Standard (MINAS) in treated effluents dye and dye intermediate industries. This implies that the treated industrial effluent should not depict acute toxicity for fish, if diluted four times.

**Preparation of Manual on Risk Assessment**

The chemical industries form a vital part of the Indian economy and their contribution towards the country's prosperity is undisputed. However, these industries should not pose hazards to workers and community as a whole. There is need to develop a tool to establish the hazard potential of chemical industries in order to implement mitigative and safety measure. With this in view, the Central Pollution Control Board has taken-up a project to develop a manual for risk assessment in chemical industries. The various attributes concerned to risk

have been considered in evolving the manual for quick assessment of the risk potential of an industry. The main aspects comprise failure probabilities, frequency, consequence distance, location sensitivity and managerial capabilities. Assessment of these factors is based on several attributes, which will be closely examined during the study. The manual to provide basis for classifying the industries with respect to their risk potential and to help in drawing mitigative and safety measures.

**Review of Environmental Statements**

The Ministry of Environment and Forests, Government of India issued notification for submission of ' *Environmental Statements* ' (ES), by the industries to the respective State Pollution Control Boards (SPCBs) in April, 1992 and further amended in April, 1993. Environmental Statement is a pro-active tool for self-examination of the industry itself to reduce/minimise pollution by adopting process modifications, recycling and reusing of the resources. Regular submission of ES will indicate the systematic improvement in environmental pollution control being achieved by the industry.

In order to assess the efficiency of ES programme, a national project has been taken up by the Ministry of Environment & Forests and is being implemented by the Central Pollution Control Board. In this project, thirteen industrial sectors have been identified for collection of respective ES submitted by the industries to respective State Pollution Control Boards in the country to assess trend of improvements and constraints, sector wise, to draw national long term programmes.

The Central Pollution Control Board has in collaboration with specialists has taken up the work of following sectors i) tanneries ii) bulk-drug industries iii) thermal power stations and in the process of taking-up studies in following sectors i) distilleries ii) sugar industries iii) cement industries iv) iron & steel plants v) textile industries vi) fertilizer industries vii) pesticides industries viii) petrochemical plants ix) pulp & paper industries x) oil refineries.

**Minimum Level of Production in Small-scale Industries**

Small-scale chemical manufacturing sector has grown phenomenally in the last three decades and producing wide range of organic chemical intermediates and finished products. The manufacturing of organic chemical intermediates involve a number of unit processes and operations, thus, generate process waste, having high variations in quantity and quality. The production capacity in small-scale industry units being small, it becomes difficult and uneconomical to treat the emanating effluents before the disposal.

The Central Pollution Control Board took up a project to study, whether certain critical chemicals produced by the SSI sector be continued or whether some minimum level of production be fixed to ensure pollution control.

Comprehensive review revealed that 750 chemicals are produced by SSI sector in the country. Considering large number of manufacturing units, usage of wide variety of organic chemicals exhibiting varying degree of toxicity, variety of unit operations and share of the total chemical production in SSI sector, dyes & dye intermediates, drugs & drug intermediates, pesticides & pesticide intermediates and leather chemicals have been given special emphasis under this study.

Among the 750 chemicals produced in SSI sector, 57 have been graded as toxic and classified into three tracks considering acute toxicity, specified long-term effect, bioaccumulation and persistence. The number of chemicals grouped, in each track are as follows:

| | | |
|---|---|---|
| 12 | Chemicals are identified as highly toxic | Track 1 |
| 19 | Chemicals are identified as medium toxic | Track 2 |
| 26 | Chemicals are identified as low toxic | Track 3 |

Ratio of annual burden due to pollution control (AB) to annual turnover (AT) has been used as a tool for calculating the desired level of production considering a minimum of physico-chemical treatment, before sending the effluent to CETP. The AB/AT ratio is found between 1.0 & 1.5 when the production is 600 TPA, which holds good and impact on cost per kg of product is minimal. Whereas, incineration of wastewater is felt compulsory for the chemicals manufacturing units (even with 1000 TPA production), the AB/AT ratio is falling between 4 & 5, which is a constraint.

**Software Package for Assessment of RIsk Potential in Chemical Industries**

The Central Pollution Control Board developed a software package for assessment of risk potential of chemical industries, which involved in batch processing with the help of environment consultant. This software would be

useful as a tool to assess the status of risk due to location, storage of chemicals/handling/processing of hazardous chemicals and management capabilities to determine the level of safety measures taken by the industries to minimise/avoid chemical hazard and accidents. In addition, it will help in preparing precautionary/safety measures to reduce risk potential.

In chemical industries, varieties of chemicals including solvents are used as raw material. Storage, handling and processing of these chemicals needs special care, lack of such care leads to accidents, which may turn out to be pool fires/fire ball/flame jet/vapour cloud explosion depending upon the constituents and their characteristics. Once there is an accident, release of toxic gases, air pollution etc. invite the care/attention of the regulatory authorities. Therefore, it is considered that while carrying inspection of the industries by the pollution control officers, a rapid assessment of risk potential of the industry may also be covered. With this backdrop, and to classify the industries based on risk potential and likely consequence effect, a user-friendly software package has been developed and proposed to be used by CPCB initially. Later the software is proposed to be distributed to all the state pollution control boards.

**Alternative Technologies for Pollution Control in Vinyl Sulphone Industry**

Vinyl sulphone is generally marketed as the sulphate ester and has the chemical formula H 2 N-C 6 H 4 -SO 2 -CH 2 -CH 2 -O-SO 3 -H. The molecular weight of the vinyl sulphone is 281 and nomenclature is 2-4-(amino phenyl)-sulphonyl ethanol hydrogen sulphate.

The effluents emanating during the manufacturing process are highly toxic and difficult to treat by conventional biological treatment methods. Therefore, these industries are directed to attain zero discharge by local regulatory authorities, which influence the industry to establish incinerators for destruction of toxic wastes. These proceedings led to more investment and operation & maintenance costs for pollution control by the vinyl- sulphone manufacturing industry.

Therefore, to extend technical support to the industry in pollution control, the Central Pollution Control Board in association with the National Chemical Laboratory (NCL), Pune studied the vinyl-sulphone industries in India, to suggest process modifications and technologies for better pollution control.

**Development of Standards**

The Central Pollution Control Board (CPCB) has been allocated a fund of US $ 1.00 million by the Ministry of Environment & Forests for the sub-component: Development of Standards to be taken up under the World Bank Funded India Environmental Management Capacity Building Technical Assistance Project (EMCBTA). CPCB has identified the projects, which are scheduled for execution in phases till March, 2003. Highlights of some other activities taken up under this project are as follows:

**National Emission Standards for Pesticides Manufacturing Industry**

The Central Pollution Control Board has engaged M/s Shriram Environment & Allied Service, Gurgaon, Haryana to study the Indian pesticides industries for different products, processes, identification of emission sources, pollution control equipment being used, performance of control equipment, cost bearing on the industries due to the emission control etc. The local consultant has completed the study and submitted the findings including the in-depth studies to be carried out in seven pesticides industries.

Pesticides industry is critical in terms of raw material usage and final products/by-products demand special care/attention. It is well established that the process of development of industry-specific-standards considers techno-economic feasibility as the criteria. This criteria demands the review of technologies for control of pollutants emanating from the industries and cost implications due to such pollution control equipment and bearing on health & environment. Therefore, looking at the complexity, foreign consultant has been engaged to review the findings of the study conducted indigenously and to suggest the best practices being followed in advanced countries, and options for improvement in terms of technologies ( *best available & best practicable* ) suitable to Indian pesticides industries.

**National Emission Standards for Petrochemical Plants**

The Central Pollution Control Board has an environmental consultant to study the Indian petrochemical plants for processing of various petrochemicals, identification of emission sources, pollution control equipment being used, performance of control equipment, cost bearing on the plants due to the emission control etc. The consultant is

conducting in-depth studies in petrochemical plants and nearing completion.

Petrochemical plants involve cracking of different feedstock to separate various petrochemicals. These petrochemicals are further reformed to get desired end-use products. As number of petrochemicals are being produced in India in varying capacities, the emissions arising from the process are varying in characteristics and in general the process-vents are either let-out or subjected to flaring or incineration depending upon the pressure. Besides these process-vents, a considerable amount of emissions escape the system in the form of fugitive emissions (VOC). It has been considered that the process equipment can be modified to restrict the fugitive emissions and the process-vents shall be collected to box-flaring/incineration. Precisely, it is aiming for the review of process technologies, equipment besides conventional approach to review control equipment and their efficiencies, monitoring etc. Considering these, M/s Lurgi (India) Company Limited, Delhi comprising experts from Germany, a process technology development company, is being engaged for reviewing the status of indigenous petrochemicals plant and to explore the options for equipment modifications, control of emissions etc. and retrofitting of developed criteria.

**Control of Total Dissolved Solids in Industrial Effluents**

The Central Pollution Control Board has engaged the National Chemical Laboratory (NCL), Pune to study the pesticides, bulk-drugs, tanneries and dye & dye intermediate manufacturing industries to assess the present practices of control of total dissolved solids (TDS) level in various effluent streams, process modifications needed toavoid/reduce TDS generation, control equipment and their feasibility. Within the scope of study, some industries in each sector have been studied by CPCB & NCL teams to assess the status of TDS conc. in industrial effluents and their control. It has been seen that when the control technologies available for TDS are compared, each system has their merits as well as limitations. It has been concluded that the issue of TDS management should be seen holistically *i.e.* i) control at the source by process modifications & control equipment as far as possible ii) Utilising available dilution to the wastewater as long as not impairing any treatment systems. It implies that the available dilution in sewerage network may be explored to such an extent that mixing with sewage can be attained to such a level where there is no interference in treatment of sewage; iii) Wherever, such sewerage facilities are not available, minimum possible dilution available in natural water bodies may be explored. The discharge of TDS containing effluents to rivers/ lakes should be limited to the extent so that the TDS level of the water body is maintained within the potable limits iv) Where there are no options of either sewerage system or natural streams is available, the industries shall relocate their principal activities causing generation of TDS, near coasts so that after required treatment, effluents may be disposed into the sea.

A strategy for exploring all the possibilities to relieve the industries from economic burden because of control of TDS and to protect receiving environment, has been proposed and is being considered for development of national standards.

**New Projects Initiated**

- Development of Rationale for Prescribing Location specific Standards
- Control of Volatile Organic Compounds in Industrial Emissions
- Development of National Emission Standards for Oil Refineries

**Overseas Training on Development of Environmental Standards and their implementation**

The Central Pollution Control Board, with the aim to study the approaches adopted by the advanced countries, and their experience, has taken up the project for developing guidelines, so that suitable modifications, if any, to the existing rationale and implementation strategies can be made. In this regard, a training has been arranged in selected European countries for officers of CPCB, SPCBs & MoEF to familiarise with the approaches/ strategies followed in leading European countries.

The Network for Preventive Environmental Management (NetPEM), a representative of the International Institute for Industrial Environmental Economics (IIIEE), Lund University, Lund, Sweden, arranged the training programme in five European countries during August, 2000. In this programme, eight officers from MoEF, CPCB and SPCBs have participated.

**Development of Certified Reference Material (CRM's) for Toxic Metals in Industrial Effluents**

Trace metals are on one hand essential micronutrients, while on the other hand these may pose significant health hazard at elevated concentrations. The trace metal studies in environment, therefore become an area of significant concern imposing research priority on availability, behaviour and fate of trace metals in the environment. The need of standards for accurate measurements of trace metals during environmental monitoring is well recognised.

Standard reference materials (SRM's) are well characterized materials utilized during analytical measurements to ensure the analytical quality. The use of certified reference material (CRM's) in analytical measurements for trace metals is increasing day by day, alongwith quality consciousness of analytical results. But the availability of CRM's, of the shelf and at economical cost are important aspects requiring immediate attention. The need for development of CRMs for heavy metals in the country for environmental measurement has been realized and accordingly Central Pollution Control Board (CPCB) has undertaken a project for development of CRM's for toxic metals. Department of Science & Technology (DST), New Delhi has sponsored the project.

During the Ist Phase of the Project, the Certified Reference Material for Nickel and Chromium have been proposed to be developed for use of environmental organisations. In order to develop the CRM's from effluents of electroplating industries, the effluent samples from various electroplating industries have been collected and analysed for Chromium, Copper and Nickel.

Based on the preliminary studies, standard solutions have been prepared in the laboratory and electroplating industrial effluent have been utilized for developing CRMs of Chromium, Copper and Nickel metals and distributed to 32 reputed environmental and R&D laboratories in the country for analysis, in order to certify their Reference value.

## Hazardous Waste Management


The project on inventorisation and management of hazardous waste in various states was taken-up, with a view to identify hazardous waste generating industries, quantification of hazardous waste generated, present hazardous waste management practices adopted by various industrial sectors and proposed hazardous waste management plan for the state. So far, CPCB has published the study reports for the states of Punjab, Gujarat, J&K, Kerala, Orissa and recently for the state of Andhra Pradesh and National Capital Region (Noida, Ghaziabad, Meerut and Faridabad).

The Ministry of Environment & Forests, Govt. of India has notified the Hazardous Waste (Management & Handling) Amendment Rules, 2000 vide notification No. SO 24(E), dated January 6, 2000. According to the rules, the hazardous wastes are defined as:

1. Waste substances which are generated in the process indicated in column 2 of schedule 1, and consist of wholly or partly of the waste substances referred to in column 3 of the same schedule.
2. Waste substances which consist wholly or partly of substances indicated in schedule 2, unless the concentration of substances is less than the limit indicated in same schedule and
3. Waste substances indicated in part `A' of schedule 3 applicable only to the import and export of hazardous wastes unless they do not possess any of the hazard characteristics as indicated in part `B' of the same schedule.

In the light of amended Rules, CPCB has undertaken the project on identification of hazardous waste streams in various industrial sectors, their characterisation and waste minimisation options, with a view to identify and characterise hazardous waste streams from each process, estimation of hazardous waste generation per tonne of product, and to assess the scope of pre-treatment, reuse & recovery of hazardous waste generated from each stream and also to propose the waste minimisation option to be adopted for reduction of hazardous waste generation. During this year, the study has been taken-up for Pesticides, Dye & Dye Intermediates and Petrochemical Sectors.

CPCB has also undertaken the project on Assessment of Hazardous Waste Management in Caustic Soda Industries, Oil Refineries and Fertilizer Sectors with a view to estimate the various types of hazardous waste generation and status of hazardous waste management practices adopted by each industry. The report on technology development and control of pollution in caustic soda industries is under documentation.

According to the Hazardous Waste Management Rules, as amended, the wastes are classified based on the process and hazardous waste streams, waste substances with concentration limits and waste characteristics. In view of the importance of analysis and characterisation of waste, for classification as hazardous waste, in the laboratories of State Pollution Control Boards, CPCB sponsored the 4-days hands-on training programme for the officials of all State Pollution Control Boards, on "Sampling, Analysis and Characterisation of Hazardous Waste". The monitoring protocol has been circulated to all the SPCBs which may help in establishment of laboratory facility for analysis of hazardous waste.

## Decentralised & Cost Effective Treatment Technology


In the decentralised treatment system of domestic wastewater, a balance between the advantages of large scale treatment in terms of economics of scale and individual responsibility for domestic wastewater treatment can be obtained by providing colonywise/sectorwise treatment system.

The first meeting of the Expert Committee on Decentralised and Cost-effective Treatment Technology (DTS), under the Chairmanship of Dr. G.D.Agarwal, was held on 21 st Sept 2000. After detailed discussions, following decisions were taken:

- A concept paper to be prepared by CPCB;
- CPCB will interact with Madhya Pradesh Pradushan Nivaran Mandal and Raipur Municipality for implementation of DTS in the new capital area to come up in Raipur for the new State of Chhatisgarh;
- A meeting of builders and developers will be organised to bring awareness among them about DTS; and
- CPCB should interact with the concerned agencies for the implementation of this approach in the new capital areas in Uttaranchal and Jharkhand.

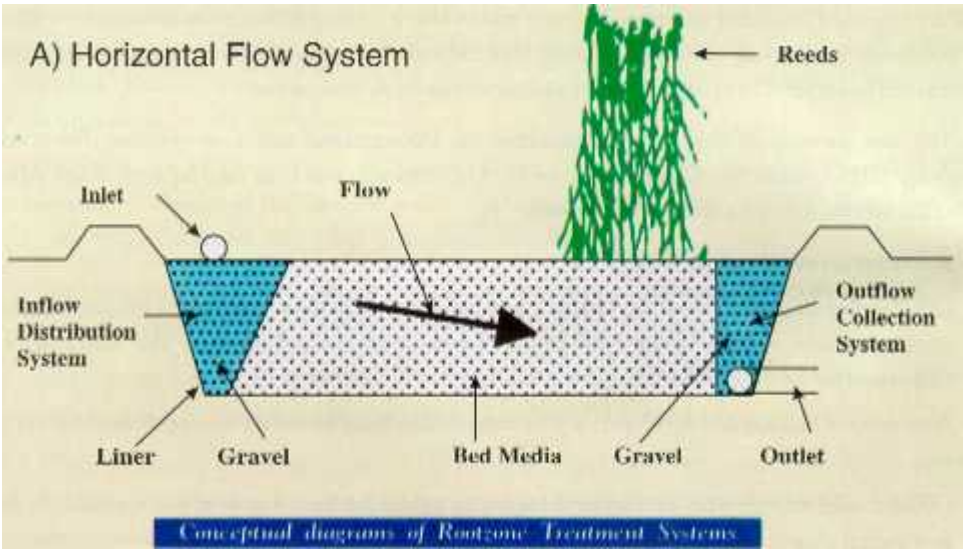
## Root Zone Treatment System

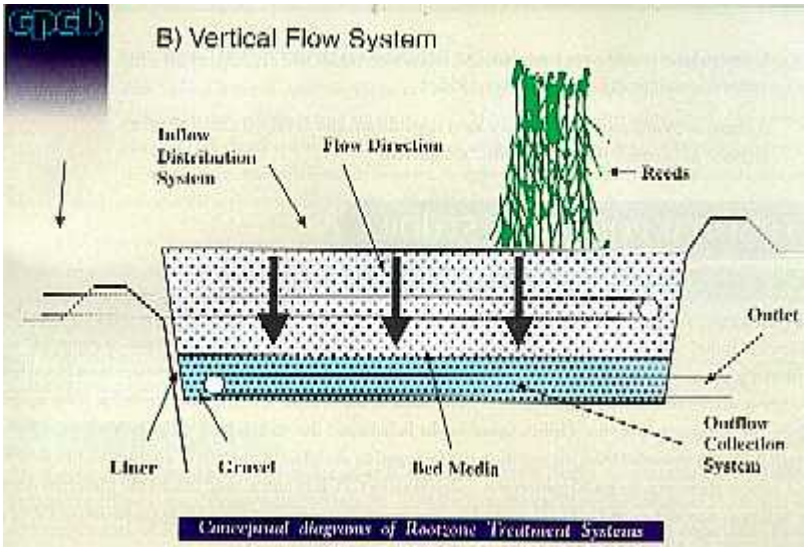
Root Zone Treatment Systems (RZTS) are artificially prepared wetlands comprising of clay or plastic lined excavation and emergent vegetation growing on gravel/sand mixtures and is also known as constructed wetland. This method combines mechanical filtration, chemical precipitation and biological degradation in one step for the treatment of wastewater. Seemingly, low operating cost, less energy requirement and ease of maintenance are some of the attributes that makes RZT system an attractive alternative for wastewater management.

CPCB in collaboration with GTZ, Germany, has taken up a pilot plant study on RZTS of dairy effluents at Mother Dairy, Delhi. At Mother Dairy, two RZTs pilot plants have been constructed - horizontal flow and vertical flow. The load will be increased gradually to find out the performance of this plant in terms of area requirement and desired effluent quality. The size of the horizontal filter bed is 6 m x 4 m x 0.6 m and bottom is lined by plastic liner. The concrete bottom vertical filter bed is 2 m x 2 m x 2 m. The design criteria of the filter beds are as follows:

| **Characteristics** | **Horizontal RZTS** | **Vertical RZTS** |
|---|---|---|
| Area | 4 m2/PE | 2 m2/PE |
| BOD Load | 10 g/m2/day | 20 g/m2/day |
| Hydraulic Load | 12.5 l/m2/day | 25 l/m2/day |

*PE is Population Equivalent*




B) Vertical Flow System
Inflow
Distribution
System
Flow Direction
Reeds
Outlet
Outflow
Collection
System
Liner
Gravel
Bed Media
Conceptual diagrams of Rootzone Treatment Systems

## ENVIRONMENTAL RESEARCH

Standardisation of method for analysis of Adsorbable Organic Halides (AOx) was taken up in collaboration with Thapar Centre for Industrial Research & Development, Patiala; Central Pulp & Paper Research Institute, Saharanpur and Gujarat Pollution Control Board, Gandhinagar.

- A technology for the process of preparation of microbial composition useful for reproducible BOD estimation has been developed by the Centre for Biotechnology (CBT) and CPCB. This technology has been transferred to M/s Indo Bioactive Labs (P) Ltd, Pune. Use of synthetic microbial culture in place of sewage as seed material in BOD tests has been approved by DST.
- Development of toxicity standards for Dyes and Dye intermediate industries has been taken up in collaboration with Gujarat Pollution Control Board; NEERI, Nagpur and NIOH, Ahmedabad. Three rounds of sampling completed.
- A study on Biodegradation of synthetic textile dyes has been taken up. Synthetic dyes were tested in batch mode by developing acclimatised microbial mixtures.
- A project on using natural low cost adsorbents has been attempted. A comparison has been made to study colour removal efficiency of activated carbon with low cost and easily available adsorbents.
- Fourteen laboratories were considered for recognition as Environmental Laboratories under Environment (Protection) Act, 1986.
- A study on "Vinyl sulphone-sulphate ester upgradation and development of alternate technology to ensure pollution control" completed.

## EPISODAL POLLUTION STUDIES

### Groundwater Contamination at Sahibabad Industrial Area

The news item "Effluent Poison Water at 200 ft. in Ghaziabad, Delhi is not safe either" was appeared in the "Times of India" dated 13 th July 2000, which states that the bore well sunk at the depth of about 240 ft. within a beverage unit premises at Sahibabad site IV Industrial Area is yielding groundwater from blood red to lighter shades and the bore wells of some other units in the vicinity also started sweeping reddish water. There are apprehensions that Delhi's water might be affected due to travel of underground water from Ghaziabad area towards Delhi. To ascertain the facts and to decipher the extent of groundwater pollution and its possible source, an investigation was undertaken by CPCB in and around Sahibabad Industrial Area as well as at border belt of Delhi-Ghaziabad to investigate the apprehension of contamination of Delhi's groundwater as a result of underground water travel.

During the investigation, 26 groundwater samples were collected within and around the Sahibabad Industrial Area, while eight groundwater samples were collected from Delhi-Ghaziabad border belt and analysed for various physico-chemical parameters including major/minor constituents, trace metals and bacteriological parameters. Some samples have also been analysed for the pesticides.

The results indicate high electrical conductivity and total dissolved solids. Chlorides in the samples ranged between 34 mg/l to 1741 mg/l depicting higher salinity. Total hardness has been violated in 50% of the groundwater samples collected from the area, while total alkalinity was well within the limit except two samples collected from Ramprastha and Rajinder Nagar. The groundwater depicted absence of total coliforms in five samples and fecal coliforms in 18 samples out of 26 groundwater samples analysed. The total coliforms have been found maximum in hand pump water collected from Sector - 3, Rajinder Nagar. Majority of coliform contamination has been observed in groundwater samples drawn from hand pumps, i.e. from shallow depth aquifer.

The trace metal contents in groundwater samples have been found well within the BIS permissible limits except presence of elevated levels of iron in nine samples, mostly drawn from hand pumps. The organo-chlorine and organo-phosphorus pesticides have been analysed in seven samples, out of which total BHC has been observed in four samples, Dieldrin in two samples, and total DDT and total Endosulphan in one sample each.

The colour of groundwater has been found offensive in five samples. Out of the two samples collected from the premises of M/s Moon Beverages, Sahibabad Industrial Area, one bore well sample was having intense reddish yellow colour with 461 Hazen unit colour intensity against maximum permissible colour intensity of 25 Hazen unit. On the other hand, groundwater samples collected from other tubewells from same premises and sunk at same depth has not depicted any coloured substance in water. It suggests that the presence of coloured substance in water is location specific and not widespread throughout the area.

The physico-chemical characteristsics of groundwater samples collected from Delhi-Ghaziabad Border area indicate overall good groundwater quality confirming the drinking water permissible limits, except one sample collected from Rajput Dhaba, Delhi Border. Total coliforms were found in five samples and fecal coliforms in two samples. The samples drawn from border belt have not depicted any trace metals and pesticides contamination. At may therefore, be concluded that the report regarding alleged effects on Delhi's water quality due to reported contamination at Sahibabad Industrial Area has no substance.

### Oil slick in Bay of Bengal

An oil spill in the coastal sea of Bay of Bengal at 10 nautical miles off Hughli river mouth occurred due to sinking of a Fillipino ship "Prime value" on July 26, 2000. Reportedly, a spill amount of about 300 tons of fuel oil formed a slick of 20 m wide and 3 miles long. Immediately after the event a study was undertaken jointly by CPCB and West Bengal Pollution Control Board to assess the impact on coastal ecosystem. The assessment, however, revealed that there was no adverse impact on the coastal ecosystem.

### Environmental Study of Cyclone Affected Areas in Orissa

Natural calamity tends to cause huge loss of life, property and environmental degradation of which some are irreparable. In October 1999, unprecedented cyclone has hit Orissa Coast resulting in large damage to the environment of the State. A study was undertaken to assess the main affected components of environment like water and soil. The study revealed the following facts:

- The surface water quality was grossly affected, particularly in Ganjam District. The coliforms level was high.
- The surface water sources are major source of water use in rural Orissa. Although, the disinfection was practiced in post - cyclone period, still a large population was affected due to poor water quality.
- The open dug-well were also found contaminated due to flood and cyclone. Such dug-wells are also used as drinking water source. People were advised to use the water either after disinfection or boiling.
- The soil quality was found to be not affected significantly.
- It was recommended that sufficient safe drinking water need to be provided in such areas to avoid any epidemic.

## Strengthening of SPCBs and PCCs


Presently there are 25 SPCBs (State Pollution Control Boards) and 6 PCCs (Pollution Control Committees) in the country. Functions of SPCBs/PCCs are enlisted under Section (17) of the Water and Air Act. In order to have effective implementation of these functions, SPCBs/PCCs need proper set up in terms of financial resources, adequate manpower, good laboratory back-up and trained manpower. Some of the achievements of SPCBs are as follows:

- Establishment of Laboratory facilities
- Identification of polluting industries
- Assessment of water and air pollution
- Industries persuaded to set up requisite pollution control facilities
- Performance studies on pollution control facilities
- Consent mechanism within the state

In addition to the implementation of Water and Air Act, SPCBs and PCCs have to undertake many activities under the following important legislations:

- Hazardous Waste (Management & Handling) Rules, 1989 (amended in 2000)
- Manufacture, Storage and Import of Hazardous Chemical Rule, 1989 (amended in 2000)
- Bio-medical Waste (Management and Handling) Rules. 1998
- Recycled Plastics Manufacture and Usage Rules, 1999
- Municipal Solid Waste (Management and Handling) Rules, 2000

After reviewing the activities to be performed by SPCBs/PCCs under above mentioned Rules, it has been proposed that SPCBs/PCCs may set up a separate group or a cell to handle the issue relating to new rules. Each SPCB should set up the cell to deal specific rules, in particular,

- Bio-medical Waste (Management & Handling) Rules, 1998
- Recycled Plastics Manufacture and Usage Rules, 1999
- Municipal Solid Wastes (Management & Handling) Rules, 2000

It has been calculated that total funds required for effective implementation of these rules by all the SPCBs and PCCs will require a sum of Rs. 27.70 million.

## ENVIRONMENTAL STATUS

**Bhopal**

The noise levels in Bhopal City is exceeding the limit prescribed at all the monitoring places under the categories residential, commercial and silence zones. Only exception was Govindpura Industrial Area, where recorded noise levels were within the limits, both during the day & night time. Maximum noise level to which the residents in residential locality are exposed during night time was as high as 85.2 dB(A) in Arera Colony. Similarly, in a silence zone, the maximum noise to which the inmates of Hamidia Hospital are exposed was high as 86.6 dB(A) during day time. Among the commercial areas, Berasia Road was found noisy and the people living in surrounding areas are exposed to very high noise upto 101 dB(A) during day time. In the institutional areas also, noise was found high. Noise level at Vallabh Bhawan, State Secretariat was recorded as 86.4 dB(A) in day time.

As on 31.03.1999, the total registered vehicles in Bhopal were 2,59,171 for a population of 14.00 lakh approximately. In addition to these vehicles, there are 25,652 other vehicles, registered as Govt. vehicles. The vehicular growth has registered annual growth rate of 13.6% during the last eight years and the number of vehicles have nearly doubled from 1,30,317 in 1991 to 2,59,171 in 1999. The highest growth was witnessed in the two wheeler category (109.5%) followed by cars and jeep (87.8%) and passenger vehicles (79.8%).

It is estimated that total vehicular pollution load in Bhopal city is 326.2 MT per day, contributed by both diesel and petrol vehicles in the ratio of 7% and 93% respectively. Out of total pollution load of 326.2 tonnes per day, the major constituent is Carbon Monoxide with quantity of 215.6 tonnes per day followed by Hydrocarbons 92.1 tonnes per day and NO x 13.6 tones per day. The Light Tonnage Vehicles (LTV), including two wheelers were found contributing 84.4% of total pollution load i.e. 275.2 tonnes per day. The Heavy Tonnage Vehicles (HTV) are responsible for emitting large quantities of NO x . Ninety percent of SO 2 emissions were found due to HTV & MTV.

**A study of the groundwater quality in Bhopal was conducted and important findings are as follows:**

- The ground water was found to be hard in most of the locations indicating natural hydrogeological features of Bhopal city.
- In an indicative survey, twenty locations spread all over the city were selected for collection of ground water samples. One time samples were collected from all locations and analysed at Zonal Office laboratory for seventeen parameters relevant for domestic use including drinking.
- At eleven locations, the ground water quality was found satisfactory. Total coliform were found in almost all places except two locations, E-1 Arera Colony & Ahmedabad. Feacal coliform was detected at Panchsheel Nagar and Narela Shankari. Presence of Faecal Coliform at these two locations indicates ground water contamination by sewage.

**Lucknow**

Lucknow the Capital and second largest city of Uttar Pradesh suffers from obvious consequences of rapid urbanization, industrialization and strain in natural and manmade resources. A study was conducted by CPCB during 1996 to ascertain the State of Environment of the city. Later-on during the year 2000, another study was undertaken to update the status. During this study, monitoring of various sources of pollution covering drains, river, water supply, ground water, traffic census, AAQM, auto exhaust monitoring, industries, were conducted. Besides the above various concerned departments like RTO, Jal Sansthan, Gomti Pollution Control Unit, UPPCB, Dept. of Tourism , Nagar Nigam etc. were interacted. Compilation of the data and preparation of the report is under progress. Following observations can be made based on the study-

Entire sewage and a major portion of industrial waste water is still finding their way to River Gomti, without any treatment. However plannings are at their final stage to construct two STPs at Lucknow to treat the sewage.

In many areas of the city, the drinking water is not meeting the desired norms. As compared to 1996 status, an additional filtration plant has come into operation to cope up the water demand to some extent. Still the collection, transfer and disposal of MSW is not being practiced as per the prescribed standards. A common incinerator for bio

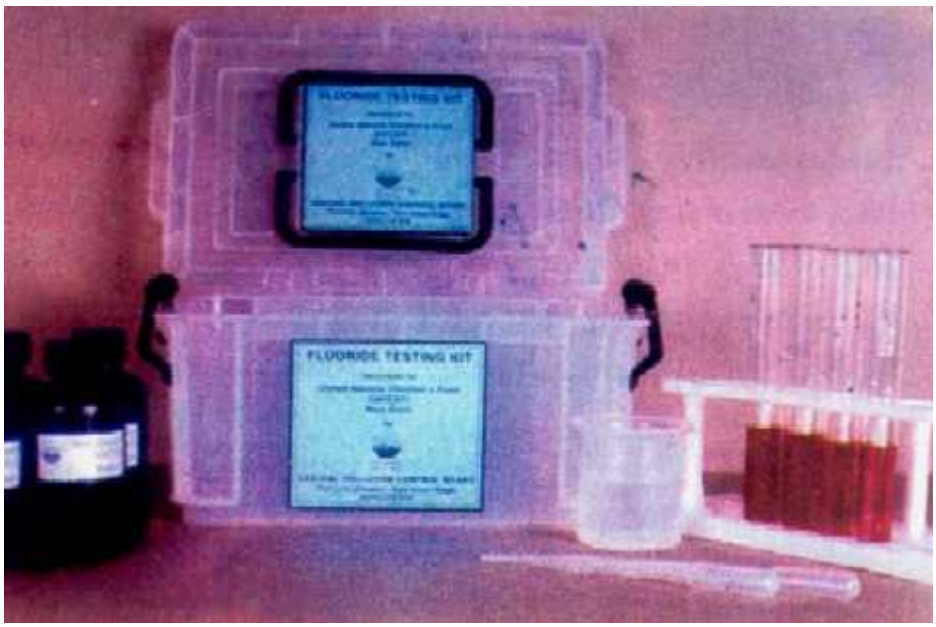
-medical wastes for hospitals of Lucknow has been installed and been given to M/s Surabhi Envirotech to cover 120 nursing homes . The capacity of the incinerator is 75 kg/hr. A number of polluting industries are operating in the city which are not treating their waste waters upto the desired levels and similar case applies with air polluting units also. Disposal of hazardous wastes is also not as per the mark. However some of the industries have improved the pollution control measures. A significant improvement in the traffic flow and ambient air quality was noticed. This is due to banning the tempos in many areas of the city. The tempos now plying are either fitted with scrubbers which reduce the emission load by about 75 % or battery operated. Constructions of fly-overs have also eased the pressure of traffic congestion to a large extent.

**Sundarbans**

A detailed study with respect to various environmental parameters was conducted in Sundarbans ecosystem. The most striking observation was that the Sundarbans sediments contained various heavy metals containment, like lead, copper, chromium, nickel, cobalt, zinc and cadmium, in varying concentrations besides presence of pathogens both in water and sediment.

## DEVELOPMENT AND DISTRIBUTION OF FLUORIDE TESTING KIT

World Health Organization (WHO) has estimated that 80% sickness is associated with contaminated water either from chemical or microbial contamination.With increasing industrialization, urbanization and deforestation, the quality of water resources available to mankind is deteriorating day by day. The supply of drinking water in terms of quality and quantity is also a great concern now a days. Out of many chemical and biological contaminants in drinking water, excessive fluoride is of most concern due to wide spread health symptoms in population of many states in the country but also in various other developing and developed countries.




The fluoride ion has potential beneficial effects but excessive fluoride in drinking water produce objectionable dental fluorosis that increases continuously with increasing fluoride concentration above the recommended control limit of 1.5 ppm (mg/l). Fluorosis, caused by intake of fluoride prevalent in India for six decades, is a slow progressive crippling malady, affects youth and old, poor and rich, rural and urban population and it has attained an alarming dimension. Fluorosis, a disease caused by excessive intake of Fluoride was first detected in India, among cattle by the farmers of Andhra Pradesh during early 1930s. It was during year later, the same disease was detected in human beings also. The study conducted by Rajiv Gandhi National Drinking Water Mission during 1990-92 has reported that 15 states in the country are endemic for the fluorosis. The endemic States are Andhra Pradesh Bihar, Delhi, Gujarat, Haryana, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, and Uttar Pradesh.

Sound management of water resources will pave way for this problem. A better surveillance and monitoring needs water testing facilities, which are to be reliable, accurate and cost-effective. In this endeavour, upon the request and sponsorship of the United Nations Children's Fund (UNICEF), New Delhi, Central Pollution Control Board (CPCB) has developed a small testing kit for fluoride determination for water samples in field as well as in laboratory conditions. One thousand such kits will be distributed to community circles in various parts of the country for monitoring fluoride levels in drinking water. The Kit has been designed and developed by a team of scientists of the Board. This is a small portable kit equipped with required glassware, plasticware, reagents, colour chart and user manual. The method of estimation is based on colorimetric principle using SPADNS [Sodium 2-(parasulfophenylazo)-1,8-dihydroxy-3,6-naphthalene disulfonate] and Ziconium-dye lake reagents. The Kit will be useful to the civic authorities and public at large for monitoring the fluoride levels of drinking water and other water sources.

## PERSISTENT ORGANIC POLLUTANTS (POPS)

Twelve priority persistent organic chemicals (POPs), popularly known as dirty dozen, have been listed under International Convention on POPs. These are Aldrin, Dieldrin, Endrin, HCB, Mirex, Toxaphene, Chlordane, DDT, Heptachlor, PCBs and unintentional by-products, i.e. dioxins and furans. The objective of the international convention is to promote and ensure banning/phasing out/restricting the use of these chemicals by all the countries.

For India, DDT, PCBs and unintentional POPs i.e. dioxins and furans are relevant among the dirty dozen. Other pollutants are either not produced or already banned. Sh. R.B.Committee recommended the following schedule for elimination of DDT production in the country by 2003. However, the alternate economically viable chemicals to replace the use of DDT needs to be identified.

| Year | Max. Production available |
|---|---|
| 2000 | 5000 MT |
| 2001 | 3000 MT |
| 2002 | 1000 MT |
| 2003 | NIL |

Polychlorinated biphenyls (PCBs) require the strategies for restricted application and eliminating the same in long run.The banning or restrictive use of any chemical requires comprehensive study in respect of direct and indirect effects, alternate chemicals, patents, technology availability, industry needs, revenue implications and safe disposal of banned chemicals. The technical calibre may not be a constraint for India, however, other factors such as financial resources, time and infrastructure facilities are limiting factors for POPs elimination programme.

## CPCB PUBLICATIONS DURING 1999-2000


The Central Board continued to collect, compile and publish scientific, technical and statistical reports relating to pollution and the measures to be taken for its effective prevention, control and abatement. During 2000, following publications were published by CPCB.

1. Inventorisation & Management of Hazardous Waste in National Capital Region, NOIDA (Gautam Budh Nagar), Ghaziabad, Meerut & Faridabad
2. Water Quality Status & Statistics (1996 & 1997)
3. Status of Municipal Solid Waste Generation, Collection, Treatment and Disposal in Class I Cities
4. Water Quality Status of Yamuna River
5. Manual on Hospital Waste Management
6. Optimisation of Combustion Efficiency & Control of Emission from Small (< 2T) Boilers
7. Guidelines for Development of Greenbelts
8. Mahanadi Basin
9. Sensitive Zones and Industrial Sites – Bihar
10. Water Quality Assessment during Solar Eclipse
11. Monitoring of Benzene Level in Ambient Air of Delhi
12. Status of Water & Wastewater Generation, Collection, Treatment & Disposal in Class II Towns
13. Status of Water & Wastewater Generation, Collection, Treatment & Disposal in Class I Cities
14. Status of Municipal Solid Waste Generation, Collection, Treatment and Disposal in Class II Towns
15. Comprehensive Industry Document on Asbestos Products Manufacturing Industry
16. Hazardous Wastes (Management & Handling) Rules, 1989 and Amendments Thereof
17. Textile Industry
18. Status of Municipal Solid Waste Generation, Collection, Treatment and Disposal in Metropolitan Cities
19. Common Effluent Treatment Plants
20. Environmental Standards for Ambient Air, Automobiles, Industries and Noise
21. Air Quality Status and Trends in India
22. Basin Sub-Basin Inventory of Water Pollution - The Brahmaputra Basin
23. A Report on "State of Environment - Varanasi"
24. National Ambient Air Quality Status - 1998