

PARIVESH

Newsletter

R & D for Pollution Control: CPCB Initiatives



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PREFACE

Pollution control is a science and technology based activity. For effective measures to prevent and control, it is necessary to develop scientifically sound, user-friendly tools and methodologies. For planning and priority setting in regard to pollution problems, scientific data base and technologies can be developed through sustained R & D initiatives. Hence, as a pre-requisite for its enforcement activities, the Central Pollution Control Board (CPCB) has undertaken R & D projects on its own and also in collaboration with specialized institutions.

The present issue of 'Parivesh' deals with the various research projects of the Central Pollution Control Board including relevant technical data generated out of the research studies. The information contained in this issue has been collated by my colleagues Dr. C. S. Sharma, Senior Scientist; Sh. A. Manoharan, Scientist 'C'; Dr. S. D. Makhijani, Additional Director and Dr. B. Sengupta, Member Secretary. I am grateful to Dr. K. R. Ranganathan for his critical review and suggestions on the background papers prepared for this issue of Parivesh.

We hope, the information on the R & D Projects will be useful to the researchers and others concerned with pollution control activities.

(Dilip Biswas)
Chairman, CPCB

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1.0 INTRODUCTION

The environmental management, pollution abatement and control activities require essential build up of systematic knowledge in multidisciplinary areas through research and development.

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The Central Pollution Control Board (CPCB) as per the provisions in The Water (Prevention and Control of Pollution) Act, 1974, and The Air (Prevention and Control of Pollution) Act, 1981 is required to carryout and sponsor investigations and research relating to problems of water and air pollution and prevention, control or abatement of water and air pollution. CPCB is also required to provide technical assistance and guidance to the State Boards, which are required to evolve economical and reliable methods of treatment of sewage and trade effluents taking into account the environmental characteristics of the country.

CPCB in discharging these statutory functions over the past three decades has taken up a number of research and development projects. Several of these have been successfully completed, while many others are under progress. Outlines of some of these projects are presented in the present newsletter. The projects have been executed directly by the scientists and engineers of the Board or in collaboration with leading Research and Development Institutions in the country or by funding the projects to be executed solely by reputed institutions. A few projects have been undertaken with the active international collaboration and assistance from Governments of Netherlands, Federal Republic of Germany and Canada.

2.0 CENTRAL POLLUTION CONTROL BOARD'S ROLE IN ENVIRONMENTAL RESEARCH & DEVELOPMENT

As per the powers and functions assigned to Central Pollution Control Board (CPCB) under various statutes, the board has to plan, execute the studies pertaining to Research & Experimental Development related with environmental management. The functions assigned under various acts are as below:

- **The Water (Prevention and Control of Pollution) Act, 1974**
 - (i) ***Chapter IV – Section 16 – Sub-section 2 (c) - Functions as Central Board***

Under the provisions of The Water (Prevention and Control of Pollution) Act, 1974, the Central Pollution Control Board has to provide technical assistance and guidance to the State Boards, carryout and sponsor investigations and research relating to

problems of water pollution and prevention, control or abatement of water pollution.

(ii) Chapter IV – Section 17 – Sub-section 1 (d) - Functions as State Board

Under the provisions of The Water Act, 1974, the Central Pollution Control Board has to function as state board in Union Territories for which the Central Board has to encourage conduct and participate in investigations and research relating to problems of water pollution, prevention, control or abatement of water pollution.

● **The Air (Prevention and Control of Pollution) Act, 1981**

(i) Chapter III – Section 16 – Sub-section 2 (d) - Functions as Central Board

Under the provisions of The Air (Prevention and Control of Pollution) Act, 1981, the Central Pollution Control Board has to provide technical assistance and guidance to the state boards, carryout and sponsor investigations and research relating to problems of air pollutions and prevention, control or abatement of air pollution.

3.0 CONSTITUTION OF RESEARCH ADVISORY COMMITTEE (RAC) OF CENTRAL POLLUTION CONTROL BOARD (CPCB)

The Central Pollution Control Board has constituted a Research Advisory Committee (RAC) comprising researchers in the field, representatives of CSIR national laboratories, nominees of DST, MoEF for guiding and reviewing its research and development activities. The Terms of Reference (TOR) of Research Advisory Committee (RAC) are as follows:

- The Research Advisory Committee will oversee the research activities of Central Pollution Control Board as per guidelines of Department of Scientific & Industrial Research, Ministry of Science & Technology, New Delhi.
- The Research Advisory Committee will advise the Central Pollution Control Board on thrust areas regarding investigations and research to be undertaken.

- The Research Advisory Committee will provide directions to consolidate the on-going pollution control and abatement activities and advise regarding projects to be undertaken under each identified thrust areas.
- The RAC will meet at least once a year for guidance of research activities as well as for monitoring of ongoing research activities.

4.0 THRUST AREAS FOR ENVIRONMENTAL RESEARCH AND DEVELOPMENT

Thrust areas presently identified for Research and Development studies are presented below. Depending on future needs additional areas would be identified:

- Effect of air and water pollution on human health.
- Bio-assessment & Biomonitoring
- Bio-remediation.
- Industrial wastewater Treatability Studies.
- Abatement of pollution from non-point sources.
- Environmental Mapping and Planning.
- Methods for restoration of environmental quality in problem areas/polluted stretches of rivers.
- Bio-medical waste Management.
- Clean Technology of Production
- Pollution Control and Treatment Technology.
- Development of Analytical Methods.
- Air / Water quality Monitoring Methods

5.0 OBJECTIVES OF ENVIRONMENTAL RESEARCH

- ⇒ To strengthen the scientific / technological base for environmental regulations and environmental protection work.
- ⇒ To develop cost effective approaches for prevention and control of environmental pollution.
- ⇒ To develop sound approaches to characterize various risk to human health and environment.
- ⇒ Perform research relevant to identify, understand and solve current and future environmental problems and environmental sustenance.
- ⇒ To develop relatively broad, knowledge base for strategic priority setting process for environmental management.

6.0 TYPES OF ENVIRONMENTAL RESEARCH AND DEVELOPMENT STUDIES

Research and development activities play an important role in assessment and control of pollution, environmental quality assessment, identification of priority areas in air and water pollution control and industry specific research studies. The Research and Development comprise of three exclusive activities viz. basic research, applied research and experimental development (OECD, 1994).

● Basic Research

Basic research is any experimental or theoretical research work, conducted primarily to acquire new knowledge of underlying foundations of phenomena, observable facts without directly giving consideration to specific applications/uses.

There are limited basic research activities in CPCB.

● Applied Research

Applied research are activities/investigations undertaken with the objectives to ascertain the possibility of practical application by establishing specific goals or that which explore new applications of method which are already in practical application using knowledge discovered through basic research. It is however, directed primarily towards a specific practical aim or objective.

Mostly, research work for environmental application lies in the category of applied research in which the technology/theories/ methodology is applied for finding solution of the problems.

- **Experimental Development**

It is the utilization of knowledge acquired from basic/applied research and actual experience and research designed for introduction of new materials equipment, system or processes and their improvements. It is the systematic work, drawing on existing knowledge gained from research and or practical experience that is directed to produce new materials, products and devices to install new processes, systems and services and to improve substantially those already produced or installed.

Experimental development in context to environmental applications are attributable to new methodology development, quality control and application for treatment.

There is the global shift in approaches in environmental pollution control to pollution prevention. The pollution prevention research is relatively new field, stressing the important role in reduction of environmental risks from toxic releases and exposure to chemicals. The goal of pollution prevention and control can be achieved through anticipatory research and exploratory research.

- **Anticipatory Research**

Anticipatory research is the research and development undertaken to evaluate and anticipate future environmental problems. The necessary information is generated from findings and developing strategic actions against emerging environmental issues and their early warning. Anticipatory research requires priority settings and development of thrust areas.

- **Exploratory Research**

The exploratory research includes areas demanding identification of high priority research to solve some of the most pressing environmental problems. The exploratory research as a first step requires identification, screening, evaluation and prioritization of environmental problems and issues.

7.0 RESEARCH & DEVELOPMENT STUDIES UNDERTAKEN AT CPCB

Water Pollution Related Studies

AUTOMATIC WATER QUALITY MONITORING OF RIVER GANGA

A need to monitor the water quality of the river Ganga continuously by establishing Automatic Water Quality Monitoring Station (AWQMS) was recognized. Accordingly, five AWQMS have been designated and set up on river Ganga from Kannouj to Garden Reach. The Central Pollution Control has taken up this work as a development project.

Publication:

- Automatic Water Quality Monitoring of River Ganga 1992-95: ADSORBS/30/1997-98.

STANDARDIZATION OF METHODOLOGY FOR ANALYSIS OF ADSORBABLE ORGANIC HALOGENS (AOX) IN ENVIRONMENTAL SAMPLE

The majority of organic halogens are the chemical compounds of anthropogenic origin. Some of the organic halogens are having bioaccumulation characteristics and may induce acute toxicity by being mutagenic, carcinogenic and teratogenic.

Photo 1

Adsorbable Organic Halogens (AOX) Analyzer

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Some major sources of organic halogens (OX) in the environment are pulp & paper industries, paints & varnishes, textile units, halogenated pesticide/insecticide industries, potable water treatment, PVC plastic industries, tanneries etc. The analysis of organic halogen may be performed individually by GC or HPLC, but their individual analysis is not only time consuming but also cost prohibitive. Therefore, increasing need has been realised for analysis of organic halogens as summary parameter. It is realized that the introduction of summary parameter will be useful tool for measurement of organic halogen load in the environmental samples. Central Pollution Control Board (CPCB) has, therefore, taken up the project to adopt the German Standard Procedure for AOX analysis (DIN Standard) to Indian condition, and to develop the capability for estimation of AOX in different types of environmental samples. CPCB involved three more laboratories for carrying out the studies and the data generated by participating laboratories is compiled, processed for repeatability, reproducibility and spike recovery studies.

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Publication:

- Adsorbable Organic Halogens (AOX): LATS/14/1999-2000.

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STANDARDIZATION OF METHOD FOR PESTICIDES ANALYSIS

A participatory research project was initiated during 1993-94 involving CPCB and four other laboratories viz. NEERI, Nagpur; ITRC, Lucknow; Jadavpur University, Calcutta and Pesticides Association of India (M/s Gharda Chemicals, Thane). The following are the objectives of the project:

- Standardization of method for pesticides analysis including concentration, clean-up of sample and recovery studies in water;
- Testing the method with synthetic and real samples and preparation of standard manual for pesticides analysis; and
- Inter-laboratory analytical quality assurance for pesticides analysis.

During phase-I of the project, recovery studies of four organo-chlorinated pesticides viz. DDT, BHC, Endosulfan and Cypermethrin have been undertaken in synthetic and field samples. The results indicated recovery of more than 90% for Cypermethrin, 60-78% for PP'DDT, 80-90% for BHC and 90% for Endosulfan.

In phase-II of the project, recovery studies of organo-phosphorus pesticides viz. Monocrotophos, Dimethoate, Anilophos and Chloropyriphos have been undertaken. The average recovery on zero day was 97.22% for Dimethoate; 95.11% for Chloropyriphos; 91.05% for Anilophos and 73.87% for Monocrotophos pesticides in distilled water. In river water, the recovery was 90.77% ; 88.27% 87.50% and 68.19% respectively for these pesticides. In sewage, the recovery was 87.31%; 81.72%; 82.98% and 57.01% for Dimethoate, Chloropyriphos, Anilophos and Monocrotophos

pesticides respectively. The data related to repeatability and recovery studies in pesticide standard solution and field samples have been compiled in the report.

Publication:

- Pesticides Analysis in Environmental Samples (Under Publication).

PERFORMANCE EVALUATION AND VALIDATION OF THE WATER TESTING KIT (WTK)

Central Pollution Control Board has developed a Water Testing Kit to assess the water quality of rivers, lakes and other water bodies including ground water and drinking water. This kit is an inexpensive, portable micro-laboratory equipped with apparatus and chemicals needed for testing water samples. This kit is addressed to NGOs, students, and public at large. The main aim to develop this kit was to create mass awareness and to promote public participation for prevention and control of water pollution. Using this kit one can perform physical (5), chemical (13) and biological (3) parameters.

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Photo 2

Water Testing Kit developed by CPCB

In the present study, an attempt was made to evaluate the performance of the Water Testing Kit developed by CPCB as well as to compare the results obtained in field condition using river and ground water samples with standard laboratory methods. It is observed that the parameters like pH, Dissolved O₂, Total Alkalinity, Total Hardness, Calcium, Magnesium and Chloride are showing good or moderately accurate results whereas, other parameters like Fluoride, Nitrate, Ammonia, Phosphate and T. Iron are showing less accuracy. It is found that most of the titrimetric

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parameters are showing positive values, whereas colorimetric estimations showed in both positive and negative values. It may be inferred that the WTK developed by Central Pollution Control Board, Delhi would be able to generate good or moderately accurate data for titrimetric parameters and less accurate for colorimetric parameters. It is to mention that United Nations Children Fund (UNICEF), New Delhi validated this WTK during 1998 and it was assessed as good performance testing kit out of 15 kits validated by the organisation. The CPCB's Water Testing Kit (WTK) was highly appreciated by Her Excellency Khunying Dr. Suthawan Sathirathai, President, Good Governance for Social Development and Environment Institute (GSEI), Thailand and shown keen interest in Transfer of Technology for Commercial production of WTK in Thailand. The water testing kit has also been appreciated by Thai Resources and Environmental Management Institute (TREMI) and Ministry of Natural Resources and Environment, Bangkok as an economical, community friendly, technological innovation useful even in electricity deficient rural areas.

Publications:

- Manual for Water Testing Kit,
- Information Brochure for Water Testing Kit (WTK) – Developed by CPCB.

DEVELOPMENT AND DISTRIBUTION OF FLUORIDE TESTING KIT

Excessive fluoride in drinking water is of most important concern due to wide spread of health symptoms found in not only in many states of India but also other developing and developed countries. Under the sponsorship of the United Nations Children Fund (UNICEF), New Delhi, Central Pollution Control Board (CPCB) has developed a small testing kit for fluoride determination in water samples in field as well as in laboratory conditions.

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Photo 3

Fluoride Testing Kit developed by CPCB

A set of 500 Fluoride Testing kits were distributed to UNICEF for onward distribution to community circles in various parts of the country for monitoring fluoride levels in drinking water. This is a small portable kit equipped with required glassware, plastic ware, reagents, and colour chart and user manual. The method of estimation is based colorimetric principle using SPADNS [Sodium 2-(para - sulfophenylazo) ,1,8 - dihydroxy , 3,6 - naphthalene sulfonate] and a Zirconium-dye lake reagents. The Kit is useful to the civic authorities and public at large for monitoring the fluoride levels of drinking water and other water sources.

Publication:

- Manual for Fluoride Testing Kit,

WATER QUALITY MODELLING STUDIES OF RIVER GANGA IN THE KANPUR STRETCH ; ESTIMATION OF NON-POINT SOURCES

The study objectively analyzes the state of water quality (in terms of DO-BOD) in the Kanpur stretch of river Ganga and assesses the non-point sources and their impact by employing water quality modeling. The Enhanced Stream Water Quality Model (QUAL2E) of USEPA has been used for the study. A stretch of 31-kilometer (starting from a few kilometers upstream of Kanpur) was covered and on the spot water quality sampling and analysis was carried out at various locations to generate the required database for model calibration/validation. The data on various point load discharges were collected in terms of flow and water quality characteristics. Initially the model predicted a better water quality than the quality observed. This mismatch was attributed to the undefined non-point sources of waste discharges. Efforts to calibrate the model estimated the non-point sources in terms of BOD load as about 15700 kg/day and high Sediment Oxygen Demand (SOD). It was observed during field survey that the pollution from non-point sources (e.g. small drains, solid waste disposal etc.) was wide spread along the river and unless non-point sources are controlled, the desired water quality levels are difficult to achieve.

ANALYTICAL QUALITY CONTROL (AQC/WATER) OF THE LABORATORIES OF POLLUTION CONTROL BOARDS AND RECOGNISED LABORATORIES

The Water Quality studies / monitoring programme involves collection, comparison and interpretation of analytical data, which leads to decision – making. The correctness of decision or action depends largely upon reliable analytical results. If the errors of the analytical results are high, the manpower material and money spent on any monitoring programme or

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study would be futile and further leads to wrong decision and improper action plans. Since the success and usefulness of all these information systems derived from analysis results, depend on the quality of input data, it is essential to ensure that adequate comparability and accuracy of analytical results are maintained.

Photo 4

AQC Sample Preparation at CPCB Laboratories

Keeping this fact in view, Central Pollution Control Board (CPCB) started regular and organized Analytical Quality Control (AQC) programme with the laboratories of SPCB, PCC and laboratories recognized under Environment (Protection) Act, 1986 from 1991 onwards as a continuous project activity with the following objectives.

- To assess the status of analytical facilities and skillness of the participating laboratories.
- To identify the serious constraints (random & systematic) in the working environment of laboratories.
- To provide necessary assistance and guidance to the concerned laboratories to overcome the difficulties in the analytical methods.

- To validate the Water Quality Monitoring data.
- To promote the scientific/analytical competence of the participating laboratories to the level of excellence for better output.
- To improve the internal and external quality control of the laboratories of Central and State Pollution Control Boards and also others in an organized manner.

The AQC exercise is conducted routinely by Central Pollution Control Board for improving the analytical capability of the concerned laboratories besides enhancing integrity of the data. The acceptable limits for various parameters are arrived using "youden 2 sample plot" method. The data are processed using a software called "PROLAB" developed by Dr. S.Uhlig, Professor in Statistics, German for various applications using ISO, DIN, Q-method/ Huber estimator, Youden, Z- scores and other Robust statistical methods. This software has been procured by GTZ and offered to CPCB under the Quality Assurance programme.

In general, the performance of the laboratories for various parameters in the decreasing order of magnitude is as follows:

Chloride, Total Hardness, Calcium, Boron, Potassium, Total Dissolved solids, Conductivity, Chemical Oxygen Demand, Sodium, Ammonical Nitrogen, Chromium, Magnesium, Fluoride, Sulphate, Total Kjeldahl Nitrogen, Nitrate-N, Biochemical Oxygen Demand, Fixed Dissolved solids, Total Suspended Solids, Phosphate-P.

DEVELOPMENT, STANDARDIZATION AND PREPARATION OF AQC SAMPLES FOR TOTAL COLIFORM AND FAECAL COLIFORM FOR CONDUCTING AQC EXERCISES

CPCB is conducting AQC exercises covering various physico-chemical parameters. In the AQC exercises, bacterial parameters like Total Coliform and Faecal Coliform are not yet included because of constraints in preparation of bacterial AQC samples and their preservation and despatch under ice-cold condition. To overcome these problems it was decided to prepare lyophilized bacterial samples in solid form like the one developed for BODSEED in collaboration with Centre for Biochemical Technology (CBT), CSIR, Delhi. The main objectives of the project are:

- To introduce the bacteriological parameters like Total Coliform and Faecal Coliform in AQC scheme;
- To improve the analytical efficiency of concerned laboratories with reference to bacteriological parameters; and,
- To get accurate and reliable data on total coliform and Faecal coliform.

The microbial samples developed were tested in CPCB laboratory to assess the precision and accuracy of the test results. It is planned to introduce Bacterial samples in AQC Inter-laboratory Proficiency Testing (PT) programme during the forthcoming exercises.

TESTING AND VALIDATION OF "BODSEED" (A MICROBIAL MIXTURE) AN ALTERNATIVE TO CONVENTIONAL SEWAGE-SEED IN BOD DETERMINATIONS

Biochemical Oxygen Demand (BOD) is the most important and commonly used parameter in monitoring of water and wastewater. While conducting BOD test, domestic sewage is added as seeding material, a source of microbial population, to decompose the organic waste. The microbial seeds being used in different laboratories at different time are not of uniform nature. Moreover, the microbial community varies from season to season at any place. There are variations in microbial diversity in terms of species and number, which lead to variations in the results of BOD estimation. To overcome these problems associated with use of conventional sewage seed, a standard mixture of microbial cultures has been developed in collaboration with Centre for Biochemical Technology, CSIR, Delhi. This culture is named as BODSEED, which is used as an alternative to conventional sewage, to get reproducible and comparable data in BOD determination. Moreover, the BODSEED is inexpensive, convenient and safe to handle as compared to conventional sewage seed. The developed "BODSEED" has been tested and validated along with conventional sewage-seed for BOD determinations using various synthetic and industrial samples involving seven more laboratories besides Central Pollution Control Board.

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Photo 5

The findings of the study revealed that use of BODSEED yields better performance when compare to conventional sewage-seed, which can be replaced by BODSEED, a microbial mixture for BOD determinations. The developed "BODSEED" had been patented and the technology transferred for commercial production.

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Publication:

- Testing and Validation of "BODSEED" (A Microbial Mixture), An Alternative to Conventional Sewage Seed in BOD Determination: LATS/11/1998-99.

STANDARDIZATION OF METHODOLOGY FOR BOD DETERMINATION AT HIGHER TEMPERATURE AS AGAINST STANDARD CONDITION OF 20 °C FOR FIVE DAYS

The project entitled 'Validity of BOD determination at Higher Temperature as against standard condition of 20 °C for 5 days was taken up to evolve incubation condition which will be realised for Indian aquatic environment and also comparable to standard condition of 20 °C for 5 days. The Project involved analysis of about 12,000 samples in 12 laboratories in various sample matrices. The findings of the project recommended incubation condition of 27 °C for 3 days for tropical countries like India. The Bureau of Indian Standards (BIS) has approved the methodology for adoption of test at 27 °C and 3 days incubation for India and published as Indian Standard ("Methods of Sampling and test (physical and Chemical) for Water and Wastewater" Part 44 Biochemical Oxygen Demand (BOD) - IS: 3025 (Part 44): 1993.

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Publication:

- Validity of BOD Determination at Higher Temperature as Against Standard Condition of 20°C for 5 days: LATS/4/1987-88.

TESTING AND VALIDATION OF BOD BIOSENSOR BASED ON MICROBIAL MIXED CULTURE FOR RAPID BOD DETERMINATION IN WASTEWATER

Biochemical Oxygen Demand (BOD) is the most important and commonly used parameter in water quality monitoring and designing of effluent treatment plant. The test takes considerable time say 3 days at 27 °C or 5 days at 20 °C, as well as consumes lot of energy. To overcome these constraints, attempts have been made to carry out the test in short time through the technique using BIO-SENSOR probes. This technique involves selection of suitable microbial composition for using Bio-sensor so as to degrade the wide range of wastes. In this endeavour, CPCB is attempting in collaboration with Centre for Biochemical Technology (CBT), CSIR, Delhi to develop BIO-SENSOR for BOD test. The project is in progress.

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BIOLOGICAL MONITORING AND ASSESSMENT OF POLLUTION (BIOMAP)

The water quality monitoring and management is usually performed only on the basis of limited number of physico-chemical variables. This approach has several inherent drawbacks and limitations.

The Netherlands Government under its International Cooperation Programme on Environment with the Government of India agreed to include the development of integrated water quality monitoring method as one of the project, which can overcome the drawbacks & limitations of physico-chemical approach of water quality monitoring & management. This project was executed as a joint venture of the National Institute of Public Health & Environmental Protection (RIVM), Bilthoven, the Netherlands, and the Central Pollution Control Board, Delhi, India. The results of this were analysed for redundancy & information content with respect to pollution gradients using advanced statistical programme in computer (principle component analysis & clustering).

- During the project an easily comprehensive yardstick methodology for integrated water quality evaluation was developed involving experts from RIVM and CPCB and discussed in an international workshop.
- Draft manual for carrying out bio-monitoring was prepared. The finalized methodologies were then validated & tested for one year on different rivers in India. On the basis of results of the validation programme, the manual has been revised and finalized.

Photo 6

- Water Quality Criteria has been developed based on diversity and Saprobity score of benthic macro-invertebrates based on bio-monitoring studies.

Photo 7

Bio-monitoring of Water Quality at Sultanpur Lake, Delhi

Photo 7a

Bio-monitoring of Water Quality at River Hasdeo

- The bio-monitoring methodology as standardized in association with Dutch Experts has been used for bio-assessment of raw water at drinking water sources, canals of Yamuna basin, lakes, rivers and their tributaries and other water bodies.

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- The transformation of biological water quality information of a water body in the form of a colour map to indicate various water quality classes in terms of clean, slight pollution, moderate pollution, heavy pollution and severe pollution of a water body have been employed. Bio maps of Yamuna River and tributaries in respect of their pollution load have been prepared.

- The studies on Bio-mapping of Rivers of Meghalaya State have been undertaken in collaboration with Meghalaya State Pollution Control Board. The data is under compilation and processing.

- The water quality management in problem areas is complex task due to several ongoing environment management problems in highly polluted areas. On the basis of various environmental problems, 24 problem areas have been identified in the country in collaboration with the concerned State Pollution Control Boards/Pollution Control Committees in Union Territories. The pollution control measures had already been initiated through time bound action plans to mitigate the environmental problems and ensuring improvement in environmental quality of problem areas. The bio-monitoring of environmental components of problem areas will provide information about the state of ecological environment of surface water bodies in vicinity of problem areas, as well as extent of deterioration/improvement taken place as a result of implementation of pollution control measures.

- The bio-monitoring methodology has been employed for monitoring of Damodar River in collaboration with the Zoological Survey of India (ZSI), Calcutta and the Central Pollution Control Board, Zonal Office at Calcutta.

- Biomonitoring study has been carried out in the lakes and reservoirs in and around Delhi using the bio-monitoring methodology. The physico-chemical, heavy metal and pesticide contents in the water were analysed. The water bodies are lying under moderately and severely polluted category. Bioaccumulation of heavy metals and pesticides were also carried out.

Recommendations to preserve the lakes and reservoirs have been presented in the report.

Publications:

- Specifications for Instruments/Equipments Required for Biomonitoring of Inland Surface Waters: LATS/7/1991-92.
- Manual on Integrated Water Quality Evaluation; Indo-Dutch Project Report 802023003, January 1994.
- Bio-monitoring of Water – CPCB Newsletter, 1995.
- Bio-mapping of Rivers – CPCB Newsletter, 1999.
- Water Quality Status of Lakes and Reservoirs in Delhi: ADSORBS/37/2000-01.
- Bio-monitoring of Water Quality in Problem Areas – CPCB Newsletter, 2001.

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APPLICATION OF ARTIFICIAL SUBSTRATUM FOR BIO-ASSESSMENT OF WATER BODIES

Bio-monitoring can be done by measuring the change in structural and/or functional components of an eco-system due to adverse effect caused by environmental change such as pollution. Several bio-monitoring methods have been developed all over the world for the measurement of water quality. Each method has got its own advantages and limitations. The method developed by the Central Board in collaboration with Dutch scientists for measurement of water quality using biological parameters rely on benthic community structure. In the situation where river-beds are sandy or concrete structures, properly established biological communities are very rare, and thus, bio-monitoring can not be done properly. To overcome this problem, use of artificial substratum is considered as best option in western countries.

Photo 8

Artificial Substratum (Iron Cage) developed by CPCB for Bio-monitoring

Artificial substratum is an iron cage containing glass marbles, submerged at a number of places in the water body. The cages are retrieved after 4 to 6 weeks and the macro-invertebrates, which are colonized on the marble substrata are collected. The number of species of benthic macro-invertebrates are identified and scored for the evaluation of water quality.

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Photo 9

Bio-monitoring through Artificial Substratum at Wazirabad Water Works, Delhi

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Two methods have been adopted for the evaluation of water quality i.e. Diversity Index and Saprobity Index. The Diversity Index is the ratio of the total number of runs (when the next macro-invertebrate is different from last one a new run starts) and the total number of organisms encountered. High diversity of benthic macro-invertebrates always supports a good quality of water.

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Publication:

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- Application of Artificial Substratum for Bio-assessment of water bodies: LATS/13/1998-99.

WATER QUALITY ASSESSMENT DURING SOLAR ECLIPSE MASS BATHING AT BRAHM SAROVAR, KURUKSHETRA (HARYANNA)

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More than 10 lakhs people took bath during the solar eclipse of August 1999 at Brahm Sarovar, Kurukshetra. Water quality study was carried out before, during and after solar eclipse mass bathing to assess the changes in the water quality due to mass bathing. It was deduced from the study that there were slight change in the values of conductivity, total alkalinity and considerable variation in bacteriological parameters due to mass bathing. Residues of Organo-chlorine pesticides were observed in some raw water samples. Recommendations for maintaining water quality during mass bathing have been provided in the report.

Photo 10

Mass Bathing during Solar Eclipse at Brahm Sarovar, Kurukshetra (Haryana)

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Publication:

- Water Quality Assessment during Solar Eclipse, Mass Bathing at Brahm Sarovar, Kurukshetra (Haryana): ADSORBS/31/1999-2000.

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IMPACT OF SEWAGE DISPOSAL ON GROUND WATER QUALITY AROUND DINAPUR SEWAGE TREATMENT PLANT AT VARANASI

The sewage treatment plant (installed capacity 80 MLD) was commissioned in 1994 at village Dinapur, Varanasi. The treatment plant receives approximately 100 MLD sewage. The treated sewage is partly used for irrigation purpose and rest is discharged into River Ganga. The total irrigation area is approximately 9 sq. km. covering villages Dinapur, Kamoli, Kutwan, Chirai gaon, Raghunathpur, small Yadav and Harijan Basti.

It was observed that because of improper functioning of STP and over loading of sewage inflow, the treatment is inadequate and it overflows to nearby fields at Sewage Treatment Plant. The public complaints were received frequently from the villagers of the nearby areas around Dinapur sewage treatment plant at Varanasi.

To assess the impact of treated sewage on ground water quality, ground water was monitored at 20 locations selected in the villages around Dinapur STP with five control points approximately at 3.5 Km. radial distances from STP, where the effect seems to be minimum. The ground water quality was monitored for a year at regular interval.

The major observation indicated serious Bacteriological contamination in the open wells in the villages on both sides of the treated sewage flowing channel. Higher concentrations of Hardness, Calcium, Magnesium, Alkalinity, Total Dissolved Solids (TDS), Chlorides, Sulphates, Sodium, Phosphates and Heavy Metals; like Cr⁺⁶ and Fe were observed in the ground water in comparison to the quality of control points, the values were above the permissible limit for drinking water norms.

The level of ground water in the open wells up to 1 Km. on both sides of the treated sewage channel have been increased by about 4 to 5 meters against the wells situated at 3 to 4 Km. away from the channel. The level of ground water in the open wells near STP channel was observed at only 1.5 m depth from top due to the influence of treated sewage to the ground water, thus poor villagers were deprived of drinking water source.

Due to uncontrolled irrigation and poor maintenance of irrigation channel and minors, water-logging occur, which aggravates the problem of infiltration.

Publication:

- Status Report of Dinapur Sewage Treatment Plant and Surroundings : PROBES/83/2001-02.

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STUDIES ON GROUND WATER QUALITY AND POLLUTION ASPECTS

Ground water plays an important role and an essential and vital component of our life support system. The ground water resources are being utilized for drinking, irrigation and industrial purposes. There are exploitation pressure on ground water resources and growing concern of deterioration of ground water, due to unplanned disposal of effluents, sewage and sewerage. The following project studies have been conducted related with ground water quality and pollution aspect.

- During August/September, 1995 severe flood situation was observed in Delhi and nearby areas of Yamuna river basin and water intrusion in ground water table has been reported at various low-lying areas in the city. Inadequate drainage facilities caused mixing of flood water with urban and industrial wastewater, and its percolation led to the risk of groundwater contamination. The ground water quality in flood-affected areas of Delhi has been studied and seventeen samples of groundwater were collected and analysed for 35 parameters immediately after the flood water receded. Deterioration of water quality in terms of physico-chemical parameters has been observed. The concentrations of heavy metals were found within the permissible limits of drinking water standard except iron and manganese. The total coliform was

noticed only at few locations and surprisingly the faecal coliforms were not recorded in any of the locations. The pesticides (BHC) exceeded the limits in most of the locations, whereas the other pesticides were within the limits prescribed by WHO for drinking water. The comparison of water quality data of the flood-affected areas between pre and post-monsoon reveals that in general the concentration of cations, anions and pesticides were towards higher side with few exceptions and these exceptions may be due to different nature of solubilities of solutes and their leaching into the groundwater.

- The collaborative study has been conducted by Central Pollution Control Board, Delhi alongwith Central Ground Water Board during February and March, 1998 to assess the ground water quality and its suitability. The extensive field survey have been undertaken, during which 303 ground water samples were collected and analysed from different abstraction structures (Hand pumps, tube wells, dug wells, bore wells etc.) representing various depths and locations in Delhi. The analysis of ground water samples have been undertaken for physico-chemical parameters (including trace metals), bacteriological parameters, organo-chlorinated and organo-phosphorous pesticides and total organic carbon.

- Ground water quality monitoring was carried out at 19 locations in Najafgarh drain basin area, occupying around 832 sq. km in Delhi. The ground water samples were collected at monthly frequency and analyzed for 34 parameters covering physico-chemical parameters including heavy metals and pesticides and also bacteriological analysis of Total and Fecal coliform. The results of monitoring revealed that the ground water quality in this region was highly polluted in respect of dissolved solids, alkalinity, hardness, calcium, Magnesium, Iron, Chromium, sodium, fluoride, nitrate, boron and bacteriological parameters like total and fecal coliform. The concentrations of heavy metals are not significantly high in the ground water. The main sources of ground water contamination are due to the disposal of liquid and solid wastes generated from domestic and industrial origin and also certain extent from agricultural and farm activities.

Publications:

- Groundwater Quality in Problem Areas - A Status Report (Part-I): GWQS/1/1995-96
- Groundwater Quality in Problem Areas - A Status Report (Part-II): GWQS/2/1995-96
- Groundwater Quality in Problem Areas - A Status Report (Part-III): GWQS/3/1995-96
- Groundwater Quality in Problem Areas - A Status Report (Part-IV): GWQS/4/1995-96
- Groundwater Quality in Ten Towns of Uttar Pradesh: GWQS/5/1995-96
- Groundwater Quality in Problem Areas - A Status Report (Part - V): GWQS/6/1995-96
- Groundwater Quality of Flood Affected Areas of Delhi - 1995: GWQS/7/1995-96
- Groundwater Quality and Pollution Aspects in NCT – Delhi – Collaborative Project Report with Central Ground Water Board, Chandigarh, January 2000.

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ARSENIC POLLUTION IN GROUND WATER OF SOME DISTRICTS IN WEST BENGAL AND ITS CONTROL TECHNIQUES

The arsenic contamination of groundwater in some districts in West Bengal is the cause of concern. The removal of arsenic from ground water is necessary before its human consumption. During the study various techniques and principles for removal of arsenic from ground water and pilot plants erected by different private and Government agencies have been studied. It has been observed that As (V) species can be easily removed as compared to As (III) species and Iron based flocculants and adsorbents are having better capacity than Aluminium based chemicals. Fly ash based candle is also recommended for treating arsenic in drinking water.

Publication:

- A Report on Sources of Arsenic and its Control in West Bengal; IMPACTS/4/2000-01.

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RECOVERY OF SILVER AND MERCURY FROM WASTEWATER GENERATED IN COD ESTIMATION

Chemical Oxygen Demand (COD) is an important parameter for determining the pollution potential of domestic and industrial wastewater. During the course of its analysis, silver sulphate is added as catalyst while mercuric sulphate is added to overcome the interference from halides. After analysis, the COD waste containing the compounds of silver and mercury are disposed off. Considering the hazardous nature and cost factor, an effort was made to recover silver as metallic silver and mercury as mercuric iodide.

Photo 11

A view of Metallic Silver recovered from COD Waste

During the process the COD waste was treated with dilute HCl to precipitate silver as silver chloride. The silver chloride was dissolved in dilute ammonia and sodium sulfide was added to precipitate silver as silver sulfide. The silver sulfide was mixed with flux material and ignited to 1200 °C to separate silver metal and slag material.

The waste after recovery of silver, contains mercury in its compound form. Potassium iodide can precipitate mercury as mercuric iodide. But excess addition of potassium iodide will dissolve the precipitate. Hence, calculated amount of 10% potassium iodide was added to precipitate all mercury as mercuric iodide.

Photo 12

A view of Mercuric Iodide recovered from COD Waste

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As much as 18 grams of silver were recovered from 15 litres of COD wastewater. The recovery percent for both silver and mercury was found more than 95%.

ALTERNATE CHEMICAL COMPOUNDS IN PLACE OF MERCURIC SULPHATE/SILVER SULPHATE IN COD ESTIMATION

The chemical oxygen demand (COD) is a summary parameter, commonly tested for various effluent samples for estimating total oxygen demand. In this method, toxic and costly heavy metal chemicals like mercuric chloride and silver sulphate are used for removal of chloride interference and to act as catalyst. In order to replace these chemicals with other chemicals of same properties and reaction with a main objective to abate the toxic/costly chemicals and also to develop a cost-effective method for COD estimation, study has been carried out using other compounds such as zinc oxide, copper sulphate, nickel sulphate, titanium oxide for synthetic sample, glucose-glutamic acid mixture with different concentrations of chloride levels and the results are encouraging. Further studies under various permutations and combinations are in progress.

BIO-ACCUMULATION STUDIES OF CRITICAL TRACE METALS IN FISH FAUNA OF RIVER YAMUNA

The increasing contamination of aquatic water bodies with pollutants bearing trace metals cause deleterious impact not only on the immediate aquatic ecosystem but also on the well being of human population. Heavy metals are toxic elements with lipophilic affinities and bio-accumulation tendencies in biotic tissue. Bio-accumulation is the process in which chemical substances are concentrated, accumulated and magnified in the body tissue of living organisms either directly from surrounding environment or indirectly through the food chain. In aquatic organisms, trace metals uptake occurs directly from the surrounding water across the permeable body surface, alongwith food and water. The metallic species are accumulated in biotic tissue in critical ranges due to the imbalance of absorption and elimination mechanism in living system.

Fishes, which occupy highest trophic level of food pyramid in aquatic ecosystem are important target of bio-magnification of trace metals and also act as possible bio-transfer route to human beings. With above in view, the project studies on bio-accumulation of trace metals in commonly available species of fishes of river Yamuna have been undertaken with following major objectives.

- To generate information regarding bio-accumulation of critical trace metals in fish tissues of various edible species available in Delhi stretch of river Yamuna.

Photo 13

Fish Catch for Human Consumption

- To establish suitability of various species of fishes and their consumption as food by the public and to suggest mitigation measures to counteract bio-accumulation process.
- To determine suitability of various species of fishes and their consumption as food by the public and to suggest mitigation measure to counteract bio-accumulation process.

The results of the Bio-accumulation studies indicated that there is no significant accumulation of heavy metals traceable from fish muscle tissue. The metals - Lead, Nickel and Zinc have been found in the fish body, but these were within permissible limits. The study suggests the consumption of fish as food is supposed to be safer in respect to critical trace metal accumulation perse.

STUDIES ON SEWAGE FED VEGETABLES AND FISHES IN THE EASTERN PART OF KOLKATA

Kolkata (22° 34'N and 88° 22'E) is a typical riverine city situated in the lower tidal reaches of Hugli. The city does not yet have any full-fledged sewage treatment plant. A qualitative study of the sewage revealed that the city sewage is mixed with industrial waste owing to the presence of good number of hazardous industries within the city limit. It however, possesses a unique system of utilization of sewage. About 2000 acres of land in the eastern part of the city (Dhapa and Bantala area) developed by dumping of solid wastes, is used for growing sewage irrigated vegetables, which comprises a major part of the city's vegetable supply. The vast wetland here also supports sewage fed fisheries, which supply a considerable quantity of fish to the Kolkata market. The studies on the impact of sewage on vegetables and fish quality are being continued at CPCB Zonal Office – Kolkata.

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DEVELOPMENT AND USE OF REFERENCE MATERIALS IN INDIA

The Central Pollution Control Board organized the first national workshop on "Development and Use of Reference Materials in India (DUREM-1)", during February 14-16, 1996 at New Delhi to make an assessment of the existing activities and the future needs of the environmental reference materials which have a direct relevance in the implementation of standards and the performance evaluation of the emission/effluent facilities existing in the country. As a follow-up of decisions taken at DUREM-1, 1996, a national task force for reference materials (REMTAF) development and use in India has been formed. The first meeting of the REMTAF was held on September 25, 1996 at CPCB, Delhi. The meeting identified 12 nodal agencies on different areas. The first meeting of the nodal agencies was

held on March 3, 1997. The meeting decided preparation of comprehensive proposal by CPCB for development of priority certified reference materials (CRM's) through the nodal agencies.

Publications:

- International Directory of Suppliers and Dealers of Standard Reference Materials For Measurement of Metals and Organics: LATS/8/1991-92
- First National Workshop on Development and Use of Environmental References Materials – DUREM-1:LATS/10/1997-98
- Second National Workshop on Development and Use of Environmental References Materials: DUREM-2:LATS/12/1998-99.
- Proceedings Second National Workshop on Development and Use of Reference Materials, LATS/15/2000-01.

DEVELOPMENT OF CERTIFIED REFERENCE MATERIAL (CRM) OF TOXIC METALS USING INDUSTRIAL EFFLUENTS

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The need for analytical measurements of metals during environmental monitoring is well recognized and accomplished with use of reference material. Standard Reference Materials (SRM's) are well-characterized material used to maintain the quality of measurements. The use of certified reference material (CRM) during routine measurement of trace metals is quite expensive therefore it has become necessary to develop economical and indigenous Certified Reference Material (CRM). Central Pollution Control Board has undertaken project for preparation of Reference Material for toxic metals in industrial effluents under sponsorship of Department of Science & Technology (DST).

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The Certified Reference Material for toxic metals like Chromium, Copper and Nickel in Electroplating industrial effluent were selected and the homogeneous samples were distributed to 32 reputed environmental and R&D laboratories in the country for analysis. The analytical data as obtained from 32 laboratories have been compiled, statistically processed and computed in order to certify its use as reference material.

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Relevant Publications:

- International Directory of Suppliers and Dealers of Standard Reference Materials For Measurement of Metals and Organics: LATS/8/1991-92
- First National Workshop on Development and Use of Environmental References Materials – DUREM-1:LATS/10/1997-98
- Second National Workshop on Development and Use of Environmental References Materials: DUREM-2:LATS/12/1998-99

DEVELOPMENT OF TOXICITY BASED STANDARDS

- Toxicity test method based on Dimensionless Toxicity Factor has been developed by CPCB, which has been recognized and adopted by the Bureau of Indian Standards (BIS) New Delhi and published as “Bio-assay Method for Evaluating Acute Toxicity of Industrial Effluents &

Wastewater – Part 2 using Toxicity Factor to Zebra Fish (Brachydanio rerio)” as IS-6582 (Part 2):2000.

- A toxicity factor (T_F value) has been introduced for evaluation of industrial effluent standards. It is a number on geometrical scale by which the samples need to be diluted for hundred percent survivals of fish. The T_F values for tannery, pesticide, pharmaceutical, dye & dye intermediates and textile industries wastewater were 16, 4,4,4 and 1, respectively.
- The project is being taken up by CPCB in collaboration with three other laboratories i.e. Gujarat Pollution Control Board, Gandhinagar; National Institute of Occupational Health, Ahmedabad and National Environmental Engineering Research Institute (NEERI), Nagpur to develop toxicity based Minimum National Standards (MINAS) for various industries. The standards are being developed based on Dimensionless Toxicity Factor based standardized method.

Photo 14

Preparation for Toxicity Factor Experimentation

- Studies have been undertaken under project for "Development of Toxicity Based Standards for Dye & Dye Intermediate, Bulk Drug and Textile industries". The effluents were collected from various industries in collaboration with Gujarat State Pollution Control Board, Gandhinagar; NEERI, Nagpur; CPCB Zonal Office, Kanpur and National Institute of Occupational Health, Ahmedabad and analyzed for effluent toxicity. The effluent toxicity was measured in terms of toxicity factors.

Publications:

- Dimensionless Toxicity Factor – An approach to Toxicity Testing for Regulatory purpose: LATS/10/1998-99.
- Effluent Toxicity Status in Water Polluting Industries, Part-I: Dye & Dye Intermediate, Bulk Drugs and Textile Industries – PROBES/91/2002-2003.

Air Pollution Related Studies

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DEVELOPMENT OF AIR QUALITY INDEX FOR DATA INTERPRETATION AND PUBLIC INFORMATION

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Voluminous data on Air quality is being generated under various monitoring programs, but interpreting and understanding the vast data become tedious and confusing even to scientific and technical community. As for the general public, unless information is presented in simple and lucid settings, people tend to loose interest and can neither appreciate the problem nor the pollution mitigation efforts. With the intent that air quality information must reach people in easy to understand terms, Central Pollution Control Board (CPCB) has developed an Air Quality Index (AQI) in collaboration with Indian Institute of Technology (IIT), Kanpur for easy understanding of Air Quality of a particular place/in a day/month/year for simpler way for the public and others. The index has been developed based on the dose-response relationship of various pollutants. The index is named as IND-AQI (Indian Air Quality Index). The developed index is classified in five categories: 0-100 (Good); 101-200 (Moderate); 201-300(Poor); 301-400(Very Poor); 401-500(Severe). A website is developed for display of nation-wide air quality index. As the air quality data become available, online calculation of AQI is carried out and displayed as an Air Quality Meter showing index value (with a pointer) with animation on the screen. The general public can access the information through Internet and other media agencies like newspaper, TV, Radio can also download and disseminate the information.

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Publication:

- Development of Air Quality Index for Data Interpretation and Public Information (Under Publication).

STUDIES ON INDOOR AND OUTDOOR AIR MICRO FLORA

The studies on air micro flora of indoor environment of public places have received attention because of its application in air pollution control. The presence of air micro flora in ambient environment causes an inevitable consequences in form of various illness, diseases – endemic as well as epidemic level. The assessment of microbiological quality of air is required at critical industrial sites viz. pharmaceutical, food processing, medical devices manufacture, at operation theatres and hospitals, in food service establishments.

Photo 15

Culture Plates depicting Indoor and Outdoor Microflora

To collect precise information on the bio-aerosol facilitating development of design criteria for protection of human health, the studies have been initiated by CPCB. The objective of the study included recognition, description and understanding of effects of these contaminants at various sources like hospitals, restaurant, reservation centres, courts, residential apartment etc. The study included presence of air microbes, fungal spores, bacteria, pollens, plant spores etc., which are responsible for various diseases as well as produces microtoxins. The study is in progress.

EFFECT OF ENVIRONMENTAL POLLUTION ON HUMAN HEALTH OF DELHI RESIDENTS

The studies on the effect of air pollution on human health have been undertaken in collaboration with All India Institute of Medical Sciences. The symptoms related to adverse impact on respiratory, cardio-vascular and nervous system were observed in the population. One thousand three hundred and twenty one individuals have been surveyed for their health status at Sirifort, a residential area. The carboxyl hemoglobin levels in the blood were within WHO Standard limit. Considerable extent of lung related diseases have been identified during the survey. Irritation to eyes, cough, pharyngitis, dyspnoea, headache, nausea and vomiting were the symptoms commonly observed due to air pollution effect.

Publications:

- Respirable Particulate Matter and its Health Effects: NAAQMS/19/2000-2001.
- CPCB Newsletter – Air Pollution and Human Health, September, 2001.

MONITORING OF HUMAN EXPOSURE TO AIR POLLUTION IN A HIGHLY INDUSTRIAL AREA

In this study, human exposure to air pollution has been assessed in a highly industrialized area in the city of Mumbai. The target group was people of low socio-economic level, who are residing and work in the study area as they

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are subjected to the worst exposure due to air pollution. The major objectives were to investigate the relation between ambient air quality and personal exposure measurements as well as to identify the factors, which effect exposure concentrations. This can provide important inputs for estimation of health risk of population.

Publication:

- Monitoring of Human Exposure to Air Pollution in Industrial Area, PROBES/77/2000-01.

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PERFORMANCE EVALUATION OF AIR QUALITY MODELS

The air quality modelling studies in India, particularly its applications for predicting environmental impact resulting from proposed industrial projects, are often questioned. One of the reasons for this is that most of the air quality models, which are in use, are borrowed from developed countries and used without validating them for Indian conditions. Without such adaptation and validation, this technique does not give meaningful output. To overcome this problem to some extent and to have uniform procedure for conducting air quality modelling studies (with reference to prediction of impact from point sources for EIA studies), CPCB has formulated the necessary guidelines. However, performance of various model parameters viz. plume rise equations, dispersion coefficients, etc. are required to be evaluated under Indian conditions.

In view of the above, a project has been initiated that will provide scientific means for validation and adaptation of air quality model suitable for Indian conditions and subsequently help in formulating more appropriate guidelines.

An exhaustive data set including emissions, plume characteristics, measured concentrations of pollutants and meteorological parameters have already been generated for a chosen site. Necessary software, based on Gaussian plume model, has also been developed for computation of ground level concentrations of pollutants emitted from point sources. Further work on evaluation of model parameters is under progress.

DEVELOPMENT OF CERTIFIED REFERENCE MATERIAL FOR AIR MIXTURES

Certified reference materials are a pre-requisite for calibration of air monitoring instruments and also to check the accuracy of analytical methods. The accuracy of analytical data depends on the quality of reference standards, used for calibration. In India, availability of indigenously manufactured reference material is scanty and much work

needs to be done in this direction. In order to overcome this problem, the project was taken up with the sponsorship of the Department of Science & Technology, New Delhi. Few standard reference materials for air mixtures have been prepared on trial basis.

Photo 16

Calibration Gas Dilution Facility at CPCB for Preparation of CRM Air Mixture

IMPACT OF AUTO EXHAUST LEAD POLLUTION ON VEGETATION IN UNION TERRITORY OF DELHI

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The impact of ambient air quality constituting elevated levels of SO₂, NO₂, SPM and Pb content, were undertaken at five locations (high traffic sites) in Delhi during the period January 1984 to June 1985. Lead in the ambient air at five various traffic intersections were observed in the range of 185-324 ng/m³, while concentration at non-traffic area was 62 ng/m³. Soil samples and plants grown on the soil at the exposure site were analyzed to find out lead contamination. Plant species such as Nerium, Alstonia and Eugenia were cultivated at all the five locations and also at the reference site. Eugenia has been observed as highly tolerant to air pollution and suitable for growing along the roadside.

Publications:

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- Impact of Auto Exhaust Lead Pollution on Vegetation in Union Territory of Delhi: EIAS/1/1985-86.
- Impact of Auto Exhaust Lead Pollution on Vegetation in Union Territory of Delhi (Part-II): EIAS/2/1986-87.

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STUDIES ON TRACE METALS IN PARTICULATE IN AMBIENT AIR

The determination of heavy metals in airborne suspended particulate is important in order to assess the anthropogenic pollutants contribution to ambient air, which may lead to emission source identification, to assess existing levels to which human population is exposed, and application of strategies in air pollution control programme. Measurement of various metals like Lead (Pb), cadmium (Cd), zinc (Zn), copper (Cu), manganese (Mn), nickel (Ni) and iron (Fe) in airborne particulate matter in Delhi is being continuously carried out to assess metallic loading of ambient environment.

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MONITORING OF BENZENE AND BTX IN AMBIENT AIR

The following are the monitoring activities of Benzene in Delhi

- **Monitoring of Benzene in Delhi (using Passive Sampling)**

Benzene is being monitored regularly at seven locations in Delhi (since May, 1999) and at five locations in Kanpur (since June, 1999) on fortnightly basis in collaboration with Indo-German Bilateral Project. Samples are also being sent to M/s Draegers, Germany for analysis.

- **Benzene Monitoring in Delhi (using Active Sampling)**

Monitoring of Benzene using active sampling is being conducted at number of locations covering different land use areas.

- **Benzene Monitoring in Delhi (using Portable/On-line G.C.)**

Portable/On-line G.C. based BTX Analyzers are being used for Benzene monitoring in the field at selected locations in Delhi. This monitoring will also be continued not only in Delhi but also in other cities like Kolkata and Bangalore.

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Photo 17

Monitoring of BTX is a continuous activity using following techniques: (1) Active Sampling (Pumped); (2) Passive Sampling; and (3) On-Line instruments, i.e. BTX Analysis based on GC-FID and GC-PID. An attempt has been made for standardization and analysis of BTX in CPCB laboratory using GC-FID and ATD-GC-FID techniques. Further studies are in progress to improve the analytical capability.

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- ***BTX Monitoring in Delhi and Kanpur (Using Passive Sampling)***

Vehicle engine fuels have considerable quantity of Benzene and its derivatives. Application of petrol and diesel fuels in vehicles increases the BTX content in the atmosphere. The BTX are carcinogenic in nature, therefore, it is imperative to monitor the BTX content in the atmosphere.

- ***BTX Monitoring in Kolkata***

Monitoring of Benzene alongwith toluene and xylene being undertaken at busy road intersections at three locations i.e. Behala, Garia and Tollygunge. The monitoring being undertaken for 24 hours at 15 minutes interval.

Publications:

- Monitoring of Benzene Level in Ambient Air of Delhi: TOS/1/1999-2000.
- Benzene in Air and its Health Impact, CPCB Newsletter, February, 2002.

Photo 18

GC-FID-SPT System at CPCB Laboratories

MONITORING OF POLYCYCLIC AROMATIC HYDROCARBON (PAH's)

Polycyclic Aromatic Hydrocarbons (PAH) are carcinogenic in nature and harmful to health. Routine measurement of 15 PAH compounds namely Naphthalene, Phenanthrene, Anthracene, Fluoranthene, Benz-anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(e)pyrene, Benzo(a)pyrene, Perylene, Indeno Pyrene, Dibenz(ah)anthracene and Benzo(ghi)perylene are regularly being conducted in air particulate samples collected at mega metropolitan cities like Delhi, Kolkata to assess their levels in ambient air and at traffic intersections & petrol filling stations.

STUDIES ON FOG FORMATION IN NORTHERN BELT IN WINTER

In recent years, dense fog throughout the northern belt including Delhi during winter season has caused many problems resulting in slow vehicular movement, delay and cancellation of trains and air services resulting in direct economic losses. The complexity of fog and its accurate measurement needs collaboration of concerned agencies to pool their resources to make measurement of various parameters, required for development of predictive model. With this objective in mind, CPCB decided to work in close cooperation with National Physical Laboratory (NPL), New Delhi in specific areas of national importance. A Memorandum of Understanding was signed with National Physical Laboratory (NPL), New Delhi on March 27, 2000. The scope of the joint research activity will cover:

- Studies on fog occurrence in Delhi and in northern India, mechanism of its formation, its prediction and development of an early warning system;
- Measurement of mean mixing height and occurrence of inversion in Delhi vis-à-vis other areas;
- Studies on characterisation of suspended and respirable particulate matter in Delhi and other areas in order to characterise its origin;
- Development of facilities in NPL and CPCB to calibrate and standardize the air quality monitoring analyzers; and
- Development/revision of source base noise standards including their compliance testing.

The monitoring of various parameters influencing the onset of fog has been conducted by NPL using the available infrastructure. The studies provided information on the meteorological and other processes as fog condenses,

changes with time and eventually disappears. The number of parameters like mixing height, temperature, relative humidity, pressure, size fraction analysis, Sulphur Dioxide and Nitrogen Dioxide in ambient air being monitored during the study.

STUDIES ON MIXING AND INVERSION HEIGHT FROM SODAR SYSTEM

Sound Detection and Ranging (SODAR) system is a unique remote sensing device, used for mapping of atmospheric turbulence, depth of planetary boundary layer using naturally occurring fluctuation in atmospheric temperature, wind velocity, atmospheric stability, convective plumes and low level disturbances etc.

SODAR system has been installed at 'Parivesh Bhawan' in March, 1992 in collaboration with National Physical Laboratory (NPL), New Delhi. The system employs the acoustic waves of 2.2 KHz frequency for accurate sensing of thermal and wind structure of lower atmosphere upto 700 metre vertical height. The system has unique application for real time measurement of atmospheric condition, thermal and wind structure of lower atmosphere, mean wind velocity, component wind velocity and echo-intensity which are useful in air pollution dispersion and modelling studies.

Mixing height is the height upto which proper mixing takes place in the atmosphere. It is same as the height of the base of inversion layer. Mixing height can be obtained from SODAR by studying the echogram and these are useful to know the pollution potential and to find out ground level concentrations. The SODAR system installed at 'Parivesh Bhawan', CPCB is being used to generate the data.

Publication:

- Spatial Distribution of Hourly Mixing Depth; PROBES/92/2002-03.
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ASSESSMENT OF RESPIRABLE SUSPENDED PARTICULATE MATTER

The monitoring of Respirable Suspended Particulate Matter is undertaken at various cities and towns viz. Hyderabad, Vishakhapatnam, Delhi, Ahmedabad, Parwanoo, Bangalore, Cochin, Dehradun, Thiruvananthapuram, Mumbai, Nagpur, Pune, Solapur, Angul, Rourkela, Jaipur, Chennai, Kanpur, Lucknow and Kolkata, with objective to determine status of PM₁₀ in ambient air. RSPM levels are exceeding the ambient air standards at many locations in the country. The high RSPM levels mainly attributed to vehicular pollution, which is increasing exponentially in most of the cities. The concentration of RSPM also depend on total emission load and meteorological condition like ventilation, inversion, humidity, wind

direction, wind velocity and rainfall pattern. Thus, the city with low emission of RSPM may have high ambient air concentration of RSPM.

Photo 19

RSPM Monitors in Operation at Tajmahal, Agra

Publications:

- Respirable Particulate Matter and its Health Effects: NAAQMS/19/2000-2001.
 - Air Quality Status and Trends in India: NAAQMS/14/2000-01.
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PHYTO-REMEDICATION OF PARTICULATE MATTER FROM AMBIENT ENVIRONMENT THROUGH DUST CAPTURING PLANT SPECIES

Ambient Air constitutes various size ranges of suspended particles commonly recognized as Dust, which are continuously agglomerated and deposited on various surfaces. The deposited particulate matter is a conglomerate of chemically heterogeneous substances. Many different types act on plants in a variety of ways. Studies are proposed to identify the plant species, which have higher potential of dust capturing from environment while sustaining their well being. The Phytoremediation of particulate matter from ambient environment through dust capturing plant species involves a unique combination of concentration and exposure period to the pollutant (or pollutants), plant species, plant age and environmental conditions. The studies will enable the user to determine simply and directly the factors involved in dust capturing capacity of the plant species. This is ongoing collaborative project with Pollution Control Research Institute (PCRI), BHEL, Haridwar.

The main objectives of the project are:

- To Study relative exposure vs. dust capturing capacity of various identified plant species through natural and controlled exposure.
- To evaluate out the rate of dust deposition/capture capacity of different plants species (Herbs, Shrubs & Trees)
- To identify the Plant species with high potential for Control of Dust/Suspended Particulate Matter in Ambient Air.
- To prepare checklist of Plant species for Phyto-remediation of particulate matter from ambient environment.

The project plan comprises the survey and identification of the plant species, which have very high natural capacity to capture Particulate dust from ambient air near Thermal Power Stations, Coal Mines, Lime Kilns and at metropolitan cities with high automobile movement and review of available documents/reports. Morphometric measurement of plant foliage for assessment of dust capture area available with the plant species. Controlled development of plant species in nursery and then exposure at identified heavy dust particulate sites. Relative assessment of level of Suspended Particulate matter and relative dust capture by plant species (Herbs/ Shrubs) during the exposure period.

QUALITY ASSURANCE THROUGH INTER-LABORATORY COMPARISON OF AMBIENT AIR QUALITY MEASUREMENT METHODS

Quality Assurance (QA) programme plays a vital role in generating reliable, good and representative data of any monitoring programme and especially in a complex condition of ambient air quality measurements. Central Pollution Control Board is monitoring 290 stations in the country for air quality assessment in terms of SPM, SO₂, NO₂ and also meteorological parameters through various SPCB's/PCC's. In order to generate reliable air quality data and to improve the performance of various laboratories, a Quality Assurance programme with "Static Injection System" for carrying out "RING TEST" for gaseous pollutants such as SO₂ and NO₂ was set up through technical assistance from German Technical Co-operation (GTZ) in 1997 and it is the only one of its kind in the entire country. Starting from 1999, four rounds of inter laboratory exercises have been conducted for laboratories for SPCB's/PCC's. The result indicates that the performance of participating laboratories was found good at higher concentrations than lower concentrations for SO₂ and NO₂. The participating laboratories need to adopt sound Quality Assurance for generating good, reliable and representative Air Quality data.

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Photo 19a

Static Injection System at CPCB Laboratories

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Pollution Control Related Studies

DUCKWEED BASED WASTEWATER TREATMENT SYSTEM AND ASSESSMENT OF NUTRITIVE VALUE AND ECONOMIC RETURN

With the objective to evolve a low cost treatment technology, the project has been undertaken to study the efficacy of treatment of wastewater by duckweed, to assess the economic return from pisciculture (fed on duckweed) as well as evaluating the nutritive value of duckweed.

The duckweed based stabilization pond functions as anaerobic pond except at the top layer where aerobic condition prevails. The top aerobic zone effectively controls the odour problems of the pond. The capability of up taking nutrients and other substrate from wastewater has attributed this plant to be biological purifier. There is remarkable reduction of BOD, COD, Total Suspended Solid, Nitrogen, Phosphorus and Heavy metals from wastewater in duckweed based stabilization pond. Wastewater treatment by duckweed based stabilization pond provides the treatment at a low cost. This type of treatment system can therefore help in meeting the challenges posed in developing countries for environmental protection, due to resource recovery advantages over the conventional lagoon system.

Publication:

- Guidelines for Duckweed Based Wastewater Treatment System:IMPACTS/7/2000-2001.

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APPLICATION OF DUCKWEED BASED WASTEWATER TREATMENT SYSTEMS

Duckweed could be successfully used for removal of pollutants from domestic wastewater. The optimum conditions for efficient treatment and design parameters has to identify in order to develop Duckweed based low cost treatment technology, the Central Pollution Control Board had sponsored the project on "Duckweed based wastewater treatment system" to M/s Sulabh International, New Delhi. On the basis of the findings of the study, the following potential application for the Duckweed based treatment system have been derived:

- **Treatment of sullage of small communities (BOD 75-125 mg/l)**

Duckweed based system can be used with the following additional advantages for small term generating wastewater with low BOD (range 75-125 mg/l).

- Highly skilled personals are not required in such places.
- No energy requirement for running of the unit.
- Income due to harvested duckweed fish feed, chicken or cattle feed.

Photo 20

Duckweed based Stabilization Pond

- **Polishing of secondary treated effluent (BOD < 50 mg/l)**

This treatment system is also suitable to give further treatment to effluents from algal waste stabilization ponds and mechanically aerated lagoons to meet the BOD and TSS regulations, especially when TSS are due to algal bio-mass.

Photo 20a

Duckweed

- **As a component of STP for a large town**

Duckweed based ponds can be used as a component unit of the sewage treatment plant of a large town/ city for the purpose of removing residual organic pollutants, to provide enhanced denitrification, removal of heavy metals and inorganics, and also for generating revenue by utilising the duckweed bio-mass for economic gains to meet partial cost of operation of the STP. Duckweed pond as a component of STP of a large town may be financially beneficial because the cost of operation and maintenance of duckweed pond unit will be only a small portion of the cost of operation and maintenance of the entire STP.

Publication:

- Guidelines for Duckweed Based Wastewater Treatment System:IMPACTS/7/2000-2001.

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DEVELOPMENT OF ROOT ZONE TREATMENT TECHNOLOGY

CPCB in collaboration with GTZ, Germany has undertaken pilot study on Root Zone Treatment System for treatment of dairy effluent. The Root Zone Treatment System is artificially prepared wetlands comprising of clay or plastic lined excavation and emergent vegetation growing on gravel/sand mixtures.

To investigate the efficiency of root zone treatment system in warm climates, a pilot project has been set-up at Mother Dairy, Delhi to treat the dairy waste. The dairy wastewater, with average BOD of 800 mg/l and BOD range from 8000 mg/l to 12000 mg/l was used for the experiment.

Photo 21

Root Zone Treatment Pilot Project at Mother Dairy, Delhi

The RZT data generated from the studies will form the basis of guidelines being developed for RZT System. A committee has been constituted under the Chairmanship of Dr. K.R. Ranganathan, Member Secretary, Loss of Ecology (P&C) Authority for the State of Tamil Nadu to develop "National Guidelines for construction, use, operation & Maintenance of Root Zone Treatment System" in India. The Committee consists of members from CPCB and Experts from GTZ project, UNIDO project, Chennai, Kraft & Associates, Pondicherry, Centre for Scientific Research, Auroville, IRSBB, Chennai etc. The applications of root zone treatment technology are:

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- Treatment of domestic wastewater especially for small towns, villages is easily possible & affordable having low investment.
- RZTS can also treat biodegradable industrial effluents specially effluents of agro-based industries.
- RZTS Technology can be applied in Urban Watershed Management (UWM) through following ways:
- Transformation of urban open nullahs into cleaner streams through decentralised RZTS.
- Cost reduction for wastewater treatment through improved self-purification of restored streams.

Photo 22

Construction & Laying of Geo-textiles & Filter Media for Root Zone Pilot Project

A number of Root Zone Treatment System (RZTS) plants have been set-up in India by private companies at places such as Auroville, Chennai, Pune, Tekkadi (Kerala), Bhopal, Gurgaon, & Bilaspur (MP). CPCB has sponsored a project to Centre for Scientific Research, Auroville to monitor their four such plants for a period of one year.

Publications:

- Root Zone Treatment Technology – Brochure.
- Constructed Waste land for Wastewater Treatment: RERES/2/2001-02.

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ALTERNATE TECHNOLOGIES FOR POLLUTION CONTROL IN VINYL SULPHONE INDUSTRY

To suggest process modifications and technologies for better pollution control from vinyl sulphone industry, the project has been taken up in collaboration with National Chemical Laboratory, Pune. The project is in progress.

TECHNOLOGY DEVELOPMENT OF SPECIFIC MICROBIAL PACKAGES FOR TREATMENT OF PAPER & PULP INDUSTRIAL WASTEWATER

The efficiency of treatment of industrial wastewater depends upon the composition of chemicals and their reaction with microbial action on the wastes. There are specific groups of bacteria, which act effectively with specific types of waste and degrade the waste in a fast and efficient manner. Keeping this fact in view, the project has been taken up in collaboration with the Centre for Biochemical Technology (CSIR), Delhi with sponsorship from the Department of Biotechnology, New Delhi.

The Paper mill effluent was collected, analyzed and characterization has been made for screening the suitable and efficient bacterial composition. Trial runs were made to find out the degradation rate of the microbial package using the effluent. The outcome of the project work will be helpful in development of special microbial package, which will treat the paper & pulp wastes effectively in terms of time and pollutants like BOD, Lignin, Colour, AOX, TDS etc.

DEVELOPMENT OF TECHNOLOGIES FOR POLLUTION CONTROL AT DRUG MANUFACTURING UNITS – PARACETAMOL A CASE STUDY

Paracetamol is an important drug manufactured in the country and is being used as an analgesic and antipyretic drug in a number of formulations in the form of tablets, powder, granules and injectibles. Paracetamol is produced from para nitro phenol using iron-acid for hydrogenation as a result huge amount of hazardous waste is generated with high organic impurities, which are difficult to dispose. Since, the scale of operation is very small and it will be very difficult to dispose the wastewater even in common hazardous waste disposal site, it will be worthwhile to employ catalytic hydrogenation or any other cleaner options so that the effluent / emission/ hazardous waste generation can be minimized. Such an attempt with respect to H-acid and vinyl sulphone provided us insight for cleaner production and waste minimization.

The objective of this study comprises the development of cleaner production process for manufacturing of paracetamol, improvement in the efficiency of production, cost reduction and waste minimization.

CONTROL OF TOTAL DISSOLVED SOLIDS IN INDUSTRIAL EFFLUENTS

CPCB along with National Chemical Laboratory (NCL), Pune is studying various industrial effluent streams, process modification required to avoid/reduce Total dissolved solid generation, control equipment and their feasibility from major industries like pesticides, bulk drugs, tanneries, dye & dye intermediate manufacturing industries. The control technologies available for TDS control have been compared and their merits and limitations are being studied.

CONTROL OF OFFENSING ODOUR SUBSTANCES WITH SPECIFIC REFERENCE TO SELECTED INDUSTRIAL PROCESSES

The presence of malodours in and around organic chemical industries is an unpleasant but seemingly ubiquitous fact. Constituents of malodour are generally volatile hydrophobic molecules containing one or two functional groups made up of elements such as oxygen, sulphur, and nitrogen. Sometimes the presence of ammonia imparts odour. The off odours in the vicinity of the pharmaceuticals are mainly due to the presence of amines, hydrogen Sulphide and mercaptans. In case of antibiotics unit the odours are mainly due to thiazole, azines and lactams. In pesticide industries, odours are imparted by phosphorous, sulphides as well as chlorides. In dye and dye intermediate industries, odours are due to metal reductions, amination, coupling reactions using metals. In case of fine chemicals and bulk drugs, the odours are due to sulphur and nitrogen compounds, unsaturated olefins and several other organic reaction end products. Most of the constituents of the malodours are highly toxic gases, which can be fatal. They are irritants to respiratory system and eyes, causing damage to nervous, gastrointestinal system and skin at higher concentrations.

Photo 23

Typical Atomizer for Odour Control

The objective of the project study includes enlisting priority offensive odorous substances in the country, identification of method of odour detection and choice of control technology (BAT & BPT) for enlisted offensive odorous substances, setting norm for control of specific offensive odour substances from selected industrial processes.

Publication:

- Odour Pollution and its Control; CPCB Newsletter, January 2003.

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A BENCH SCALE MODEL STUDY ON TREATMENT OF TEXTILE WASTEWATER

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Textile industries contribute considerable amount of effluent of varying characteristics the effluent carries colour, dissolved solids and various organic and inorganic substances. Treatment of the textile effluent normally involves neutralization, coagulation followed by biological treatment. This treatment involves large amount of acid, coagulants and energy. In order to over ride high amount of chemicals, an attempt has been made to treat textile effluent by highly acclimatized microbial composition. It has also been observed that the acclimatized mixed culture shows maximum efficiency in term of pH reduction and removal of COD and TDS. Using the acclimatized microbial culture, the remaining part of the COD from the primarily treated effluent, can be further reduced to 60–69% with an improvement upto 40 % reduction in the Total Dissolved Solids contents.

Publications:

- Biological Treatment of Textile Mill Effluent – A Case Study: IMPACTS/5/1999-2000.

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TREATMENT OF PRIMARY AND TREATED DISTILLERY EFFLUENT IN BATCH AND FEED BATCH MODE IN AEROBIC ENVIRONMENT

Wastewater from distillery contains large amount of dissolved organic matter and possesses high pollution loads in terms of BOD. This organic matter is readily decomposed by microbial action and consequently discharge of these wastes to surface water causes serious damage to the aquatic life in water resources. The project study has been undertaken to find out how much treatment can additionally be given to anaerobically treated effluent.

Primarily treated distillery effluent was taken as sample effluent to study the extent of degradation of pollutants in batch and feed batch mode in laboratory scale reactors. The experimental system was initially fed with known amount of activated sludge and constantly aerated. In batch reactor, no replacement was made; however, in feed batch reactor the amount of sample withdrawn replaces the fresh sample. Temperature of the reactors was maintained by keeping in temperature controlled water

bath. All the reactors were seeded with acclimatized mixed culture. At constant aeration and temperature, samples are withdrawn from all the four reactors and analysed for BOD, COD and Total dissolved solids.

The findings of the treatment study indicate that the BOD of the sample was reduced down to 360 mg/l from the initial level of 2130 mg./l. The COD of the sample was also reduced to 7480 mg/l from the initial level of 19800 mg/l and the Total Dissolved Solid (TDS) content of the effluent was reduced to 6330 mg/l from initial level of 18340 mg/l.

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DYE DECOLORIZATION BY ACCLIMATIZED MICROFLORA

Generally dyes are the coloured compounds, which are capable of being fixed in fabric and are classified based on their application. The dyes are of special environmental concerns because of their carcinogenic nature, formation of toxic amines, persistency and recalcitrant nature. Dyes like Astrozian blue, Maxilon red, Telon blue, Congo red, Solar blue, Faron blue, Safranine, Faron brilliant red, Sandolan, Rhodine were tested for microbial degradation by Batch process. Among all the tested dyes, it has been observed that eight dyes were readily degraded by the acclimatized microflora, when the concentration of individual dyes increase from initial 5 ppm to final 50 ppm. Further studies are in progress.

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STUDY ON BIODEGRADATION OF SYNTHETIC DYES IN TEXTILE INDUSTRY

Presence of various types of dyes & chemicals make the textile effluent coloured and highly alkaline. To treat such type of effluent, conventional and cost effective treatment methods are acid neutralization, flocculation and adsorption.

To replace acid neutralization by other possible process, the project has been designed and undertaken. The study includes characterization of the textile effluent, acclimatized culture development, flocculation/coagulation treatment of combined effluent for primary treatment, treatment of primarily treated effluent at laboratory scale. Developed micro flora and freshly collected activated sludge, suitability of laboratory developed micro flora for wastewater from a problem area.

Acclimatized micro flora developed in the laboratory has been studied in the shake flask for pH change and COD reduction. The sequence of various coagulants in various combinations was tested for best reduction of pollutants.

DECOLORIZATION OF SYNTHETIC TEXTILE DYES USING NATURAL LOW COST ADSORBENTS

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A number of naturally occurring adsorbents like Water Hyacinth roots, shoots of Hydrilla plants, bagasse, orange peels, saw dust were tested for different synthetic textile dyes in batch mode and compared with activated charcoal. The dyes such as Astrazon blue, Maxilon red, Telon blue, Caongo red, Methylene blue, Malachite green, Victoria blue. Solar blue, Foran blue, Safranin, Faron brilliant red, Sandolan, Rhodine using different adsorbents and adsorption capacity for each dye adsorbent system has been evaluated in aqueous system. Parameters studied include pH, sorbent dosage, contact time and initial concentrations. The performance of different adsorbents for majority of dyes was observed as Hyancith root < Hydrilla plant < Hyacinth shoot < saw dust < orange peels < bagasse. The pattern of maximum removal of majority of dyes was observed as Methylene blue < Malachite green < Congo Red < Safranin < Maxilon red < Telon blue < Faron brilliant red < Victoria blue < Astrazon blue.

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ENVIRONMENTAL IMPACT OF SILICA SAND MINING AND WASHING INDUSTRIES

The environmental impact of silica sand mining and washing studies has been undertaken in association with Directorate of Geology and Mining Allahabad. The project study involved inventory and detailed status of pollutant from silica sand mining and washing industries at U.P., Haryana, Karnataka, Maharashtra, Bihar, Rajasthan and Gujarat. It has been derived that there is no organized management of silica sand mining practices and its excessive abstraction, which increases the risk of ground water pollution. The indiscriminate mining, lack of effluent treatment provision and improper disposal of high iron sludge from these operation may lead to environmental degradation.

TREATABILITY STUDY ON INDUSTRIAL EFFLUENT CONTAINING DDT PESTICIDE

The persistent pesticides in the wastewater have created serious ecological problems, as they transfer in food chain through successively higher organisms accumulating increasingly concentration at each level, causing effects to the producer at the end of predator chain. DDT is one of the most persistent organo-chlorine pesticide used for agriculture, public health and veterinary purpose.

The wastewater resulting from DDT manufacturing unit is not possible to treat directly by biological treatment process, some physico-chemical pre-treatment is essential to reduce toxicity before its biological treatment. It was observed that to reduce toxicity of wastewater from DDT Pesticide

manufacturing unit, dilution practice has been followed before biological process. The dilution process requires huge amount of fresh water, therefore alternative treatment to remove toxicity from wastewater to a considerable extent was envisaged so that treatment could be achieved with no dilution or little dilution.

The objectives of the study are:

- Modification in conventional chemical treatment with cost effective treatment technology.
- Biological treatment of chemically treated effluents without dilution (as practiced in ETP's) of pesticide industries.

To overcome the problem of dilution by freshwater to reduce the toxicity, single, mixed-sequential coagulation systems was adopted. By using sequential coagulation system 47 % of toxicity removal in the effluents was achieved. The chemical oxidation (using oxidants H_2O_2 , $KMnO_4$) followed by sequential coagulation, by using Fenton's oxidation system 38% of toxicity was removed. After coagulation and oxidation (by Fenton's oxidation) the effluent was treated biologically diluting it with sewage water in 1:1 ratio and the treated effluent complied the effluent discharge standard limits.

SLUDGE REAGENT PRODUCT (SRP) TECHNOLOGY FOR WATER AND WASTEWATER TREATMENT

In this project study, new treatment technology has been developed for treatment of raw water using discarded sludge from conventional water treatment plants. The developed process technology has been applied for treatment of water. The alum treated sludge is reused as alum again after chemical treatment. Thus, the volume of sludge reduced to 70-80% in comparison to conventional treatment technology. Water recovery was almost 99% and alum consumption 10-20%.

Photo 24

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The SRP Technology has been used for treatment of wastewater in which different types of commercial alum have been used as single and in sequential manner for treatment of drain water. The quantity of coagulant to be added to the sludge reagent product (SRP) to maintain 100% efficiency of the continuous treatment process were determined. The water treated with conventional technology as SRP were characterized and treated water quality was compared with drinking water quality standards. Comparison of cost for the conventional and SRP technology was performed comprehensive assessment of the findings was made and patent was filed. Based on SRP Technology 0.5 MLD pilot plant has been installed at Bhagirathi Water Treatment Plant for which Memorandum of Understanding has been executed with Delhi Jal Board.

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BIOLOGICAL REMOVAL OF TRACE AROMATICS FROM DRINKING WATER AND INDUSTRIAL EFFLUENTS BY IMMOBILIZED PEROXIDASE AND TYROSINAGE ENZYME

The enzymes are commonly used as biocatalysts for industrial process and clinical purpose. The enzymatic approach to remove toxic chemicals from drinking water and industrial wastewater has received much attention recently. The enzymes such as peroxidase and tyrosinase are extensively used for biotechnology purposes as well as removal of organic pollutants like phenols, colourants from industrial wastewater. During the process, the enzyme gets inactivated after initial reaction, therefore it has to be reactivated, which increase the cost of process. To reduce the cost, immobilization of enzyme is necessary by which it leads to high storage stability and better control of catalytic process.

Photo 24a

Bioreactor for Biological Removal of Trace Aromatics by Enzymatic Action at CPCB Laboratories

The main objective of the project is to develop viable process for extraction of peroxidase enzyme from plant sources, such as radish roots and mushroom. The purification of crude extract of enzyme, stabilization of purified peroxidase and tyrosinase enzyme and development of optimized process for immobilization of enzymes. The purified and immobilized enzymes are proposed to be used to remove organic pollutants like phenol, pesticides, amines from drinking and industrial wastewater. The peroxidase enzyme has been extracted by homogenization and centrifugation from plant sources. Further studies are in progress.

Noise Pollution Related Studies

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AMBIENT NOISE LEVELS DURING DEEPAWALI FESTIVAL

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The ambient noise levels during Deepawali festival are regularly monitored at various mega cities to find the noise level status during Deepawali festival due to firing of crackers, to compare the noise level during Deepawali day with normal day. The study being undertaken to assess the extent of violation of noise level standards during Deepawali day and to formulate strategic plan for mitigating noise level on such festive occasions.

Publications:

- Ambient Noise Level Survey in Delhi on the Occasion of Deepawali Festival: CUPS/43/1996-97
- Ambient Noise Level Survey in Delhi on the Occasion of Deepawali Festival: CUPS/47/1997-98

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STUDIES ON NOISE POLLUTION NEAR AIRPORT – A CASE STUDY

The noise pollution is prominent at airport during take off, landing and taxing of aircrafts. There is excessive generation of noise from aircraft engines, which is the cause of concern among the population living near by and the officials working at airport. In order to assess the levels of noise pollution at airports, the case study was undertaken at Netaji Subhash Chandra Bose International Airport, Kolkata. The finding indicates elevated noise levels in vicinity of airports. Suggestions have been made to control noise pollution at airports.

Publication:

- Noise pollution around Netaji Subhash Chandra Bose International Airport, Kolkata: PROBES/79/2001-2002

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Solid Waste Management Related Studies

STUDIES ON COMPOST QUALITY AND ITS APPLICATION IN AGRICULTURE

The organic manure as a source of humans and plant nutrients to increase fertility in tropical soil has been well recognized. The organic manure prepared from rural and urban wastes not only provides the plant nutrients and humic materials, but also result in hygienic disposal of organic waste, which otherwise may cause pollution problems. The research on sewage sludge has so far been largely restricted to its production, composition etc., however, few studies have been conducted on its safe and economic disposal and its application on agricultural land. The project study covered the analysis and manurial potential of Municipal Solid Waste compost and the sewage sludge.

Photo 25

Experimentation at IARI to assess Manurial Potential of Municipal Solid Waste Compost

The studies also cover safe and beneficial use of municipal solid waste compost/sewage sludge on agricultural fields and its environmental impact. The studies are being undertaken in collaboration with Indian Agricultural Research Institute (IARI), New Delhi.

STUDY OF COMPOST MADE OUT OF 'PRESS MUD' OF SUGAR INDUSTRY AND 'SPENT WASH' OF DISTILLERY

The project has been initiated at four distilleries in Karnataka and Maharashtra State from where the samples of compost and that of soil where compost is made and applied were collected. Simultaneously ground water samples were also drawn from the vicinity of the compost site and field of application.

The preliminary observations indicated that if "composting" is done in a scientific manner and adequate managerial techniques are adapted, it could be a viable solution for the distillery waste and as such may result making the distillery as 'zero discharge' industry. The economics of 'compost' process being worked out based on the data collected which indicate that due to shortage of Press Mud, complete utilization of spent wash is not achieved and at the same time, the demand of 'compost' is so high that the industry is not able to cope up with the requirement in time. The 'composting' of press mud and spent wash could not only be the treatment of the waste but also a source of revenue for the industry due to increased yield of sugarcane as well as savings toward the input cost of chemical fertilizers.

Publication:

- Management of Distillery Wastewater: RERES/4/2001-2002.

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Photo 26

TCLP Leachate Extraction System at CPCB Laboratories

COMPARATIVE STUDIES ON METHODOLOGY OF ANALYSIS AND CHARACTERIZATION OF MUNICIPAL SOLID WASTE (MSW) COMPOST

Municipal Solid Waste can be defined as "Chemical or biological refuse of domestic or consumer origin, considered potentially pathogenic to human and/or the environment. Many test procedures for characterization of Solid wastes in terms of Corrosivity, Reactivity, Ignitability, and Toxicity are available. One such test procedure is the Toxicity Characterization Leaching Procedure (TCLP). As per US-EPA method, the solid waste is leached using two levels of pH buffers i.e. 4.93 + 0.2 and 2.88 + 0.2 depending upon the chemical nature of samples. TCLP method as followed in USA and Canada is different in terms of procedure and standards, whereas in Europe, solid waste management do not include TCLP as part of regulation. The extraction method followed in European countries is Constant pH stat extraction method. Some countries follow distilled water extraction procedure.

The composition and levels of leaching substances vary from method to method and thereby the interpretation with reference to standard limits also varies considerably. Though no method could able to match with real field situation, a judicial approach is required to derive suitably standardized method. Considering these, the project study was carried out on various leachate test procedures using MSW compost samples collected from Okhla and Bhalswa in Delhi. The main objectives of the study was to assess the merits and demerits of various leaching procedures, to estimate variations in the levels of leaching under various test methods and to suggest suitable test procedure for toxicity characterization.

Related Publications:

- Management of Municipal Solid Wastes - Status and Options: CUPS/41/1994-95.
- Status of Municipal Solid Waste Generation, Collection Treatment and Disposal in Class-I: CUPS/46/1998-1999.
- Status of Municipal Solid Waste Generation, Collection, Treatment and Disposal in Class-I Cities: CUPS/48/1999-2000.
- Status of Solid Waste Generation Collection, Treatment & Disposal in Class II Towns: CUPS/50/1999-2000.

ANAEROBIC DIGESTION OF DOMESTIC SOLID WASTE

The anaerobic digestibility and effect of parameters on the anaerobic digestion of kitchen waste has been studied in the laboratory using prototype version of digester for installation. The operational problem encountered during laboratory scale studies have been taken into account for the digestion and operation of field level digester. Two stage anaerobic digester with design capacity of 300 kg of solid waste/day has been

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installed and commissioned for treatment of solid waste generated at IIT, Delhi Hostels near Jwalamukhi Hostel. The novel feature of the digester is that it is made of HDPE and mostly buried under the earth and occupies minimum space. The feed hopper, screw conveyor and grinder are used for homogenization of waste material feeded to the digester. The digested slurry goes to sand filler, from where water is recycled. The deviated slurry is dried and used as manure. The gas generated from the digester is used in Hotel kitchens.

The study includes effect of operational parameters and feed composition on the acidification as well as bio-methanation steps. The effect of process perturbations on the steady state performance of the process has also been studied. The research has been undertaken in collaboration with Indian Institute of Technology, Delhi.

DEVELOPMENT OF GUIDELINES FOR SITE SELECTION FOR SANITARY LANDFILLS

Open dumping practice is commonly adopted for the disposal of solid waste in the country, which causes deterioration of environmental quality. Development of appropriate technology for sanitary landfills is very essential for proper disposal of solid waste. Site selection is an important aspect for the development of sanitary landfill. In view of this, a site selection criteria has been developed in the form of guidelines to suit Indian conditions in keeping with the findings of the other studies. Guidelines have been developed through extensive literature search and review of earlier studies.

The developed criteria encompass environmental conditions, hydrogeological conditions, accessibility, ecological and societal effects etc. The guidelines include technical screening procedure based upon economic, engineering and environmental suitability and public approval/acceptance and scrutinizing procedures. The guidelines are indicative and are only meant for guidance of government agencies such as municipalities, corporations and other implementation authorities, who have to comply the requirement of the legislation

Publication:

- Criteria for Hazardous Waste Landfills: HAZWAMS/17/2000-01.

ASSESSMENT OF IMPACT OF POLLUTION DUE TO EXISTING LANDFILL SITE

The sanitary landfill sites have environmental impact, which is visualized in form of ground water pollution, air pollution, odour problem and related environmental problems. The study is being undertaken to comprehensively assess the impact of pollution with the objectives to

develop baseline information regarding various landfill sites at various cities and towns, in collaboration with National Productivity Council (NPC), New Delhi.

- The impact of water and air pollution due to municipal dumpsites located at Autonagar and Golconda in Hyderabad and Bangalore is being studied in collaboration with Municipal Corporation Hyderabad, Andhra Pradesh State Pollution Control Board, Hyderabad and Karnataka State Pollution Control Board, Bangalore. Based on the studies, the local bodies will be followed up to operate landfill sites as per schedule III of Municipal Solid Waste Management Rules.
- The studies have been undertaken at Landfill sites at Kanpur to comprehensively assess various environmental impact of municipal solid waste landfill sites such as ground water pollution, air pollution, odour problem and other environmental problems. The field studies about ambient air, ground & surface water and soil quality monitoring have been undertaken. In addition land use pattern, aerobiological monitoring, assessment of noise levels and determination of bearing capacity of waste and waste analysis have been undertaken at landfill sites. Assessment of hazard potential have also been made and Environment Management Plan has been formulated.

STUDIES ON POLLUTION POTENTIAL OF LEACHATES FROM SOLID WASTE DUMPS

The ability to predict the mobility of dissolved solutes in soil solution (leachates) is of considerable importance in management and disposal of solid waste. The salt content of leachate may greatly affect the water movement in soils. The study of modes of leaching solute accumulation, nutrient movement, evaporation as well as ground water pollution is important. During the project study, the quality of leachate from different depth of active solid waste dump being assessed for physical, chemical and biological properties. The leachate from designated depth are collected at regular interval with soil sampler/lysimeter apart from study of reflection coefficient, mechanical filtration capacity and solute permeability of soil at the active solid waste dump. Simultaneously, the studies are also being undertaken at laboratory in the column simulating the field conditions. Further studies are in progress.

Hazardous Waste Management Related Studies

STANDARDIZATION OF METHODOLOGY FOR MEASUREMENT OF CERTAIN HAZARDOUS ORGANIC COMPOUNDS (PCB'S)

Polychlorinated biphenyls (PCB's) are the group of highly toxic, synthetic, chlorinated organics compounds with chlorine substitution around biphenyl as basic structural unit and constitute large number of individual organic species. Several of these species are non-biodegradable, stable with high toxicity and having tendency of bioaccumulation. PCB's have potential industrial applications, where non-flammability and heat resistant properties are desired and these compounds are most commonly used in heat transfer systems, hydraulics/lubricants, transformers, and capacitors, as plasticizer and as petroleum additives. The analysis of PCB's is quite complex involving several pre-treatment, concentration, clean up and instrumental optimisation steps.

Photo 27

GC-MS System for measurement of Hazardous Organic Compounds at CPCB Laboratories

There are about 209 individual chlorinated biphenyls often referred as Congeners, resulting from 10 different levels of chlorination of biphenyl nucleus. There is fragmentary knowledge at the laboratories of Central/State Pollution Control Boards about measurements of residual PCB's in environmental matrices viz. waste water, industrial effluents, sludge and soil. With this in view, the project on "Standardization of methodology for selective PCB compounds in environmental samples" has been undertaken. The main objectives of the research project are:

- To develop facilities and standardization of analysis of PCB's in water, soil and sediment.
- To standardize the procedure for extraction, concentration and sample clean up.
- To standardize the gas chromatograph's optimum conditions (oven temperature, detector, injector flow etc.) to achieve resolved peaks of individual PCB species.
- To undertake spiking and recovery studies in field samples i.e. water, wastewater, soil and sediments.
- Intra-laboratory (within laboratory) Analytical Quality Control for each PCB's.

The analysis of PCB is complicated as several of the congeners are available in form of complex commercial mixture e.g., Aroclors each having upto 60 or more individual compounds or congeners. The large number of congeners are common among two or three Aroclor mixtures, which provides overlapping peaks during Gas Chromatographic analysis, complicating the identification and quantification of Aroclors. Moreover other organics like Pesticides also interferes with the measurement of individual PCB congeners.

During the study, the qualitative segregation of individual Polychlorinated Biphenyl congeners have been achieved from standard Aroclor mixture. The Aroclor mixture could only provide crude approximation of total PCB's concentration in the environmental samples. Therefore, Congener Specific analysis in environmental samples are presently being undertaken.

Publication:

- Polychlorinated Biphenyl – Persistent Pollutants, CPCB Newsletter, 2002.

DETERMINATION OF PCB IN WATER AND SEDIMENTS OF RIVER YAMUNA AND DRAINS IN DELHI

To assess the present situation about the PCB levels in water and sediments of river Yamuna, Central Pollution Control Board has undertaken studies in Delhi stretch of River Yamuna and five major drains joining river Yamuna. The water and sediment samples from river Yamuna and drains of Delhi were pre-treated at CPCB Laboratory and samples were forwarded to National Institute of Oceanography (NIO), Goa for analysis of PCB's. The findings of the study are:

- Minimum and maximum levels of PCB's in water samples were found at old Yamuna Bridge and at Okhla i.e. 0.190 ng/l and 1.926 ng/l respectively, whereas in sediment samples minimum and maximum levels of PCB's were observed at Palwal (0.616 ng/g) and at Palla (8.927 ng/g) respectively.
- Among the major drains, the total PCB's in the drain water was recorded in the range 0.288 ng/l to 6.545 ng/l, whereas in sediments PCB's were in the range 0.282 ng/g to 281.397 ng/g. The highest concentration of PCB's in water and in sediment were detected in Power House drain and Civil Mill drain respectively.
- The results indicate that after mixing of Civil Mill drain and Power House drain with river Yamuna, the PCB's levels in river water increased from 0.190 ng/l (at Old Yamuna bridge) to 1.926 ng/l (Okhla) indicating that PCB's are contributed by the drains along with the wastewater. The level of PCB's again decreased to 0.501 ng/l down stream to Okhla, may be due to dilution or PCB's removal through bio-accumulation.

Publication:

- Polychlorinated Biphenyl – Persistent Pollutants, CPCB Newsletter, 2002.

STUDY ON ENVIRONMENTAL CONTAMINATION WITH POLYCHLORINATED DIOXINS (TCDDs)

Polychlorinated dibenzo-p-dioxins (PCDDs) and poly-chlorinated dibenzofurans (PCDFs) are created inadvertently by a host of industrial activities in which chlorine based compounds are exposed to a high heat in the presence of organic material. These are highly stable and present in a variety of synthetic chemicals, the important environmental contamination for these compounds includes incineration of municipal, hazardous and hospital wastes, automobiles operation, fossil fuel combustion and contaminated commercial chemical products. Many effluents have been listed for the presence of dioxins, some of which are black liquor from pulp & paper industry, wood, plastics, pesticides, antiseptics, lubricating fluids and bleach. The exposure to these contaminants results in adverse health effects in human and experimental animals like liver necrosis, neurobehavioral changes, skin lesions, reproductive and endocrine dysfunction.

There are 75 positional PCDDs and 135 PCDFs. The most toxic isomer is 2,3,7,8 – tetrachlorodibenzo-p-dioxins (2,3,7,8 TCDD). These chemicals accumulates in the body and results in increased risk of cancer, reproductive and nervous system disorders over the time. It is imperative

to study such sources and work places where there is a potential of environmental contamination with PCDDs and PCDFs. The emission of dioxin-like compounds can be reduced by source identification and analysis of the life cycle of chlorinated compounds. More detailed studies of recorded depositions input from accidents and favouring process with lower dioxin outputs would help to focus strategies for further reducing dioxin emissions.

The main objective of the study is to standardize the analytical techniques for the determination of residue levels of PCDDs and PCDFs in water, wastewater and soil samples and to estimate the levels of TCDDs in water, wastewater and soil samples of the contaminated sites, e.g., waste disposal sites, fly ash of incinerators, water resources and soil around pesticides, pulp & paper, wood and antiseptic industries and of commercial chemical products and evolution of techniques for reducing the emissions of 2,3,7,8 – TCDD in the polluted areas e.g., water resources, waste disposal site and municipal incinerators.

Bio-Medical Waste Management Related Studies

DEVELOPMENT & STANDARDIZATION OF SPORE

TESTING METHODOLOGY FOR EFFICIENCY TESTING OF AUTOCLAVES USED FOR HOSPITAL WASTE TREATMENT

The increasing Bio-medical waste generation has become a matter of serious concern for safe disposal of hospital waste in recent years due to increasing health facilities & number of hospitals, nursing homes in metropolitan cities. The Biomedical Waste (Management & Handling) Rules, 1998 notified by Govt. of India, has stipulated rules for proper collection, storage, transportation, treatment and disposal of bio-medical waste. As per Bio-medical Waste Rules, 1998 the hospitals have to install treatment facilities like incinerators, autoclaves, etc. for treatment of bio-medical wastes generated to ensure safe treatment & disposal of infectious hospital waste. These treatment facilities should operate at designed efficiency level.

A project has been undertaken to develop spore-testing methodology for assessment of efficiency of autoclaves used in hospital waste treatment. The major objectives of the project are:

- To standardize 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.

Photo 28

Microbiological Assessment set-up at CPCB Laboratories

Photo 29

Spore Testing Methodology for assessment of Efficiency Testing of Autoclaves used for Hospital Waste Treatment

The standardization of spore testing methodology has been undertaken using *Bacillus Stereothermophilus* as biological indicator with a view for its application for efficiency testing of autoclaves used for hospital waste treatment. The standardized methodology has been tested at autoclaves installed at various hospitals within NCT-Delhi. The findings indicated that the developed methodology is appropriately utilized for efficiency testing of Bio-medical waste treatment autoclaves installed at the hospitals for sterilization of bio-medical waste.

Publication:

- Manual on Hospital Waste Management: IMPACTS/2/99-2000.

Development Projects

ZONING ATLAS PROGRAMME

The nation-wide environmental planning and mapping programme, known as “Zoning Atlas Programme” is being executed by the Central Pollution Control Board in collaboration with State Pollution Control Boards and other agencies under the World Bank funded ‘Environment Management Capacity Building Technical Assistance Project’. The programme covers various spatial environmental planning activities conceived as a tool for protection of the environmental resources and for achieving developmental targets in an environmentally sound manner.

The programme is receiving technical support from the German Agency for Technical cooperation (GTZ) under the Indo-German Bilateral Programme on “CPCB/SPCBs Strengthening of Environmental Quality Assessment and Control”. The activities taken up under the Zoning Atlas Programme are as below:

Environmental Atlas of India

The Environmental Atlas of India is a compilation of all the environmentally related information presented in the form of maps and text including statistical data.

The compilation of Environmental Atlas has been undertaken in a joint project with National Atlas & Thematic Mapping Organization (NATMO), Kolkata. The Environmental Atlas has been completed and published.

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Photo 30

Environmental Atlas of India – Cover

Publication:

- Environmental Atlas of India 2002.

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Mapping of Environmentally Sensitive Zones and Industrial Sites

This activity 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. The maps on Environmentally Sensitive Zones and Industrial Sites (ESZIS) were completed for Bihar, Jharkhand, Meghalaya, Kerala, Goa, Andhra Pradesh, Orissa, Gujarat, Karnataka, Assam, Manipur and Jammu & Kashmir. The preparation of ESZIS maps for Maharashtra, Punjab, Madhya Pradesh, Chhattisgarh, Rajasthan, Tamil Nadu, West Bengal, Uttar Pradesh and Uttaranchal is in progress.

Publications:

- Environmentally Sensitive Zones and Industrial Sites – Andhra Pradesh Map
 - Environmentally Sensitive Zones and Industrial Sites – Goa Map
 - Environmentally Sensitive Zones and Industrial Sites – Bihar Map
 - Environmentally Sensitive Zones and Industrial Sites – Orissa Map
 - Environmentally Sensitive Zones and Industrial Sites – J & K Map
 - Environmentally Sensitive Zones and Industrial Sites – Assam Map
 - Environmentally Sensitive Zones and Industrial Sites – Maharashtra Map
 - Environmentally Sensitive Zones and Industrial Sites – Tamilnadu Map
-

District-wise Zoning Atlas

The study on Zoning Atlas for Siting of Industries (ZASI) has been 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 has been completed for 60 districts, while the work is in progress for 50 other districts.

Several State Pollution Control Boards including those in Bihar, Orissa, Himachal Pradesh, Kerala, Uttar Pradesh, Karnataka, Maharashtra, Meghalaya, Tripura and Madhya Pradesh have issued internal orders for using the Zoning Atlases for site clearances. The Central Pollution Control Board is regularly pursuing the State Pollution Control Boards for ensuring usage of the Zoning Atlas recommendations.

Publications:

- Zoning Atlas Udaipur District (Rajasthan): EMPAS/12/1997-98
 - Zoning Atlas Bankura District (West Bengal): EMPAS/13/1998-99
 - Zoning Atlas Ludhiana District (Punjab): EMPAS/14/1998-99
 - Zoning Atlas Rangareddy District: EMPAS/15/1998-99
 - Zoning Atlas Medak District: EMPAS/16/1998-99
-

Industrial Estate Planning Studies

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 sites for industrial estates based on environmental sensitivity assessments.

The industrial estate planning studies for the Adityapur Industrial area, East Singhbhum District, Bihar; Baddi-Nalagarh, Solan District, Himachal Pradesh; and Paradeep Industrial area, Undivided Cuttack District, Orissa have been completed and are under review for finalization. The industrial estate planning studies are in progress for the following sites:

- Pipavav, Amreli District, Gujarat
- Tandya Industrial area, Mysore District, Karnataka
- Palakkad, Kanjicode District, Kerala
- Lamlai, Imphal District, Manipur
- Bhiwadi, Alwar District, Rajasthan
- Bodhjungle site, North Tripura District, Tripura
- Barjora, Bankura District, West Bengal

Publications:

- Zoning Atlas for Siting of Industries (Based on Environmental Considerations) the Conceptual Framework: EMAPS/1/1996-97
- Manual for Preparation of Zoning Atlas of Industries (Based on Environmental Considerations): EMAPS/2/1997-98
- Zoning Atlas for Siting of Industries - Central Valley Districts, Manipur: EMAPS/3/1997-98
- Zoning Atlas for Siting of Industries - Chhindwara District, Madhya Pradesh: EMAPS/4/1997-98
- Zoning Atlas for Siting of Industries - Solan District, Himachal Pradesh: EMAPS/5/1997-98
- Zoning Atlas for Siting of Industries - Palakkad, Kerala: EMAPS/6/1997-98
- Zoning Atlas for Siting of Industries - Ghaziabad, U.P.: EMAPS/7/1997-98
- Zoning Atlas for Siting of Industries - Panchmahals, Gujarat: EMAPS/8/1997-98
- Zoning Atlas for Siting of Industries - Mysore, Karnataka: EMAPS/9/1997-98
- Zoning Atlas for Siting of Industries – Mysore District (Karnataka): EMPAS/10/1997-98
- Zoning Atlas for Siting of Industries – Singhbhum District (Bihar): EMPAS/11/1997-98

Environmental Management Plans (EMP) for Urban Areas, Mining Areas, Environmentally Fragile Areas, Tourism Areas

These studies are targeted for improving environmental quality through appropriate land use planning and management. The following studies are under progress:

Environmental Management Plan (EMP) for Urban Areas

- EMP for Taj Trapezium Zone, Agra (Uttar Pradesh)
- EMP for Agra City (Uttar Pradesh)
- Incorporation of Environmental Considerations in Urban Planning - Indore (Madhya Pradesh)
- Environmental Considerations for Land Use Planning in Vasai Virar Sub-region, District Thane (Maharashtra)
- EMP for Agartala (Tripura)
- EMP for Bhubneshwar (Orissa)
- EMP for Vadodara (Gujarat)
- EMP for Patna (Bihar)
- Review of Master Plan of Chennai from Environmental Considerations (Tamil Nadu)

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The EMP for Agra has been completed. The study has resulted in identifying the priority projects to be executed for environmental improvement of Agra. Efforts are on to ensure implementation of these projects. The studies for other cities are in progress.

Environmental Management Plan (EMP) for Mining Areas

- EMP for Mining Areas of Dhanbad (Jharkhand)
- EMP for Satna Limestone Belt (Madhya Pradesh)
- EMP for Korba Region (Chhattisgarh)

Environmental Management Plan (EMP) for Environmentally Fragile Areas

The preparation of environmental management plan for Panchmarhi Biosphere Reserve, Madhya Pradesh is a pilot effort for protecting the environment and achieving sustainable development. The methodology has been developed and the studies are in progress.

Environmental Management Plan (EMP) for Tourism Areas

- Sustainable Tourism Development in Hilly Areas, Macleodganj and Bhagsunag (Himachal Pradesh)
- Environmentally Sound Development Concept for Tourist Destinations - Bakel Fort (Kerala)

CREATION OF ENVIRONMENTAL DATA BANK

The correct and updated information on various environmental aspects and its easy retrieval is necessary to mitigate environmental pollution problems. For easier information dissemination, the CPCB is working on development of environmental data bank. The data bank will help decision makers in planning the development and regulatory agencies in

formulating the pollution control strategies, its effective implementation and assessment of its policies & programmes. Besides, the data bank will also be useful to researchers, consultants, NGOs, industries and common person. The data bank will be web-enabled so that various user groups may access data/information on-line.

The proposed environmental data bank would comprise various database e.g. industrial pollution, air quality, water quality, coastal water quality, urban pollution, urban solid waste, hazardous waste, cleaner process technologies, environmental experts/consultants, offices of CPCB, SPCBs, PCCs, MoEF, etc. The data structure for various environmental parameters has been designed considering the requirement and availability of data and necessary software has been developed, which would not only help in creation of environmental data bank but also facilitate users to search & get the desired data. The software is under testing & verification and will subsequently be used for building up the database on various environmental components.

SOFTWARE DEVELOPMENT FOR e-GOVERNANCE

CPCB is undertaking development of application software for gradual shifting towards e-governance. The software include modules on public complaints, legal matter, parliament matter, activities of Environmental Surveillance Squad for creating database to help quick analysis and retrieval of information. The testing and verification of various modules is under progress and will be made operational soon. Besides these modules, development of software on budget monitoring and finance & accounts is under progress.

8.0 COLLABORATING AGENCIES IN RESEARCH AND DEVELOPMENT WORK AT CPCB

- **Federal Republic of Germany – GTZ - Indo-German Bilateral Project**
 - Standardization of Quality Assurance in Environmental Analysis
 - Upgradation of pollution monitoring and assessment
 - Dissemination of appropriate technology for low cost wastewater treatment system
 - Standardization of Air Quality Monitoring Techniques
 - Dissemination of the concept of Regional Environmental Planning
 - Promotion of Eco-label
 - Hazardous Waste Management
 - Information and Cooperation Network

- **Netherlands – Indo-Dutch Bilateral Project**
 - Biological Monitoring and Assessment of Pollution
 - Integrated Water Quality Evaluation
- **Environment Canada - Canada-India Institutional Strengthening Project**
 - Air quality monitoring and control
- **United Nations Children’s Fund (UNICEF)**
 - Development of Fluoride Testing Kit
- **National Environmental Engineering Research Institute (NEERI), Nagpur**
 - Characterization of compost quality and development of standards
 - Assessment of Impacts of pollution due to Existing and Completed Landfill sites
 - Optimization of use of chlorine and its compounds in India
 - Guidelines for treatment of oily waste from refineries
 - Sector wise inventorization of hazardous waste and its characterization in Petro-chemical industries.
 - Development of site selection methodology for sanitary landfill: A case study for Bangalore.
 - Review of Existing Municipal solid waste processing technologies and preparation of guideline paper for assistance of local bodies.
 - Characterization of compost quality (made out of municipal solid waste) and evaluation of guidelines and standards.
 - Estimation of Benzene in Ambient air and its Impact on health in Mumbai.
- **National Productivity Council (NPC), New Delhi**
 - Assessment of impact of pollution due to completed and existing landfill site at Kanpur.
- **Indian Institute of Technology (IIT), Delhi**
 - Anaerobic Digestion of Domestic Solid Waste
 - Development of Decentralized facility for waste water treatment

- **Indian Institute of Technology (IIT), Kanpur**
 - Development of Air Quality index for Indian Cities for public information
- **Indian Institute of Technology (IIT), Mumbai**
 - Monitoring of Human Exposure to air pollution in an industrial area
- **Environment Protection Training Research Institute (EPTRI), Hyderabad**
 - Assessment of Impacts of pollution due to Existing and Completed Landfill sites
 - Preparation of Manual for characterization of Hazardous wastes
 - District-wise Zoning Atlas for siting of industries
 - Industrial Estate Planning
 - Development of location – specific standards with respect to industrial effluents & emissions
 - Review of Environmental Audit Statements for bulk-drug industry
- **Anna University, Chennai**
 - Studies on coastal fragile area in collaboration with Institute for Ocean Management.
- **Pollution Control Research Institute (PCRI), Haridwar**
 - Environmental Management of Guidelines for religious places.
 - Impact of Mass bathing during Maha Kumbh Mela 2001 at Allahabad (Joint project with CPCB).
 - Phytoremediation of Particulate matter from ambient environment through dust capturing plant species (Joint project with CPCB).
- **Sulabh International, Delhi**
 - Development of technology using duckweed, as a low cost treatment.

- **Jadavpur University, Kolkata**
 - Plastic Waste Management – Re-engineering, recycling process and packaging plastics.
- **Indian Agricultural Research Institute (IARI), New Delhi**
 - Evolution of guidelines/standards for application of compost made out of municipal solid waste on agricultural crops.
 - Studies on compost quality and its application in agriculture (Joint Project with CPCB).
- **National Physical Laboratory (NPL), New Delhi**
 - Studies on Fog occurrence in Delhi and in Northern India (Joint project with CPCB).
 - Studies on Characterization of SPM, PM₁₀ and PM_{2.5} in Delhi and in other areas.
 - Development/Revision of source based noise standards including their compliances.
 - Development of facilities to calibrate and standardize the air quality monitoring analyzers.
- **Centre for Biochemical Technology (CBT), Council of Scientific & Industrial Research (CSIR), Delhi**
 - Testing and validation of BOD biosensor for rapid BOD test determination (Joint project with CPCB).
 - Testing and validation of microbial mixed seed culture (BODSEED) in BOD determination (Joint project with CPCB).
 - Development, standardization and preparation of AQC samples for Total Coliform and Faecal Coliform parameters.
 - Technological development of specific microbial packages for treatment of paper and pulp industrial wastewater.
- **National Remote Sensing Agency (NRSA), Hyderabad**
 - Preparation of remote sensing based maps for district-wise zoning atlas and industrial estate planning studies
- **National Atlas & Thematic Mapping Organization (NATMO), Kolkata**
 - Mapping of Environmentally Sensitive Zones and Industrial Sites (State-wise) for 18 states.
 - Environmental Atlas of India (joint project with CPCB).

- **National Chemical Laboratory (NCL), Pune**
 - Cleaner production options in H-acid (Dye & Dye Intermediate) manufacturing industries
 - Cleaner production options in Vinyl sulphone (Dye & Dye Intermediate) manufacturing industries
 - Control technology for Total Dissolved Solids (TDS) in industrial effluents
 - Sector wise identification of hazardous waste and their location with options for treatment & disposal
 - Preparation of Environmental Audit Methodology in respect of Dye & Dye Intermediate
- **Central Pulp & Paper Research Institute (CPPRI), Saharanpur**
 - Development of standards of AOX for small scale pulp and paper mills
- **Central Leather Research Institute (CLRI), Chennai**
 - Preparation of comprehensive industry documents for Tanneries
 - Treatment and disposal of Chrome Shaving from tanneries

9.0 RESEARCH PATENTS APPLIED AND OBTAINED BY CPCB

- **BODSEED Patent: A process for the preparation of a microbial composition useful for reproducible BOD estimation** (*Jointly with Centre for Biochemical Technology, CSIR, Delhi*)

Patent No.: 343/DEL/94

The BODSEED has been patented during 1998 in the above title and transfer of technology has been made through Biotech Consortium India Limited, New Delhi to M/s Indo Bioactive Laboratories (P) Ltd., Pune.

- **An Immobilized Microbial Consortium useful for Rapid and Reliable BOD Estimation**
 - Patent Filed in USA in 2000: Patent No. 09/557,440 year 2000 (*Jointly with Centre for Biochemical Technology, CSIR, Delhi*)
 - Patent Filed in UK, 2000 (*Jointly with Centre for Biochemical Technology, CSIR, Delhi*)
 - Patent Filed in India, 2000, NF/119/2000 (*Jointly with Centre for Biochemical Technology, CSIR, Delhi*)

- **A Reusable immobilized Microbial Composition useful as Ready-to-Use Seed Inoculum in BOD Analysis**

- Granted Patent in USA - Patent No. 5952,188, 1999
(Jointly with Centre for Biochemical Technology, CSIR, Delhi)
- Filed in UK, Patent No. 9813305.1, June, 1998
(Jointly with Centre for Biochemical Technology, CSIR, Delhi)

- **A Microbial Composition and a Process useful for the Neutralization of alkaline Wastewaters by use of Alkalophillic Bacteria**

- Patent No. 1518/DEL/94, 1994.
(Jointly with Centre for Biochemical Technology, CSIR, Delhi)
- Filed in USA, Patent No. 09/160422, 1998
(Jointly with Centre for Biochemical Technology, CSIR, Delhi)
- Filed in UK, Patent No. 9823332.3, 1998
(Jointly with Centre for Biochemical Technology, CSIR, Delhi)

- **An Apparatus for Treatment of Raw Water Sludge Reagent Product (SRP) based treatment**

- Patent filed in India, 2001 Application No. 535/Del/2001 dated 30.4.2001
(Jointly with Centre for Biochemical Technology, CSIR, Delhi)

LIST AND TITLE OF PHOTOGRAPHS

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24. SRP Technology – Laboratory Set-up at CPCB Laboratories
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