

# ANNUAL REPORT

## 1972



POLLUTION SURVEY OF HOOGLY RIVER AT CALCUTTA

CENTRAL PUBLIC HEALTH ENGINEERING RESEARCH INSTITUTE  
NAGPUR 20. INDIA



PASVEER TYPE OXIDATION DITCH

# **CPHERI**

**ANNUAL REPORT  
1972**



**CENTRAL PUBLIC HEALTH ENGINEERING RESEARCH INSTITUTE  
NEHRU MARG, NAGPUR-20 (INDIA)**

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Roy, Shri A. K.  
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Bungalow D-2,  
South Extension Part II,  
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Water Supply & Sewage Disposal  
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Link House,  
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Krishnan, Shri A. P. V.  
Joint Secretary to the Government of  
India,  
Ministry of Finance,  
Room No. 164, North Block,  
New Delhi-11.

Majumder, Prof. N.  
Professor of Sanitary Engineering,  
All India Institute of Hygiene &  
Public Health,  
110, Chittaranjan Avenue,  
Calcutta-12.

Majumder, Shri S. K.  
Chief Engineer,  
Public Health Engineering Directorate,  
1, Kiron Sankar Road,  
Calcutta-1.

Mohanrao, Dr. G. J.  
Scientist-In-Charge,  
Central Public Health  
Engineering Research Instt.  
Nehru Marg, Nagpur-20.

Nayudamma, Dr. Y.  
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Research,  
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New Delhi-1.

Santhanam, Shri S.  
Dy. Financial Adviser,  
Council of Scientific & Industrial  
Research,  
Rafi Marg,  
New Delhi-1.

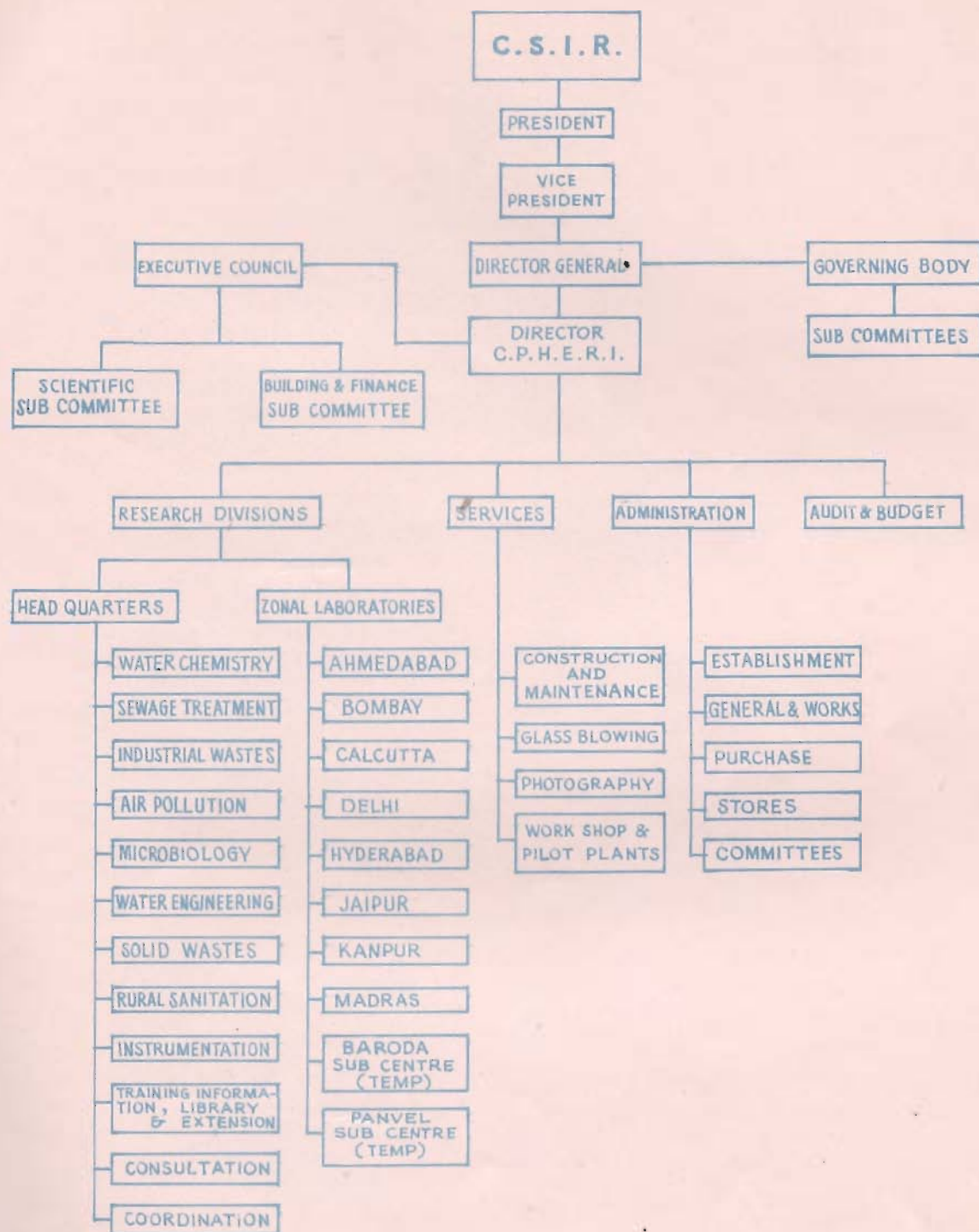


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**ORGANISATIONAL CHART**



## DIRECTOR'S REPORT

It gives me great pleasure to present the Annual Report of the Institute for the year 1972. During the year under report the Institute has worked on 150 research projects including 35 sponsored schemes and completed work on 45 projects. A few important events and research activities in this year are highlighted below.

### Industrial Wastes

The Chaliyar River Pollution Committee has presented its report to the Kerala State Government based on the work done by CIPHERI. CIPHERI is represented in this committee by the Scientist-Incharge. The committee recommended that the water pollution taking place in the river Chaliyar due to the discharge of wastes resulting from the production of rayon grade pulp can be reduced in three stages. In the first stage, wood hydrolysate effluent (strongest among the wastes) would be treated through anaerobic lagoons followed by aerated lagoons and mixed with the rest of the effluents settling the latter. Implementation of this suggestion is likely to reduce the present pollution to an extent of 72-75 per cent.

The Institute has developed a flowsheet for economic treatment of pulp and paper mill wastes. The flowsheet consists of treating the pulp mill waste water and anaerobic lagooning followed by aerated lagoon and mixing with settled paper mill

wastes before discharge into the river. It has been demonstrated that by following this method an effluent with a BOD of 30 mg/l can be obtained. Full scale anaerobic lagoons are being set up at the Orient Paper Mills, Amlai, Madhya Pradesh.

Nitrogenous fertiliser factories discharge considerable quantities of ammonia which is toxic to the aquatic life including fish. It has been found earlier that the ammonia in the effluents could be oxidised to nitrates by biological means, provided the ammonia is within certain limits. Studies during this year were concentrated on the denitrification of the nitrified wastes. Two reactors, one consisting of a pebble bed and another of a granulated coal were found to be suitable for removing 98% of the nitrate present in the waste. The pebble bed required 2 hours detention time while the granular coal bed required one hour only. Distillery spent wash was found to be suitable as a substitute to methanol used by investigators in the USA. These studies are being repeated on a larger scale.

The wastes from a factory producing laminates such as sunmica were found to contain high concentrations of phenol and formaldehyde. On the basis of treatability studies using acclimated mixed bacterial cultures, the Institute has come up with a flowsheet to remove the phenol and formaldehyde by over 98 per cent.

The Institute has developed a flowsheet for the treatment of tannery wastes. A demonstration unit is being set up in one of the tanneries in Tamil Nadu.

A new field laboratory was set up at Baroda to help the investigations on treatment and disposal of industrial wastes in and around Baroda.

## **Water**

Chlorine tablets which are effective in disinfecting water on an emergency basis and are convenient for use were developed at the Institute. During the current year, about 2 lakh tablets were made and supplied for emergency disinfection in refugee camps and other places. The process uses bleaching powder as the raw material and is fairly simple to use. Work on natural and synthetic coagulant aids has been continued and applied to full scale water treatment plants for a specific period. It was found that CA-3 developed at the Institute is suitable for treating waters with turbidity above 300 units. The effective dose was found to be 2-10 mg/l in the pH range 2-9 and this effected 40-55% savings in the consumption of alum, the coagulant normally used. A synthetic and anionic coagulant aid (CA-15) was developed at the Institute which was found to give satisfactory performance.

The Institute has supplied considerable amount of useful information for the World Bank Consulting Engineering Team working for the Bombay Municipal Corporation in connection with its Master Plan. Several suggestions made by the Institute have been taken up by the World Bank Consultants.

The Institute is making efforts to convert one of the rapid sand filter units at the Delhi Water Works into a dual media filter using good quality bituminous coal as the second layer for filtration. Laboratory experiments conducted earlier have shown the efficacy of this method with Indian coals and waters.

At the request of the State Public Health Engineering Department of J & K Government, the Institute had conducted a detailed survey of the performance of water treatment plants at Srinagar and assessed the quality of the Dal Lake and Jhelum River waters which serve as a source of recreational and public water supply. Recommendations for improved performance of the water treatment plants and sanitary quality of the raw water sources were made.

In the Arusha region in North Tanzania ground waters have high concentrations of fluorides, ranging from 3.0 to 18 mg/l. The Institute has carried out detailed investigations and proposed a suitable treatment plant. Similarly fluorosis survey was made in Jhunjhunu District, Rajasthan and based on these studies three fluoride-free sources have been located for tapping drinking water. A pilot plant using Defluoron-2 as the medium was set up at the Central Training Institute, Hyderabad to treat 25,000 gals of water containing high fluorides. This plant has given encouraging results.

A carbon chloroform extraction (CCE) unit has been fabricated for estimation of low concentrations of organics such as pesticides, insecticides and herbicides in water. The Institute has also fabricated a package water treatment plant of 200 gallons per hour capacity.

In order to provide guide lines for users in the choice of plastic pipes for water supply and drainage a brochure entitled "Plastic Pipes in Water Supply and Drainage" was published by the Institute.

## **Sewage**

Work on the low cost waste treatment methods such as aerated lagoons and oxidation ditch was continued. Design criteria for the use of oxidation ditch under Indian conditions have been developed. In warm climates the extended aeration systems can be designed to have lower sludge retention time as compared to systems in cold climates. It was found that oxidation ditches in India can be safely loaded to an extent of 0.3 kg/kg of MLVSS.

Study on the mechanisms of stabilisation of organic matter in facultative oxidation ponds and aerated lagoons was completed. Sewage organics are stabilised in both these systems by both aerobic and anaerobic reactions. In a facultative pond 32% of the influent BOD is found to be satisfied anaerobically. It is possible to operate aerated lagoon system with a minimal aerobic layer at the top to avoid nuisance and a major anaerobic zone where the organic matter is converted to methane gas.

A pilot Biological Disc having fifty discs of eight feet diameter was set up and operational data of the plant at different loadings is being collected.

A study on the health status of sewage farm workers in some typical farms in India showed that the incidence of disease and multiplicity of infection was significantly higher among the farm workers.

Further work on comparison of the efficiency of asbestos sheet and stone medium in a trickling filter in the reduction of BOD and bacterial pathogens is in progress.

### **Air Pollution**

National air sampling network programme was continued and a few more cities like Bangalore and Jamshedpur were included. Air pollution surveys are in progress in old Bombay and areas proposed for development by CIDCO in the twin City. Micro-meteorological data and base level pollution in Sheva village in the New Bombay area was collected in order to assess the probable concentration of the pollutants from the proposed fertiliser factory at Sheva and to assist the foreign consultants in supplying and helping in the preparation of the report. Recommendations were made to CIDCO on the suitability of the site location of the above industry from an environmental pollution point of view.

Assistance was rendered to a number of industries by assessing the atmospheric pollution caused due to industrial emissions and suggesting remedial measures.

Wind Direction Recorder, Wind Speed Recorder, Wind Direction Activated Sampler and Temperature Inversion Recording Unit were developed indigenously and are ready for commercial exploitation.

A three year project to conduct air pollution surveys in the cities of Calcutta and Howrah has been sponsored by CMDA. Regular sampling and analysis work is in progress. The Institute continued to work as a WHO Regional Reference Centre on Air Pollution.

### **Microbiology**

The Government of Maharashtra requested the Institute to conduct a systematic investigation on the outbreak of infectious hepatitis, typhoid and gastro-enteritis in the city of Aurangabad. The Institute organised comprehensive studies including chemical and bacteriological analysis, leakage detection and collection of epidemiological data of the affected areas. Based on these studies recommendations have been made.

Studies on the development of a synthetic indigenous medium for bacteriological analysis of water was completed and the medium so developed is being tested by other workers of different laboratories to evaluate their performance in comparison with McConkey Broth. The cost of the above medium is Re. 0.02 per sample as compared to Re. 1.00 for the imported one.

Studies on the removal of bacterial pathogens and enteric viruses from sewage during different methods of treatment are continued. A pilot oxidation ditch with a sludge retention time of 6-12 days and solids concentration of 2000-4000 mg/l brought about more than 99% reduction of the virus in raw sewage while a conventional activated sludge municipal unit removed 90-95 per cent.

A simple and elegant method for enumerating enteroviruses in sewage and sewage effluents have been developed. The method (using pH adjustment) eliminates the need for passing the sewage through ion exchange resins and makes routine monitoring relatively easy.

### **Water Pollution**

With the increasing number of industrial establishments being set up on the banks of river Hooghly, the Calcutta Metropolitan Development Authorities requested the Institute to investigate the load of pollution entering into the river and suggest remedial measures to maintain and improve its sanitary quality. Studies are in an active stage and will be completed by 1973-74.

Survey of Gomti river between Lucknow and Sultanpur with 19 sampling points is in progress.

On the request of the Central Power Research Unit, Bangalore a survey of  $H_2S$  pollution in three hydel projects namely Sabarigiri, Kundah and Bhadra was made and an interim report suggesting remedial measures was submitted.

Hydrographic survey of the Bombay coast in collaboration with National Institute of Oceanography, Bombay is in progress.

### **Solid Wastes**

The work on collection of data on the quality and quantity of refuse from 12 cities was continued under PL-480 funds. During this year 21 more towns are included in the survey.

At the request of the Calcutta Metropolitan Development Authority a study of the rational methods of disposal of refuse from Howrah city was carried out and a report was submitted. Similarly work has been initiated to prepare a long range solution to refuse disposal from Durgapur Notified Area.

Different zonal laboratories of the Institute are continuing to study the characteristics of refuse on a long term basis in the cities in which they are located.

### **Sponsored Research/Consultation Work**

The Institute continued to assist and advise Government Departments, Public Undertakings, Private Industries, Municipalities and Public Health Engineering Departments of the States on a variety of problems dealing with water supply, sewage, industrial wastes, air pollution control and solid wastes. Besides, the Institute supplied technical notes and answers to queries from a large number of public bodies.

### **Training Courses and Seminars**

The Institute offers short term training courses to suit the needs of field personnel in public health engineering. Twelve different courses were offered during this year at Nagpur as well as at Bombay, Madras, Hyderabad and Delhi.

The Institute has organised two seminars during this year, one on "Treatment and Disposal of Tannery and Slaughter House Wastes" in collaboration with CLRI, Madras during January 31 to February 6, 1972 and the other on "Estuarine Pollution" in Calcutta during March 9-10, 1972 in collaboration with Calcutta Metropolitan Development Authority. The proceedings of these seminars are brought out in the form of two books. The Institute has also collaborated with the Institution of Engineers, India (Nagpur Centre) in organising a symposium on "Problems in Water Treatment".

### **Refresher Course on Preventive Maintenance of Water Distribution Systems**

CPHERI has given a refresher course on the detection of wastage of drinking water and cleaning of the pipes in the water distribution system. The course was conducted in collaboration with the Bombay Municipal Corporation and with the aid of consultants supplied by the WHO. The course which lasted for three weeks, involved demonstrations by experts and considerable field work in addition to lectures. A 250-page manual was prepared and rotaprinted on this course. The course will be repeated in various cities in order to train the city officials for executing this work.

### **WHO Regional Seminar on Air Pollution Control**

The World Health Organization conducted a Regional Seminar on Air Pollution Control at the Institute from December 4-14, 1972. About 45 delegates from different countries of South-East Asia like Bangladesh, Indonesia, Thailand, Nepal and India attended the seminar. The WHO also provided consultants and advisers from Sweden, USA and India. The seminar was inaugurated by Shri G. S. Sarnaik, Minister of State



for Health and Urban Development, Government of Maharashtra. Shri K. G. Krishnamurthi, Secretary, CSIR welcomed the delegates on behalf of CSIR and expressed the hope that the deliberations of this seminar may result in evolving "A Clean Air Policy for India". Various aspects of technical and administrative problems of air pollution control were discussed and suitable recommendations made.

### **Open Day during Silver Jubilee Celebrations of India's Independence**

The Institute organised an "Open Day" on August 17, 1972 on which occasion 500 people visited the Institute. On this occasion eminent citizens of Nagpur were invited to take part in the discussions on "CPHERI and its contributions". The Institute organised an exhibition of the products and processes developed and circulated a booklet entitled "Objectives and Achievements of CIPHERI". The Institute also participated in Asia 1972 International Fair held at New Delhi. The Institute's scientists gave lectures on environmental pollution to college and high school students and made practical demonstrations at the Institute.

### **Post Office on Campus**

A full fledged Delivery Post Office has been established on campus exclusively for the Institute and its employees. The CIPHERI Post Office (Nagpur-20) was opened on August 17, 1972 during the Silver Jubilee (of Indian Independence) Celebrations.

### **W.H.O. Assistance**

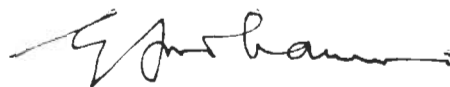
The Institute continued to work as a WHO Regional Reference Centre on Air Pollution. The Institute has recently been designated as a Regional Reference Centre for Wastes Disposal.

The Institute is thankful to the WHO for its active support in its development to the present stage where its activities have won appreciation from several parts of the world. The Institute continued to keep liaison with all the collaborating Institutes throughout the world through its Newsletters, Technical Digests and Annual Reports.

In conclusion, I must express my sincere thanks to all the staff members both at the Headquarters and Zonal Laboratories for putting up considerable research work yielding results of significance with unceasing efforts and unstinted cooperation. My thanks are also due to those State Government Departments, Industries and other agencies who evinced keen interest in the Institute's activities which included in some

cases sponsoring of various research schemes. I am also grateful to the Institute's Executive Council, the Scientific Sub-Committee, the Building and Finance Sub-Committee and the officials of the Council of Scientific and Industrial Research for their wholehearted support to the Institute's various activities. I am particularly thankful to Prof. Y. Nayudamma, the Director General CSIR for his keen interest in the Institute's activities and his personal guidance.

Nagpur :  
March, 1973



(G. J. MOHANRAO)  
Scientist-In-Charge

*RESEARCH ACTIVITIES*  
(DIVISIONS AT HEADQUARTERS)

# WATER

## *WATER TREATMENT*

### **1. Coagulant Aids (Natural)**

Several coagulant aids were developed from natural products and were studied in detail on a laboratory, pilot plant and 14 mgd capacity plant. Of the various coagulant aids studied, CA-3 was found to possess good flocculation characteristics. The others like CA-4, CA-5, CA-7 were tested on a laboratory scale. The effect of various factors like temperature of preparation, sequence of the addition of the aid and alum, pH, aging, flocculation and settling time were investigated for all the coagulant aids.

Extensive study using CA-3 on a 14 mgd plant has identified the following problems :

- (a) The aid is suitable for turbidity beyond 300 units.
- (b) A good house-keeping is essential when the coagulant aid is used.
- (c) The aid deteriorates in quality in about three months time even after the addition of preservatives.

The conclusions drawn from a four year study of various natural coagulant aids are :

- (a) These should be prepared fresh each time.
- (b) The effective dose is 2 to 10 mg/l in pH range of 2 to 9.

- (c) The aid is effective at high turbidity levels, during which period 40 to 54 per cent saving in alum consumption is possible.

A concluding report on the natural coagulant, aids is under preparation.

## **2. Synthetic Coagulant Aids**

Studies were conducted to assess the performance of an anionic coagulant aid CA-15. The results were satisfactory and efforts are in progress to commercialise the product.

Despite best efforts, no progress could be made to study the toxicity of synthetic coagulant aids. The Institute is in touch with the Industrial Toxicological Research Centre, Lucknow in this regard.

## **3. Defloridation**

Work on this project is practically completed and extension work is going on in Andhra Pradesh and Rajasthan. In order to popularise the method developed by the Institute in Rajasthan a pamphlet in Hindi on the problem of defloridation was prepared and distributed amongst the State Officials.

## **4. Fluoride Contribution by Food Stuffs**

The work is in progress and several food samples from all over the country are being analysed for their fluoride levels. Typical analyses of a few samples collected from Nagpur are as follows :

Onion	...	9 mg/kg
Rice	...	42 „
Wheat	...	118 „
Udahad	...	35 „

Considering the average daily consumption of an adult as about 600 grams cereals (rice: wheat, 1:2) and ignoring pulses, vegetables the amount of fluoride consumed per day is about 56 mg/capita.

## **5. Activated Silica**

Laboratory studies using various types of activants have been completed and the product thus developed is now under field trials. Final report is under preparation.

## **6. Iron Removal**

Studies on the removal of iron from drinking waters by the methods developed by the Institute have been completed and the extension work is in progress.

## **7. Reverse Osmosis**

A process for the preparation of cellulose acetate has been developed and films are being cast from this product. An order has been placed for a high pressure pump. As soon as the pump is obtained, the work of testing the membranes will be commenced. The Institute is in touch with CSMCRJ on the Project.

## **8. Membrane Filters**

Based on a process developed in the laboratory, several membrane filters (MF-B) of 0.45 micron pore size and different diameters are being produced and supplied.

The indigenously developed membrane filters are compared with the imported filters (MF). The results indicate a satisfactory performance of the membranes prepared



by the Institute as regards the retentivity of the organisms and the bacteria free nature of the filtrates. Detailed statistical evaluation of the coliform counts obtained from different types of samples with MFB/MF indicate that there is no significant difference in either the counts or accuracy between the two methods.

Work is in progress for the development of membrane filters of different pore sizes.

## **9. Package Water Treatment Plant for Rural Water Supply**

The Institute has fabricated a Water Treatment Plant and tested its performance rigorously. The plant has a capacity of 200 gallons per hour and is intended to meet the requirements of about 1000 population at 5 gpcd. Smaller villages with less population can curtail the duration of operation of the plant to suit the demand. Larger communities can instal more than one plant.

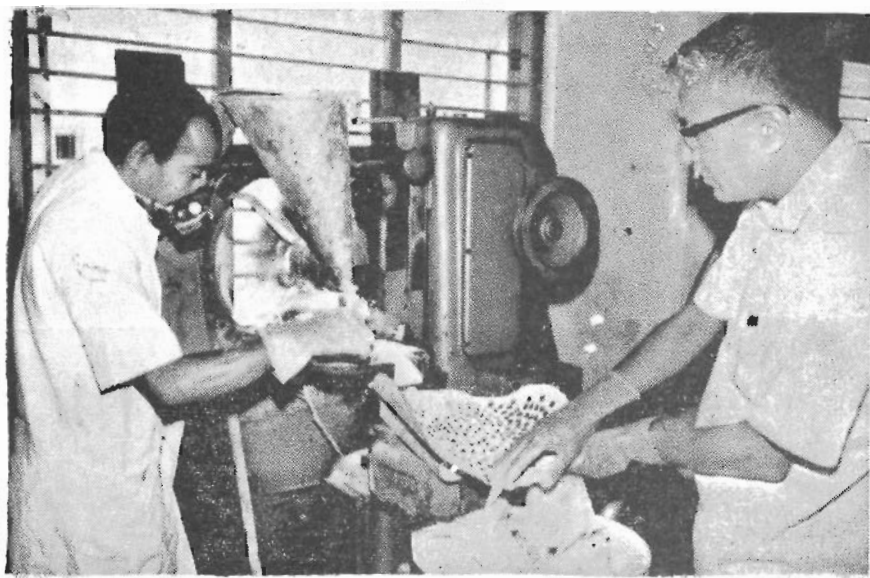
The plant can treat surface waters for the turbidity removal and can be adopted for softening of water, if necessary. The power requirements for pumping raw water, flocculation and backwash operation are 5 kwh per 1000 gallons of treated water. The chemical requirement depends on the quality of the raw water and varies between two and forty paise per 1000 gallons.

## ***WATER POLLUTION SURVEILLANCE***

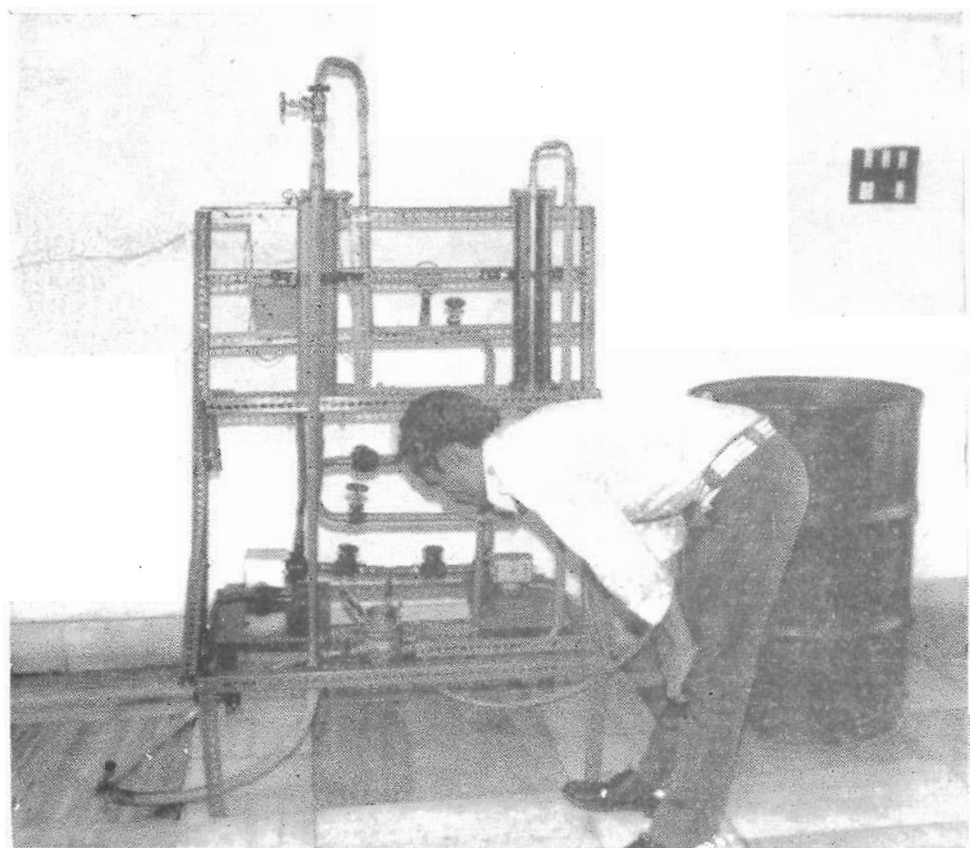
During the period under review the activities of this division have been merged with the water division and work on the following project was undertaken :

### **1. Study of the Concentration of Organics in Waters using Carbon Chloroform Extraction (CCE) Method**

Certain organics such as pesticides, insecticides, herbicides have been known to pass through the conventional water treatment units. The use of these chemicals has increased in India. The adverse effects of these chemicals on human metabolism are now known fairly well and hence their level in treated water is of public health importance. The CCE unit has now been fabricated and necessary chemicals and apparatus have been partially procured. About 4 to 6 river water sources will be selected to conduct studies on this aspect.



Disinfection tablets under preparation



Carbon Chloroform Extraction (CCE) Unit for determining micro-quantities of organic pollutants in water supplies developed by the Water Chemistry Division



**Dr. R. N. Chakrabarty, Director, IEM, Calcutta being shown the Biological Disc,  
laboratory model in Sewage Treatment Division,**

# SEWAGE

## *SAWAGE TREATMENT AND UTILISATION*

### **1. Aerated Lagoons**

Experience with facultative stabilisation ponds indicated the feasibility of operating aerated lagoon systems with a minimal aerobic layer at the top to avoid nuisance and a major anaerobic zone where the organic matter is converted into methane gas. Studies on a pilot aerated lagoon with total retention of suspended solids at CIPHERI campus showed that when the lagoon was loaded at the rate of 1200 lb/acre/day the gas produced was 11,000 cu ft/acre/day indicating more than 50 per cent of stabilisation of BOD through anaerobic reactions. It was concluded that in such aerated lagoons the oxygen requirement should not be equated to the BOD load as is the current practice but to 50 per cent of the load. This would result in economy of initial and power costs for operation of lagoon.

### **2. Biological Disc**

Operation of a plant having 50 discs of 8' diameter was initiated. The studies could not be continued due to structural failure of the discs which were made of A.C. sheets mounted on angle iron frames. Currently efforts are being made to obtain substitute materials.

### **3. Anaerobic Contact Filter**

Laboratory studies using synthetic wastes were completed. Data are now being collected on a field unit.

#### **4. Trickling Filter**

Studies were started on a single stage 8' deep and 6' dia trickling filter to establish the operational characteristics under local conditions. One half of the filter is packed with conventional stone medium and the other half with corrugated asbestos cement sheets. The study is expected to indicate the possibility of using such media in place of the conventional media.

#### **5. Sewage Irrigation**

Field experiments were continued using differentially diluted raw sewage and treated sewage effluent with and without nutritional fortifications.

A pot culture experiment was initiated to study the effect of direct irrigation of liquid aerobic sludge slurry on soil properties and plant growth.

Studies on soil wastewater interactions were started in laboratory and under field conditions.

### ***BIOLOGY CELL***

#### **1. Pisciculture in Stabilisation Pond Effluents**

Studies were continued on the growth of *Cyprinus carpio* in culture ponds receiving stabilisation pond effluent without any dilution. Primary productivity of the ponds was also measured.

#### **2. Health Status of Sewage Farm Workers**

The survey was continued from previous year and one more farm was investigated. Stool samples were examined for parasitic, helminthic and protozoal infections.

# INDUSTRIAL WASTES

## 1. Pulp and Paper Mill Effluents

### (a) Orient Paper Mills, Amlai, M.P.

Pilot plant studies carried out at the factory site employing anaerobic lagoon treatment of pulp mill effluents indicated that with a detention time of 10-15 days the BOD in the wastes could be reduced by 45-72 per cent. If the detention time is doubled the same BOD reduction could be obtained even without addition of nutrients. Treatment of the anaerobic lagoon effluent in a pilot aerated lagoon employing a detention time of 3-4 days was found to give a final effluent with a BOD of 30 mg/l. Colour in the wastes could not be reduced in the two systems studied above.

A full scale anaerobic lagoon of 80 MG capacity is being developed to treat 4 million gallons per day of pulp mill wastes at M/s. Orient Paper Mills, Amlai (M.P.).

### (b) Removal of Colour from Paper Mill Effluent by using Fungi

Pulp mill wastes as well as pure lignin solution did not support a good growth of **Polyporus versicolor** which is known to degrade lignin in synthetic media. The lignin solution which was supplemented with 1% malt extract, could support the growth of fungus and was able to remove the colour as well as COD by about 50%, with a contact period of 25 days. From this study it was clear that there should be a readily available carbon source for the fungus at least in the initial stages of its growth.

### (c) Detailed survey reports have been prepared for the following paper mills

- (i) West Coast Paper Mills, Dandeli, (Mysore).
- (ii) J. K. Paper Mills, Jaykaypur, Rayagada (Orissa).
- (iii) Central Pulp Mills, Songad (Gujarat).



## **2. Treatment of Rayon Pulp Mill Wastes Gwalior Rayons, Mavoor**

### **(a) Performance of Anaerobic Lagoons**

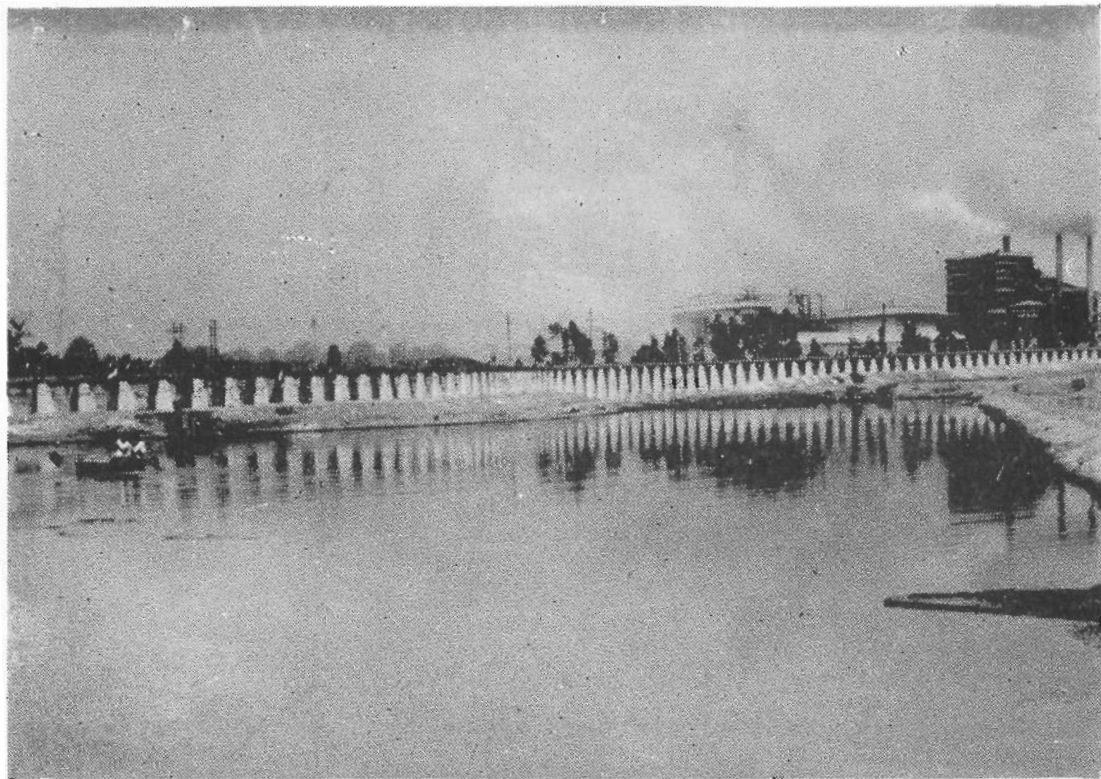
Three large scale anaerobic lagoons each of 15000 M<sup>3</sup> capacity were developed to treat 600-800 cubic metres of Prehydrolysate liquor from the factory at Mavoor. Performance study showed that these 3 lagoons operating in series as well as parallel gave an overall BOD reduction of 80-95 per cent and corresponding COD reduction varied from 65-85 per cent. The final effluent going out of the lagoon III had a BOD of 3000-4000 mg/l, with a pH of 7.0-7.5. Treatment of the anaerobic lagoon effluent in aerated lagoon was attempted. The data available so far indicated that a BOD reduction of 80 per cent could be obtained with a detention time of 15 days. Further work is in progress.

### **(b) Utilization of Prehydrolysate Wastes**

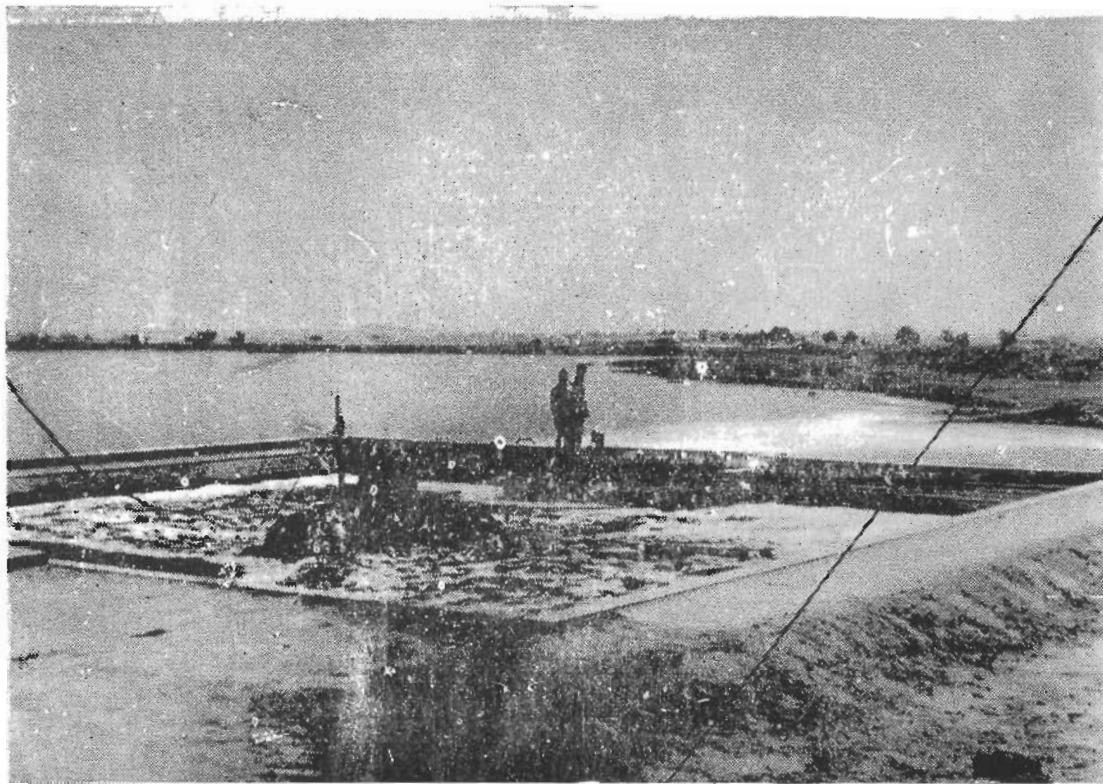
Pilot plant trials using a 800 litre capacity fermenter gave a yield of about 4.5 kg of yeast per cubic metre of waste. The reduction of yield is attributed to the low reducing sugar concentration of the waste. The detention period for optimum growth was found to be 30-35 hours instead of 96 hours. Certain modifications like yeast creamer, yeast filter press, and a drying chamber have been suggested for the production of dry yeast. The study on economics and utility are in progress.

## **3. Biological Denitrification of Nitrate bearing Wastes**

Experiments on denitrification were carried out using synthetic waste containing potassium nitrate and methanol which served as a source of carbon. Two units, one with pebbles and the other with coal particles were employed in this study. Of the two units, the unit containing coal particles was able to remove 98% of nitrate present in the waste with a detention time of 57 minutes while the pebble bed unit required twice the detention time. It was also observed that methanol could be replaced by distillery spent-wash. These studies are being repeated on a larger scale.



**2 MG Capacity anaerobic lagoon treating pulp mill wastes designed by the  
Institute at Orient Paper Mills, Amlai.**



**Pilot Aerated Lagoon for treating pulp mill waste set up by the Institute at  
Orient Paper Mills, Amlai.**

#### **4. Bakelite-Hylam Wastes, Hyderabad**

Bakelite-Hylam factory produces wastes containing high concentrations of phenol and formaldehyde. The characteristics of the individual wastes were determined by Hyderabad Zonal Laboratory. Treatability studies employing acclimatised activated sludge showed that the waste could be successfully treated and phenol and formaldehyde concentration could be reduced by over 98%. Optimum loading, excess sludge produced are being worked out.

#### **5. Characterisation and treatment of wastes from a Bank Note Printing Press**

Bank note printing press discharges mainly four different wastes, viz. intaglio machine wash, photographic etching, and electroforming. The first 3 sections samples were analysed. The waste from intaglio press and etching department were highly alkaline, coloured and exerted a high BOD.

A mixture of the first 3 wastes was alkaline, and the COD of the combined wastes could be reduced by 50% by simple pH adjustment to 8.3. Chemical coagulation with calcium chloride, ferrous sulfate, appreciably removed the colour, BOD and COD. The waste can be treated biologically after pH adjustment and with admixture of sewage.

## **AIR POLLUTION AND INDUSTRIAL HYGIENE**

### **1. National Air Sampling Network**

Work on this project was continued on the lines described in the last year's report. Besides the 8 Zonal Laboratories where this survey was being carried out, the Visvesvaraya College of Engineering, Bangalore has started collaborating in the air monitoring survey for the Bangalore city. The project which was hitherto limited to only one or two air monitoring stations in each of the cities was expanded to cover more stations in order to collect comprehensive data for the respective cities. The

following common parameters were studied:

- a) Gaseous pollutants.
- b) Suspended particulates.
- c) Sulfation rate
- d) Dust fall.

## **2. Sponsored City Air Pollution Surveys**

### **(a) Calcutta**

The air pollution survey project for the city of Calcutta was started in January 1971 for a period of 3 years. This project is being financed by the Calcutta Metropolitan Development Authority (CMDA). Calcutta Zonal Laboratory is executing the programme of work in collaboration with Headquarters. More details are given under the activities of the Calcutta Zonal Laboratory.

### **(b) Bombay**

The air quality survey of Bombay city has now entered its third year of operation and is expected to be completed by the end of 1973 when a final report on the investigation will be prepared and submitted to the Bombay Municipal Corporation. More details have been given under the activities of Bombay Zonal Laboratory.

### **(c) New Bombay**

The air pollution and climatological aspects have been studied for the New Bombay city region under the sponsorship of the City & Industrial Development Corporation (CIDCO) of Maharashtra State. This project has entered its second year. More details are given under the activities of Bombay Zonal Laboratory.

**(d) Studies on Location of a Fertiliser Plant**

The Institute has undertaken on behalf of the City & Industrial Development Corporation of Maharashtra studies on the problem of selecting a suitable site for the proposed fertiliser industry which is likely to be established in Maharashtra. The studies carried at Nhava Sheva have been completed and a report submitted.

**3. Sponsored Industrial Air Pollution Surveys**

There have been requests from the following factories during the year to assess the nature of pollution and to recommend control measures.

<b>Industry</b>		<b>Nature of problem</b>
Orissa Cement, Rajgangpur	...	Cement dust from the kiln polluting the environment.
Mysore Cement, Ammasantra	...	Kiln dust problem.
Manganese Ore (India) Limited, Nagpur	...	Measurement of carbon monoxide, NO <sub>x</sub> in the mines. Pollution due to diesel engines.
Air Pollution Survey at Bhilainagar	...	Pollution problem of the factory in planning the residential areas adjacent to the factory.
Brooke Bond India Limited, Nagpur	...	Assessment of the solvent vapours in printing section of the factory.

Survey work has been completed and reports are under preparation.



#### **4. Manganese Poisoning**

The Institute has started working in collaboration with the Industrial Toxicology Research Centre, Lucknow (another CSIR Laboratory) to carry out investigations on the Clinical and Pathological Aspects of Human Exposure to Manganese. The aim of this project is to correlate with the experimental data various factors causing manganese toxicity to human beings so as to arrive at suitable parameters for early diagnosis and to prevent manganese poisoning. Only preliminary investigations have been made. Work on this project is being continued.

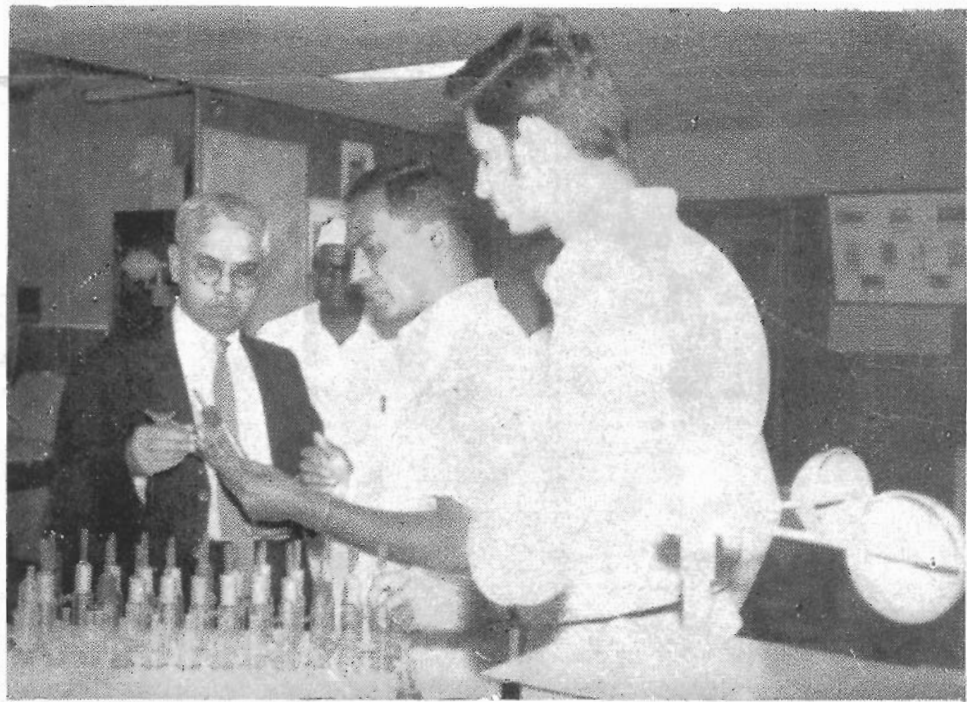
#### **5. WHO Regional Reference Centre on Air Pollution Control**

In addition to the routine work of collecting air pollution data from the country, WHO has selected CPHERI as one of the centres on its global monitoring network to develop air pollution monitoring programmes for uniform recording and processing of aerometric data. As a first step of the scheme WHO has planned a pilot phase to record such data in which CPHERI has been advised to collect the information for the city of Calcutta.

#### **6. Development of Air Pollution Control Instruments**

The Division in collaboration with the Instrumentation Division and Glass Blowing Section of the Institute has helped in the development of the following instruments :

- a) Sampler for suspended particulates.
- b) Air bubblers.
- c) Battery Sampler.
- d) Accessories for the Air Pollution Equipment.



**Dr. R. N. Chakrabarty, Director, IEM, looking at the gas impinger developed by the Air Pollution Division.**



**Dr. Chakrabarty visiting Microbiology Division**

# MICROBIOLOGY

## 1. Development of a Synthetic Medium for Bacteriological Analysis of Waters

The synthetic medium wherein ammonium salts were used as a major source of nitrogen and compared with McConkey broth for its performance, has been produced in a dehydrated form during 1972. It is presently being tested by other workers of different laboratories to evaluate its performance in comparison with the Standard McConkey broth. While the dehydrated McConkey broth available in India costs Rs. 16-00 per litre, the synthetic medium costs Re. 0-55 only.

## 2. Die-away of Bacterial Pathogens and Parasites in Different Sewage Treatment Plants

The results of the work on die-away of bacterial pathogens carried out in oxidation ditch and aerated lagoon, worked under different conditions, show that practically no effluent sample is free from *Salmonella*. While the raw sewage had a *Salmonella* count ranging from 50 to 7000 organisms per litre, the effluent contained organisms in the range of 2 to 480 organisms per litre. The removal of parasites in the oxidation ditch ranged from 77 to 100% while in the aerated lagoon it varied from 52 to 100 per cent.

With fecal coliforms in the oxidation ditch, it was observed that low solids retention time (SRT) like 0.97 to 1.33 days allowed high number of organisms to pass in the effluent. As the SRT was increased, there was an increased reduction in the number of organisms coming out in the effluent. The reduction was sharp when the SRT was increased from 0.97 to 6 days. However, SRT more than 6 days did not substantially bring down the reduction in the number of organisms in the effluent.

Work has also been undertaken on the full-scale activated sludge treatment plant at Dadar, Bombay. Monthly samples are being collected and analysed. The *Salmonella* count in raw sewage was 54,000 per litre and the effluent had 350 *Salmonella* per litre. Parasites are not completely removed.

Further work on comparison of the efficiency of asbestos sheet and stone medium in a trickling filter in the reduction of bacterial pathogens is in progress.

### **3. Use of Soil Cultures for the Biological Treatment of Wastes**

The capability of soil cultures degrading toxic substances like cyanides, phenols etc., present in the industrial wastes has been taken as the basis for this project. Preliminary experiments with soil cultures, developed by enrichment on a waste from a pharmaceutical industry (Suhrid-Geigy) showed a fall in BOD by 90 per cent and COD by 65 per cent within 8 hour of aeration. Along these lines, development of soil cultures for treating cyanide bearing wastes was taken up. During the course of this investigation, it was observed that a significant amount of cyanide was lost by mere aeration. Efforts are made to develop from soil a microbial culture that can metabolise cyanide in the wastes from metal plating and case hardening. Further work is in progress.

### **4. M.F. Technique—Development of Suitable Media to Replace the Imported & Dehydrated Media**

Though CIPHERI has developed a technique for the preparation of membrane filters indigenously at a nominal cost, these filters cannot be used unless an indigenous medium is developed for the bacteriological analysis of waters. Experiments were, therefore, carried out incorporating different concentrations of peptones that are easily available indigenously, yeast extract and different amino acids in the medium, using pure culture of coliforms. It was found that CIPHERI medium gave comparable results to that of the imported one. To study the efficacy of CIPHERI medium, different types of waters, such as raw, settled, filtered, chlorinated waters and well waters from different regions were analysed for the presence of coliforms using the imported dehydrated medium in parallel. Sewage samples were also analysed. It was found that CIPHERI medium gave equal results with that of the imported one. The concentration of ingredients in the medium are finalised and is ready for extensive field trials. The cost of the medium is Rs. 0.02 as compared to the imported one, which costs Rs. 1.00 per sample.

Work to develop an indigenous medium for fecal streptococci is under progress

### **5. Public Health Aspects of Sewage Farming: Presence of Parasites and Enteric Bacterial Pathogens in Soils and on Farm Products**

At Nagpur, where sewage farming is practised by private land owners, soils from different sewage farms and vegetables grown on them are under thorough study to establish whether they will be potential sources for the spread of diseases in man.

A few vegetables were found positive for **Salmonella** and parasites during summer months. Almost all the vegetables were positive for coliforms and fecal streptococci. However, it is too premature to arrive at any conclusions.

## **6. How Safe are the Piped Water Supply Schemes in Rural Areas**

To study the bacteriological quality of water supplied in rural areas where piped water supply schemes exist, monthly samples from Tumsar, Bhandara, Mauda, Katol, Dhapewada, Ladgaon, Metpanjra, Chhindwara, Mohkhed and Ramakona were collected and quantitatively analysed for Coliforms, Fecal coliforms, **E. coli** and Fecal streptococci. One sample from the source and 4 to 6 samples from the distribution system of each place were collected every time. Residual chlorine was also recorded. Except for the samples collected from the distribution system from Tumsar, all samples showed presence of fecal contamination. In places like Mauda, Ladgaon, Metpanjra, Mohkhed and Ramakona, samples showed heavy fecal contamination.

The local authorities were frequently informed regarding the quality of water supplied to the consumers and they were requested to improve the quality by means of disinfection.

## **7. Bacteriophage Model Studies for the Concentration of Viruses from Polluted Soils**

Investigations with animal viruses involve a lot of time and expense, particularly when it is required to develop a method for the concentration of viruses from polluted soils. Bacteriophage has been used as a model for animal viruses for the development of a concentration procedure since it is less time consuming, cheaper and the results can be obtained in 24 hours.

Earlier work has shown that a two step concentration procedure by centrifugation could handle only small quantities (5 g) of soil samples. After flocculating the soil extract containing phages with alum, it was observed that 99.4 to 100% phage could be trapped in the flocs. Later, the desorption of phages from flocs was carried out with different agents like sodium bicarbonate, 3% and 1% beef extract of pH 8.0, nutrient broth, 1 M sodium chloride and phosphate buffer of various pH values. It was observed that 1% beef extract at pH 8.0 and phosphate buffer could desorb (elute) 52-70% phage from the alum flocs.

Work is in progress to assess a suitable desorbing agent which can give a 100% recovery from the flocs.

## 8. **Salmonella in Sewage and Polluted Waters**

Raw sewage from the city of Nagpur is drained into the Kanhan river through Nagnullah (Nag River). To find out the survival of **Salmonella** in the receiving waters, samples were collected from Nag River before confluence point, from Kanhan River upstream of confluence point, from the confluence point and from one mile downstream of confluence point. They were analysed for the presence of **Salmonellae** and Coliforms quantitatively. Samples from Nag River, and the confluence point were positive for **Salmonellae** while samples from Kanhan and one mile downstream were negative. Work is in progress to cover different seasons of the year.

## 9. **Virus Removal in different Sewage Treatment (Pilot) Plants**

### (a) **Oxidation Ditch**

Analyses of results of studies on oxidation ditch operated under different conditions for one year showed that an optimum detention time of sewage for 13-14 hours, a sludge retention time of 6-12 days and a solids concentration of 2000-4000 mg/l brought about more than 99% reduction of the virus in the raw sewage. Though the oxidation ditch was treating sewage to an effluent quality of 5-20 mg/l BOD under different operational conditions, in 50% of the observations, the quantity of virus in the effluent was equal to or less than 24 PFU/l and in 98% cases it was equal to or less than 88 PFU/l. The quantity of virus entering the system was 3200 and 7300 PFU/l respectively.

### (b) **Trickling Filter**

Evaluation of the virus removal efficiency of two types of media, conventional 4" stone and corrugated ACC sheets at 1" spacing packed to a depth of 6 feet in a trickling filter has been taken up. Results obtained during May—December indicate that the effluent from stone media contained 50% less virus than in the effluent from corrugated sheet media.

## **10. Virus Removal in Different Full Scale Sewage Treatment Plants**

To obtain data regarding the virological quality of the effluent from full scale sewage treatment plants, studies on the performance of the activated sludge treatment plant at Dadar, Bombay have been taken up. Preliminary results showed that 90-95% of virus in the raw sewage was removed during treatment in this plant. Further work on the extent of virus removal in the different stages of sewage purification in this plant is in progress.

## **11. Survey of Healthy Children for the Excretion of Enteric Viruses**

Stool samples (115) were collected from healthy children of the age group 1-15 years in CIPHERI colony and Lakshminagar, Nagpur for the presence of symptomless excretors of enteric viruses.

Stool specimens were prepared in 20% by weight in EBSS-LAH and yeast extract solution. These are clarified at 3000 rpm for 30 minutes and further clarified at 10,000 rpm for 20 minutes. A mixture of antibiotics was used. Samples were stored at -20°C till the time of inoculation.

Sixty five samples were examined using monkey kidney cell cultures. Out of these, 9 were found to cause cytopathogenic effect (CPE). All these samples will be examined for the presence of viruses on human amnion cell cultures.

# **WATER ENGINEERING**

## **1. Water Treatment**

(a) High rate sedimentation in combination with high rate filtration using two-layer filters can increase the throughput of existing water treatment plants or reduce the physical size of new units. Earlier studies on high grade bituminous coals have indicated their suitability as a good substitute for anthracite normally used in two