annual report

1962-63

CENTRAL
PUBLIC HEALTH
ENGINEERING
RESEARCH INSTITUTE
NAGPUR-3.

CENTRAL PUBLIC HEALTH ENGINEERING
RESEARCH INSTITUTE, NAGPUR-3.

ANNUAL Report

1962-63

C O N T E N T S

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INTRODUCTION

This report presents briefly the important work carried out by Central Public Health Engineering Research Institute, Nagpur during the year 1962-1963. During the year under report the research activities of the Institute continued to be carried out through its Headquarters at Nagpur and its Zonal and Field Centres at different places.

An attempt is made in this report to explain clearly the work carried out on a variety of problems of public health importance. The report also gives an account of new projects taken up at Headquarters, Zonal and Field Centres.

The Institute is maintaining close relation with all State Public Health Engineering Departments and Corporations. It is hoped that all those who are interested in solving public health engineering problems - either in public or private sector - will take the facilities provided by the Institute to solve them. The Institute has fairly good equipment and facilities to give advice on all technical matters connected with Public Health Engineering. The donation given to the Institute from the Special Fund of United Nations by W.H.O. is enabling us to equip the laboratory with the latest apparatus. The construction of the building at Headquarters is nearing completion. It is hoped that as before all the Public Health Engineers interested in the promotion of this subject in this country will co-operate with the Institute in achieving the purpose for which it is established.

R.S. Mehta

(R.S. Mehta)
DIRECTOR

Central Public Health
Engineering Research Institute,
Nagpur

GENERAL ADMINISTRATION

BUILDING & HOUSING

Laboratory Building at Nagpur:

The campus of the main laboratory has a total area of 110 acres. The building is a three-storied R.C.C. structure with all the essential facilities like water, gas, compressed air etc. The building accommodates laboratories as well as administrative and accounts branches. A committee room as well as room for symposia have been provided. A small structure has also been constructed to be used as cafeteria. A separate shed is provided for housing the workshop which is fairly well-equipped.

The Executive Council of the Institute, in its first meeting held on 17.11.61 had recommended the construction of (i) Hostel, (ii) Guest House and (iii) Library, Auditorium and Museum at Nagpur. The Vice-President had approved all these works. However, in view of the National Emergency and consequent budget cuts, these proposals had to be dropped. One of the four C-II type bungalows has been converted into a Guest House; four units of H-type quarters have been converted into Hostel and Library is temporarily located in the main-building.

Field Laboratories:

The proposals to construct laboratory buildings for Bombay and Hyderabad Zonal Centres, though approved by the Executive Council in principle, had

to be postponed due to National Emergency. Madras Field Centre, which was opened during the second quarter of 1962 had also to be closed by the end of the same year due to National Emergency.

EXECUTIVE COUNCIL

The Executive Council for the year 1962-63 constituted as follows:

Chairman:-

1. Dr.Sushila Nayar
Minister of Health
New Delhi

Members:-

2. Representative of the
Ministry of Health,
New Delhi.

3. Dr.C.G.Pandit,
Director,
Indian Council of Medical Research
New Delhi.

4. Dr.B.V. Bhoota,
Dorr-Oliver (India) Ltd.,
"The International",
16, Queen's Road Estate,
Bombay-1.

5. Representative of the
Ministry of Defence,
New Delhi

6. Shri.P.C. Bose,
Chief Engineer
Public Health Engineering
Govt. of West Bengal,
Calcutta

7. Chief Engineer,
Water Supply
Delhi Corporation
Delhi.

8. Shri. K.N.Bhargava,
Additional Chief Engineer,
Public Health
Government of Rajasthan,
Jaipur

9. Dr. S.L. Kalra
Head of the Department of Microbiology,
All India Institute of Medical Sciences,
New Delhi

10. Maj.Gen. S.S.Sokhey,
Hony. Adviser
Council of Scientific & Industrial Research
Rafi Marg, New Delhi-1

11. Dr. M.Mohiuddin,
Chief Chemist
Orient Paper Mills
Brij Raj Nagar,
Calcutta

Ex-Officio Members:-

12. Director-General,
Scientific & Industrial Research,
Rafi Marg, New Delhi-1

13. Financial Adviser to CSIR

14. Director,
Central Public Health Engineering Research Institute,
Nagpur

Non-member Secretary:-

15. Prof. M.V.Bopardikar,
Assistant Director,
CPHERI, Nagpur.

The second meeting of the Executive Council was held at Nagpur on the 20th January, 1963. The following were present:

1.	Dr.Sushila Nayar	Chairman
2.	Shri. M.V. Modak	Member
3.	Shri.R.D. Verma	"
4.	Dr. B.V. Bhoota	"
5.	Shri. K.N. Bhargava	"
6.	Dr. C.G. Pandit	"
7.	Shri. S. Rajagopalan	"
8.	Shri. B.N. Chadha (On behalf of Financial Adviser)	"

9.	Shri. R.S. Mehta	Member
10.	Prof. M.V. Bopardikar	Secretary

A meeting of the Finance and Building Sub-Committee of the Executive Council was also held at Nagpur on the 20th January 1963. The following were present:

1. Shri N.V. Modak,
2. Dr. B.V. Bhoota,
3. Secretary, CSIR,
4. Assistant Financial Adviser,
5. Shri. R.S. Mehta, Director, CPHERI.

ADVISORY COMMITTEES

The Advisory Committees were constituted for Delhi and Hyderabad field laboratories in the preceding year with a view to obtain advice on the research problems to be undertaken by each field laboratory of the Institute. During the year under review, such Advisory Committees were also formed for Bombay Zonal Centre, Poona Field Unit and Enteric Virus Research Laboratory, Poona.

Advisory Committee for Delhi Zonal Centre

Chairman:

1. Director, CPHERI (Ex-officio)

Members:-

2. Chief Engineer (Water)
   Delhi Municipal Corporation
3. Drainage Engineer
   Delhi Municipal Corporation
4. Dr. G.P. Kane,
   Senior Industrial Adviser
   Ministry of Commerce & Industry
5. Dr. K.L. Rao,
   Member,
   Central Water & Power Commission

6. Chief Engineer
Public Health
Punjab

7. Chief Engineer,
Public Health
Rajasthan

8. Shri. K.S. Krishnaswamy
Deputy Director-General
Ministry of Health

Advisory Committee for Hyderabad Zonal Centre

Chairman

1. Director, CPHERI (Ex-Officio)

Members:-

2. Shri. A.Krishnaswamy, Secretary
to the Government of Andhra Pradesh,
(Health, Housing & Municipal
Administration)

3. Dr. K.N. Rao
Director of Medical Services
Andhra Pradesh

4. Director
Regional Research Laboratory
Hyderabad

5. Shri K. Ramaswamy
Chief Engineer
(Building & Public Health)
Government of Andhra Pradesh

6. Shri Sastry,
Special Director of Industries & Commerce
Andhra Pradesh

7. Shri M. Lokanathan,
Municipal Commissioner
Hyderabad Corporation

8. Dr. Gulam Ahmed
Director of Public Health
Andhra Pradesh

9. Dr. M.W. Williams, Director
Institute of Preventive Medicine
Hyderabad

10. Shri R.K.V. Narasimhan, Director
Engineering Research Laboratory
Hyderabad

Advisory Committee for Bombay Zonal Centre

Chairman

1. Director, CPHERI (EX-Officio)

Members:-

2. Director of Industries
Government of Maharashtra

3. Director of Fisheries
Government of Maharashtra

4. Director, Bombay Textile
Research Association

5. Director
Haffkine Institute
Bombay

6. Director
Indian Institute of Technology
Powai, Bombay

7. City Engineer
Municipal Corporation
Bombay

8. Hydraulic Engineer
Municipal Corporation
Bombay

9. Head
Radio-Chemistry & Isotope Dn.,
Atomic Energy Estt., Trombay
Bombay

10. Deputy Director of Public Health
Government of Maharashtra

11. Prof. S.J.Arceivala
Head of the Civil &Sanitary
Engineering Department,
V.J.T.I., Matunga, Bombay

12. Director of Smoke Abatement
Bombay

Member Secretary:-

13. Officer-in-Charge,
CPHERI Zonal Centre
Bombay

Advisory Committee for Poona Field Unit

Chairman

1. Director, CPHERI (Ex-Officio)

Members:-

2. Superintending Engineer
Western Public Health Circle
Poona

3. Director of Public Health,
Poona

4. Medical Officer of Health
Municipal Corporation
Poona

5. Dr. G.S. Kasbekar, Director
Hindustan Antibiotics,
Pimpri

6. Director
National Chemical Laboratory
Poona or his representative

7. City Engineer
Municipal Corporation
Poona

Member Secretary:-

8. Officer-in-Charge,
CPHERI, Poona Field Unit

Advisory Committee for Enteric Virus Research Laboratory, Poona

Chairman:-

1. Director, CPHERI or his representative (Ex-Officio)

Members:-

2. Dr. C.G.Pandit, Director
Indian Council of Medical Research

3. Dr. Anderson, Virus Research
Centre, ICMR, Poona

4. Director
Haffkine Institute
Bombay

5. Commanding Officer,
Armed Forces Medical College,
Poona

6. Director of Public Health,
Poona

Member Secretary:-

7. Officer-in-charge,
Enteric Virus Research Laboratory
Poona

STAFF

The following statement shows the strength of the staff as on 31st March 1963.

	Actually on roll as on 31.8.1963
1. Scientific (JSA & Above)	69
2. Auxilliary (Technical)	108
3. Administrative & Housekeeping	78
4. Class IV	107
Total	362

The details of the staff are shown in the Appendix to this report.

BUDGET

(Rupees in lakhs to the nearest hundred)

	1961-62		1962-63	
	Final Provision	Expenditure	Final Provision	Expenditure
(1)	(2)	(3)	(4)	(5)
Capital Grant	08.400	09.204	13.550	13.189
Recurring (Including pay and allowances)	13.200	13.070	15.730	15.747
Grant for pilot plants	01.000	00.335	00.125	00.124

EXTERNAL AID

An amount of US $ 5,25,000 is granted from the United Nations Special Fund assistance in the form of equipments and apparatus for the main laboratory at Nagpur, Zonal Centres at Bombay, Delhi, Calcutta, Hyderabad and Enteric Virus Research Laboratory at Poona. The statement showing the aid received during the year 1962-63 is given below:

Centre	Aid (in US Dollars)
CPHERI Nagpur	40,497
Bombay Zonal Centre	9,927
Calcutta Zonal Centre	10,546
Delhi Zonal Centre	11,448
Hyderabad Zonal Centre	11,514
EVRL, Poona	4,068
Total	88,000

Membership of Outside Organisations

The Institute is represented on various Advisory Committees of National and International Organisations. The details of the membership are given below:

Shri R.S.Mehta, Director

1.	Executive Board, International Water Works Association, London	Member
2.	Scientific & Technical Committee, International Water Works Association, London	"
3.	W.H.O. Expert Advisory Panel on Environmental Sanitation	"
4.	Local Qualification Committee of American Society of Civil Engineers	Chairman
5.	Public Health Engineering Group, Institution of Engineers (India)	"
6.	Faculty, Board of Studies of Baroda University	Member
7.	Sanitary Appliances and Water Fittings Sectional Committee and its Sub-Committees - BDC:3 of ISI	"
8.	Sluice Valve Sub-Committee BDC 3:5 of ISI	Convenor

9.	Polythene Tube Sub-Committee BDC 3:8 of ISI	Member
10.	Water Meter Sub-Committee BDC 3:4 of ISI	"
11.	Building Materials and Components Sampling Sectional Committee BDC 31 of ISI	"
12.	Fluid Flow Measurements in Closed Conduits BDC 17:3 of ISI	"
13.	Public Health Engineering Plants & Equipment Sectional Committee BDC 40	" (Principal)
14.	Technological Institute Committee, Nagpur University	Member
15.	Committee to recommend model design for suitable receptacles, handcrafts and other mechanical devices for sanitary collection and disposal of nightsoil (Ministry of Health)	"
16.	Working Group on Waste Disposal Problems in Food and Fermentation Industries - ICMR	Member (Director or his representative)

<u>Prof. M.V.Bopardikar, Assistant Director</u>

1.	W.H.O. Expert Advisory Panel on Environmental Sanitation	Member
2.	Sub-Committee for Development of Meat Technology - Scientific Food Advisory Panel, Ministry of Food and Agriculture	"
3.	Water Sectional Committee CDC 26 of ISI	"
4.	Drainage Sub-Committee BDC 24:2 of ISI	"
5.	Sanitary Appliances and Water Fittings Sectional Committee BDC:3 of ISI	"
6.	Public Health Engineering Plants and Equipment Sectional Committee BDC 40	Alternative member
7.	Environmental Hygiene and Sanitation Advisory Committee - ICMR	Member

Shri J.M. Dave, Assistant Director

1.	Sanitary Installation Sub-Committee BDC 24:3 of ISI	Member
2.	Air Pollution Sub-Committee CDC: 18:5	"
3.	Chemical Hazards Sectional Committee CDC 18	"
4.	Industrial Chemical Hazards Sub-Committee CDC 18:4	"

Dr. S.V.Ganapati, Officer on Special Duty (S.S.O-I)

1.	Panel for River Water and Trade Effluents CDC 26 P:4 of ISI	Member

DEPUTATIONS

Shri R.S. Mehta, Director has been on a tour to America and Europe from the 19th May 1962 to the 27th September 1962, on WHO Travel Fellowship in Public Health Engineering (Project No. India 176).

During this tour, Shri R.S. Mehta had the privilege of attending the following meetings of scientific & Technical interest:

International Conferences:

(a) International Water Supply Association Meeting of the Executive Board and Scientific and Technical Committee in Amsterdam (Netherlands), May 20-25, 1962.

(b) Pan American Sanitary Engineering Congress in Washington, D.C., June 10-15, 1962.

(c) Health and Health Education Conference in Philadelphia, July 1-5, 1962

(d) International Conference on Water Pollution Control Research in London, September 3-10, 1962.

Symposia (in the Robert A. Taft Sanitary Engineering Centre, (Cincinnati):

(a) New Developments in Sewage Treatment, June 3-8, 1962

(b) Aquatic Biology, June 25-29, 1962

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American Water Works Association in Philadelphia, June 17-22, 1962.

TRAINING

The Institute organised Training Programme and the following personnel received training in the field mentioned against their respective names:

Name	Subject	Period
1. Shri A.Adinarayana Teacher Muzaffarpur Institute of Technology	Public Health Engineering	15 days
2. Dr. S.Ahmad Asstt. Professor, Bihar Institute of Technology	Public Health Engineering	15 days
3. Shri A.D. Bhide Teacher, University of Roorkee	Public Health Engineering	8 weeks
4. Shri J.N. Kardile Asstt. Research Officer All-India Institute of Hygiene and Public Health, Calcutta	Public Health Engineering	5 weeks
5. Shri R.D. Verma Lecturer M.B.M. Engineering College, Jodpur	Public Health Engineering	15 days
6. Shri H.S. Jagannath Overseer Kalamb Block Development	Design and Construction of Gas Plant	2 days

DISTINGUISHED VISITORS

Shri P.K. Sawant, Minister for Public Health Maharashtra State.

Shri B.L. Raina, Director-General, Health Services, New Delhi.

Shri L.D.Thatte, Deputy Director of Medical Services Nagpur.

Shri Kaz Kawata, Sanitary Engineer, Christian Medical College, Ludhiana, Punjab.

Maj. Y.R. Tipnis, Chief Engineer, Indian Institute of Petroleum, Dehradun.

BACTERIOLOGY DIVISION

1. MICROBIOLOGY OF OXIDATION PONDS :

The treatment of sewage by oxidation pond is of relatively recent origin. Hence very little information is available regarding the microbiological aspects of treatment by this process. From the Public Health point of view, the effluent quality depends to a great extent on the removal of pathogenic organisms from sewage. Hence it was felt that a study of the microbiological characteristics of the influent and effluent is of great importance. For this purpose, preliminary studies were carried out on the enumeration of the total bacteria, coliforms and enterococci. The samples were also analysed for the presence of salmonella and shigella groups of organisms both in influent and effluent at Bezonbagh, Nagpur. It was found that the coliforms and enterococci reductions were 79 - 98.6 and 78.8 - 98.8 per cent respectively. This study indicated that salmonella and shigella if present in influent were eliminated during treatment in the oxidation pond.

Grab samples of influent and effluent collected from the oxidation ponds at Bezonbagh, Nagpur and composite samples thereof were analysed for total bacteria and coliforms to ascertain the proper sampling technique in the analysis of these samples.

Sewage normally contains large numbers of bacteria. Hence, difficulty is experienced in the proper assessment of the number of bacteria using the usual dilution technique (MPN). To find out a better and suitable method to overcome this difficulty, loop technique was employed in analysing the samples of influent and effluent of the oxidation pond, in parallel to the dilution technique (MPN).

2. BACTERIOLOGICAL ANALYSIS OF WATERS USED FOR PUBLIC WATER SUPPLY IN THE CITY OF NAGPUR :

Nagpur derives its water supply from three sources, Kanhan River, Gorewara and Ambazari Lakes. The waters from Kanhan and Gorewara are treated by the conventional methods of coagulation, sedimentation, rapid sand filtration with post-chlorination, while the Ambazari raw water is straight-away chlorinated before distribution. The work was carried out to investigate whether the waters used for the water supply in Nagpur City meet the bacteriological standards of USPHS (United States Public Health Service) or not. The samples of raw water were collected weekly and analysed bacteriologically. The results indicate that the Ambazari raw water should be treated by the conventional method of water treatment instead of mere chlorination. In case of Kanhan there should be pre-treatment like pre-sedimentation or pre-chlorination during rainy season because the counts go higher than the limits set up by the USPHS for the conventional method of water treatment.

Also to assess the bacterial reduction at different stages in water treatment of the water works at Nagpur, was another aim of this project. The water samples of raw, settled, filtered and chlorinated waters from Kanhan and Gorewara water treatment plants were collected weekly and analysed bacteriologically for coliform, E.coli and Enterococci counts. The results indicate that the performance of Gorewara water treatment plant is better than the Kanhan Water Treatment Plant.

3. BACTERIAL INDICATORS OF FAECAL POLLUTION :

The organisms used as indicators of faecal pollution differ from country to country. For example in U.K. the presence of E.coli in water is considered as a definite indication of excremental pollution, whereas the presence of other members of coliform group is of doubtful sanitary significance. In U.S.A. on the other hand, the presence of any organism of the coliform group

is considered as an indication of faecal pollution.

However, we do not have any standards for the indicators of pollution. In order to establish our own standard, work was started in this Institute. Faecal specimens from normal individuals and hospitalised patients, not suffering from enteric diseases, were analysed for the presence of different members of the coliform group.

The results obtained with about 500 specimens show that in 20 per cent of the cases E.coli type I does not occur at all but the other members of the coliform group do. It is obvious that if E.coli type I alone is taken as an indicator of faecal pollution, it will be correct only in 80 per cent of the cases. Hence we should consider the presence of any member of the coliform group in water as indicative of faecal pollution. The work is in progress on sewage samples.

4. REMOVAL OF E. HISTOLYTICA CYST (Amoebic Cysts) FROM WATER :

With the usual doses of chlorine employed in water works amoebic cysts are not killed. This problem is more acute in places, where water is just chlorinated before distribution without sedimentation and filtration. In water treatment plants a large sum of money is usually spent for the erection and maintenance of the filtration plants. If amoebic cysts can be removed from water completely by flocculation and sedimentation, a lot of expense can be avoided by dispensing with filtration.

Work was carried out on a laboratory scale to study the removal of known concentrations of amoebic cysts from raw water of known turbidity at different sedimentation periods, using varying doses of alum. It was found that an alum dose of 11 ppm, could remove the cysts from water of 100 ppm turbidity with 2 hours sedimentation time even when their concentration is 100 cysts per ml.

5. STUDIES ON THE MEMBRANE FILTER TECHNIQUE :

One of the major concerns of all Public Health Administrators is the time that lapses between the submission of a water sample and the reporting of bacteriological results. It generally takes 72 to 96 hours to decide whether a particular water is suitable for drinking or not. Unfortunately by this time the water is consumed by the consumers and nothing can be done if the sample was found to be unfit for drinking.

As a result of intensive efforts to cut down this time for analysis during the last so many decades, Membrane Filter Technique (M.F.) was developed. This technique can give us results within a period of 18 hours. However, it is not universally accepted by all countries as a standard procedure.

Experiments were carried out to compare the performance of this method with the conventional procedures. Results obtained showed that the M.F. technique is quite suitable for water analysis. However, this cannot be recommended for general use in our country, since filter membranes are not manufactured in India.

6. DISINFECTION OF RURAL WELL WATERS :

Disinfection of wells in rural areas is of great importance in view of the fact that 80% of the population live in villages in our country. The method should be cheap, simple and should require minimum attention. Zdrakov in Bulgaria has suggested the use of Earthenware porous pots with bleaching powder for controlled disinfection of waters. He demonstrated its utility for continuous water disinfection with particular reference to well waters.

The porous earthenware pots, for its utility for continuous disinfection was thoroughly studied. These

were made from china clay by mixing combustible organic matter, like horse-dung, saw dust, etc. and by baking them at high temperature like 1200°C. It was difficult to increase the porosity to an appreciable degree. Moulding of such pots was also found to be difficult. The process needs high temperature and skill which is not available with ordinary pot maker.

When such pots were tried they were found to get easily chocked within four to five days. The blocking material was examined and found to be mostly calcium carbonate. Work is in progress with a modified method.

BOTANY DIVISION

1. OXIDATION PONDS :

During the year under review, the two experimental ponds situated at Bezonbagh have been operated in parallel at 5' operational depth. The ponds are having capacities of 21276 (Pond I) and 23400 (Pond II) gallons respectively. Wooden baffles were installed at the effluent ends, of the ponds so that the effluents are tapped from 1½' below the surface of the ponds which will cut short the loss of Algae from the top layers. In Pond II one alkathene pipe line of 2" diameter was laid at 2' height from the bottom all along the length of the Pond. Glass pipettes or diffusers of 2 inches length with extremely narrowly drawn openings were fixed at 3 inches intervals in two rows on the alkathene pipe line facing the bottom of the pond. Through this line this pond was agitated or aerated with compressed air for 2 to 3 hrs. daily. Various Detention Periods - 1.5, 2 and 4 days were tried.

The results so far obtained indicate that :

(1) The oxidation pond treatment of sewage is very efficient and economical;

(2) A loading of 800 lbs per acre per day could easily be obtained at 2 days detention period;

(3) Correlations between Solar Radiation and BOD of raw sewage and pond effluent, algal numbers, dissolved oxygen, percentage reduction of BOD and the rainfall indicated (a) that the ponds worked efficiently, (b) that the solar energy ranged from 321-594 langleys per cm^2 all through the year and in the rainy season from 324-450 langleys per cm^2, (c) the percentage of reduction in BOD is less, comparatively in the rainy season, but it never went down below 66 per cent.

(4) (a) The pH, Temperature, Light Intensity and Dissolved Oxygen are directly related with Algal populations there by influencing the photosynthetic

process, (b) The BOD and COD are inversely proportional to the algal growth rate, (c) Uptake of Nitrogen fractions, sodium and potassium ions are clearly indicated;

(5) The aeration of 1 to 2 hrs. in Pond II encourages better efficiencies due to intermittent exposure of algal cells to light and additional of carbon dioxide and oxygen from the atmosphere;

(6) At no time during the operation of the ponds Mosquitoes were observed; however, Dipeterian flies were observed for a short time during December 1961;

(7) The effluent samples of the oxidation ponds have not shown so far any pathogens of Salmonella and Shigella group. Furtner analysis is required to confirm this fact;

(8) The accummulation of the sludge at the bottom of the pond is negligible; and

(9) The 'Moina dubia' blooms could be controlled successfully by addition of lime to the ponds. High pH coupled with active photosynthesis was found to be unfavourable to the red blooms of Moina. Sodium chloride was found to be lethal to Moina at a concentration of 600-800 ppm.

2. HARVESTING OF ALGAE :

Maximum algal production in the oxidation ponds is needed because the algal crop defrays the cost of operation to certain extent. The yield of algal crop from the ponds varies according to the climatic conditions. Bezonbagh pond algal yields came to about on an average 50 metric tons per acre per year.

For harvesting the algae, at present, centrifugation method is adopted. After experimenting with various chemical coagulants, calcium hydroxide (0.5%) and calcium chloride (1%) were found quite effective (in alkaline range) in forming a good floc in reasonable time. Combination of $CaCl_2$ and $Ca(OH)_2$ in proportion of

8. MANOMETRIC STUDIES WITH WARBURG APPARATUS :

Studies on the comparative evaluation of conventional 5-day BOD method and short term Manometric method of BOD estimation were started in December 1962, and are in progress.

1. STUDIES ON LEWATIT M-600, A STRONG BASE ANION EXCHANGE RESIN

The cause of deterioration of strong base anion exchange resins during their use were studied. Treatment with alkaline sodium hypochloride (0.5 to 1.5 per cent) for 3 to 4 hours was found to improve the exchange capacity of deteriorated strong base resins.

2. DEFLUORIDATION

A cheap high capacity defluoridating substance was prepared by sulphonating saw dust at room temperature and by impregnation with 1 per cent alum solution.

3. OXIDATION DITCH

Laboratory scale studies on oxidation ditch have shown that this method is most suitable for the treatment of sewage from small communities.

4. ANAEROBIC DIGESTION OF SLUDGE

Experiments on digestion of sludge obtained from Bezonbagh have shown that the digestion characteristics of Indian sludges were different from those reported in other countries. This difference is found to be due to low volatile matter content in Indian sludges.

5. STRAW BOARD WASTE

It is found possible to grow Chlorella in straw board waste and use them for the treatment of the same.

6. DESIGN OF AIR DIFFUSER

A tile plate air diffuser for sewage and wastes treatment by activated sludge process has been developed

by which air bubbled into the bottom of a tank is deflected upward by tile plates arranged at an angle. The oxygenation efficiency achieved has varied from 3500 - 6000 gms/KW hr. The system is non-mechanical, cheap and non-clogging.

7. PORTABLE WATER DEMINERALISER

A portable water demineraliser employing the principle of ion-exchange has been developed to cater to the needs of educational institutions, hospitals and research laboratories. Its salient features are : (i) Cheapness (cost Rs 8000); (ii) Simplicity of operation; (iii) High efficiency; and (iv) Good quality effluent 2-5 ml.

ENVIRONMENTAL SANITATION DIVISION

GOBAR GAS PLANT

Anaerobic digestion using a gas plant is the most efficient method for the disposal of organic wastes produced in villages. But the cost of gas plant is prohibiting the large scale use of the plant. CPHERI took this problem with a view to reduce the cost. It was decided to tackle the problem from two angles (1) operational aspect or to ascertain optimum conditions for efficient operation, (2) engineering aspect or the plant design.

During 1962-63, three phases of the first part were concluded. The summary of phases and findings are as below :

Phase 1 Effect of Dung Loading on Gas Production in Pilot Scale Dung Digester

At increased loading there was an increase in the (1) total volatile acids (2) percentage of CO_2 in the gas evolved (3) percentage of volatile matter in the digester dung and decrease in the (1) pH of digester content (2) Gas produced per Kg. of organic matter added and (3) percentage reduction in volatile matter.

Gas production was maximum with 24 kg. of fresh dung loading/cum/day irrespective of temperature.

Phase 2 Effect of Slurry Concentration on Gas Production in Pilot Scale Dung Digester

In the pilot plant under study the gas production was optimum when the input total solids percentage was between 9.08 - 9.44 %. This corresponds to mixing of fresh dung with water in equal proportions.

Phase 3 Effect of Premixing (Seeding the Input prior to Loading in Pilot Scale Dung Digester

The premixing (seeding) of the raw input with an already digested slurry prior to loading appreciably increases the daily gas production of the pilot scale

dung digester. The limits of such mixing can be stretched conveniently to suit any plant under operation. In community gas plant, introduction of raw input in the recirculating slurry can enhance the digester performance.

From the plant design angle, the location of inlet and outlet was studied in detail. The location of outlet at the bottom of digester with a baffle plate located at predetermined distance from inlet has been found to ensure regular sludge removal. The baffle plate gives sufficient mixing of digester contents and prevents short circuiting. Maximum digester capacity for bacterial activity is envisaged.

A CPHERI type Design on the basis of findings was evolved. The same is put to trial in village Bamani and has been found to work satisfactorily.

B HELMINTHIC VIABILITY IN PIT LATRINES AND ITS MANURAL VALUE

The object of the study is to get a manure from pit latrines free from health hazards. About 24 latrines (CPHERI type design No. 4) were constructed at village Kohli to conduct this work. The contents of the pit were examined under progressive stages of digestion in the pit. It was concluded from this study that the material in the pit is free from viable helminthic ova after 3-4 months. The chemical value of the end product indicates that they fall in the optimum range.

C HIGH RATE MECHANICAL COMPOSTING

The design of the pilot plant of two tins capacity was finalised. The machinery parts of the plant are being fabricated in the workshop of this Institute. The major machine like chaff cutter is also being assembled by a local firm with necessary modifications and improvements suggested. The civil work of the building of pilot plant is in progress.

D DISINFECTION OF RURAL WELL WATERS

(i) The object of this study is to devise a method which would be simple, economical and within the reach of a villager. The device is modified by replacing the glass carboy with plastic bucket of about 3 gallons. The plastic was quite resistant to the action of bleaching powder. At the bottom of the plastic bucket a hole of 1/4" is made in which is fixed a glass tube bent at right angle to prevent chocking from suspension. The plastic has a cover to avoid the loss of chlorine to the atmosphere. The device is under experimental conditions.

E RESIDUAL CHLORINE ESTIMATION KIT

A sanitary inspector of Corporation has always a problem to find out whether the dose of chlorine used is sufficient or not. They cannot afford to keep a "Lovibond Comparator" like apparatus. So a cheap type of comparator has been fabricated in this Institute which is suitable for a village and Sanitary Inspectors.

The kit consists of two glass capsules having 1 ppm and 0.5 ppm chlorine standard. In between these two capsules is placed a test water tube. The water is taken in this test tube and drop of O-Toluidine, provided in another tube, are put and colour developed in chlorinated water is compared with the standards. The colour developed should be between 0.1 and 0.5 ppm. All components are kept in a small wooden box. The cost of this box is as less as Rs 3.00. These kits have been used by Nagpur Corporation very satisfactorily.

INDUSTRIAL HYGIENE & AIR POLLUTION DIVISION

FABRICATION OF THE INDUSTRIAL HYGIENE EQUIPMENT

One of the objectives of this Institute is to help Indian industries to solve their occupational health and industrial hygiene problems. To be able to undertake industrial hygiene research problems, considerable equipment has been ordered from the U.N. Funds. Due to technical difficulties in procuring the equipment in time, fabrication of simple air sampling accessories, e.g., the gas absorbing devices, the flow meters and dust trapping devices like the impinger tubes was taken up. As a part of this project, the gas absorbing vessels and the flow meters for measuring different rates of suction were fabricated. They were calibrated for different conditions of sampling and were found to be suitable for field work in industrial hygiene investigations.

OCCUPATIONAL HEALTH PROBLEM IN A RAYON INDUSTRY

The Factory Inspectorate of one of the State Governments referred this problem to the Institute for investigations and expert opinion. The concern specialised in the acetate process of rayon manufacture. During the course of manufacture, considerable quantity of acetic acid fumes were given out and the environmental conditions in certain sections had become a bone of contention between the management and the labour.

A preliminary industrial hygiene investigation carried out in this connection showed that there was sufficient justification in the complaint of the workers regarding the potential health hazards in certain sections. A report put up to the State Government authorities was approved and the Institute was requested to undertake a scientific assessment of the environmental conditions and its health effects. Such an investigation was undertaken and a preliminary report of investigations with suitable recommendations put up to the State Government for implementation.

ZOOLOGY DIVISION

1. HYDROBIOLOGICAL STUDIES OF GANDHISAGAR IN RELATION TO FISH MORTALITY

An intensive hydrobiological work was undertaken during the year to detect the plausible reasons for the large scale mortality of fish. Detailed and round-the-clock sampling for chemical and biological analysis was done. The analysis of the data revealed that the fish mortality is preceded by a depletion of dissolved oxygen due to the depletion of phytoplankton.

2. KANHAN RIVER SURVEY

A survey has been taken up on Kanhan River by a team of workers representing various disciplines and this division has been engaged in the collection of plankton samples and bottom fauna. In total, 8 sampling stations were set up in the total distance of 12-14 kilometers. Fortnightly collections were made from all the 8 stations for chemical, biological and bacteriological analysis.

For Zooplankton surface collections were made with the plankton net. Bottom fauna was collected with the acid of Ekman's dredge and the samples were analysed.

The quantitative study of Zooplankton was also done and the data is recorded.

The survey would give an insight into effect of domestic and industrial effluents on aquatic fauna and other pollution of the stream as well as the nature of the bottom fauna.

3. ERADICATION OF DAPHNIDS FROM OXIDATION PONDS, NAGPUR

A daphnid, Moina dubia appears periodically in a bloom in oxidation ponds and forms a visible 'red tide' over the surface of slightly below. Immediate result of

the presence of a large number of cladocerans is the grazing effects and the population of the algae in the oxidation ponds and particularly Chlorella declines, resulting in the depletion of the oxidation ponds. Work has been undertaken with a view to study the taxonomy, growth stages, life history, and ecology of the daphnids present in the oxidation ponds. The bloom appears at a particular period and disappears after some days.

Laboratory studies on the effect of Hydrogen Ion concentration on these daphnids have been undertaken. If the pH of the oxidation pond is above 9, the menane was reduced to a great extent. The optimum pH which favours the growth of these forms is 8. The effect of pH on Chlorella is not significant.

Work in connection with the chemical method of eradication of daphnids has also been undertaken. A sample of the insecticide orthodibrom-8 was obtained from the Californium foundation, U.S.A. and its toxicity on daphnids studied in detail. Simultaneous study was also carried out on Chlorella with the insecticide and the toxicity. Even though the insecticide was very toxic at as low as 1 ppm to daphnids it also affects Chlorella considerably at that concentration. Since the algae is adversely affected it would not be advisable to use the insecticide for eradication of daphnids. Reports on the above experiments are under preparation for submission.

4. BIOASSAY STUDIES WITH REFERENCE TO INDUSTRIAL WASTES

From time to time samples of industrial wastes are received for toxicity studies. Bioassay experiments on these samples are being done using fish as the test animals. The work involves a detailed chemical analysis of the toxic elements such as Zinc, Lead, Cyanide and Arsenic. Therefore necessary standardisation for the estimation of these elements was undertaken colorimetrically in collaboration with the Chemistry Division.

5. ORGANISMS AS INDICATORS OF POLLUTION

Intensive collections of Rotifera, Oligochaeta and Protozoa from different localities (clean, medium polluted and heavily polluted water bodies round Nagpur) are being made periodically. The taxonomy and ecology of the different forms are being studied in great detail.

It has been possible as a result of water surveys to establish relation between fauna and pollution levels.

(a) Rotifera : The taxonomy and ecology of some of the Rotifera has been collected from different water bodies and the data has been recorded.

The studies on the dynamics of population of one species, viz., Bachionus angularis is being continued.

(b) Oligochaeta : All the oligochaetes collected so far from potable and foul waters (24 forms) have been identified.

The Tubificid worms inhabit specific localities and therefore a study of the bottom mud of these localities was undertaken to estimate the factors responsible for the presence of these worms.

Further work on the ecology of Tubificids is in progress.

(c) Protozoa : Since Protozoa are extremely important both because of their cyclic appearance in sewage purification plants and of the indication they give for water pollution, a detailed programme of work has been set out for the study of this group. Forms have been collected, cultured and identified.

(d) Gastrotricha : During routine collections, some 'Gastrotricha' were collected and have been identified. This group has not been studied earlier in India.

Work in connection with the taxonomy and ecology of Chironomid larvae is in progress. The life history of one of the species has been completed.

BOMBAY ZONAL CENTRE

Water Treatment

Water Resources of Bombay

The investigation into the method of treating waters that are supplied to Bombay from Vehar, Vaitarna and Tansa Lakes and attempts directed towards location of trouble both at the treatment plants as well as at the consumers' end, have been continued at the centre, during the year under review. This work is being done in collaboration with the Hydraulic Engineer's Department of the Bombay Municipal Corporation.

Micro-strainer and an Up-flow Filter

In the case of Vehar lake, microstraining which has been tried on (1mgd pilot plant) pilot plant scale proved to be quite a successful method of removing algae but has not been a workable proposition due to periodic clogging of the strainer's mesh. Alternatively, filtration with or without the use of coagulants using an up-flow type of filter bed has been under observation. Algae removal has been of the same order in both these processes. However, the percentage removal of turbidity was higher in case of up-flow filter bed. Though the ultimate turbidity was usually within the permissible limits, it was hoped that through certain modifications in the filtered bed, further reduction could be achieved. In this direction, the depth of the up-flow filter media was increased from 21" to 40". The results obtained were favourable. On further experimentation, it was observed that with the gradings of quartz sand as under :

2½" – 1½"	9½"	depth
1½" – ¾"	5½"	"
¾" – ½"	7"	"
½" – ¼"	3"	"
1¼" – 10 mesh	4"	"
10 mesh – 20 mesh	31"	"

and with a filtration rate of 200 gall/sq.ft./hr and alum dose of $\frac{1}{8}$ grain/gallon only, turbidities of filtered water were of the order of 1 to 2 ppm.

Hydraulic Engineer expressed some doubts about the "after precipitation" of floc in the distribution system. Towards this, experiments were conducted with different rates of filtration varying from 100 to 200 gall/sq.ft./hr and doses of alum from 0.13 to 2.4 gms/gallon to find out extent to which the gravel was responsible for the floc formation so as to arrive at the optimum conditions. The rates of flow and the corresponding doses of alum for floc formation were as under :

Rate of Flow gall/sq.ft./hour	Alum Dose grains/gall.
100	2.4
150	1.6
200	1.2
250	1.9

Bi-flow Filter

The bi-flow filter, constructed by the Bombay Municipal Corporation was put into commission on the 4th April, 1962. Initially, some difficulty was experienced due to clogging of the embedded filtrate collectors. The filtrate collectors seemed also to create undue resistence to the up-flow of water during back-washing operations. It was proposed to replace the terylene cloth, mounted on the collecting pipes of the filtered water system should be replaced by stainless steel mesh. Meanwhile, the filter was used as a shallow up-flow filter without any coagulants. The turbidity of the filtrate was often less than 5 ppm. Long filter runs were achieved of more than 100 hrs. The loss of head was also remarkably low being less than 1' as against a maximum of 5' to 6', in the case of the other reverse flow unit.

The filtrability index tests carried out and algal counts taken on the bi-flow filter indicated that the

filtrate was of high standard.

Besides, data was collected on the pilot water treatment unit at Powai and some arrangements in connection with the Evaporation Control project at Vehar and Tulsi were made.

The Municipal Corporation was advised on some doubts raised over biological infestation of the supporting media of the up-flow filter plant and plans were prepared for 20 mgd Vehar Plant on the up-flow principle.

Cyclops :

A study about the presence of cyclops in the raw water of the Vehar lake was made. These organisms, though harmless by themselves, have got to be eliminated because they can act as hosts to Guniea-worms. The study consisted of finding out the concentration of such organisms before and after chlorination. Except in a few cases, the cyclops were found not to survive the normal doses of chlorination administered for disinfecting the water. The killed cyclops readily settle down owing to their comparatively large size. Some tests for determing their settling velocities have also been carried out and some more are proposed to be performed for confirmation.

Water Distribution:

In view of the fact that large sums of money are being spent in our country in laying distribution pipe-lines both in new developments and for over-hauling the existing system and the fact that these lay-outs are based mostly on the judgment of individuals, the centre has undertaken to demonstrate the availability of modern methods of analysis in tackling such problems scientifically. The network of Dongri Zone of Bombay was selected for this purpose of studying the distribution system with the use of an electronic digital computor belonging to the Tata Institute of Fundamental Research. A countour survey of the district, under study, was made by the Hydraulic Engineer's Department and the optimum drops

in pressure from point to point in the system were worked out. Side by side, using the available data of pitometer gaugings, the load distribution in the zone was worked out in each junction assuming that the load was proportional to the area governed and tentative values of discharge were worked out on the basis and handed over to Tata Institute of Fundamental Research for further processing.

Data was also collected on the actual pipe net work of the Dongri Zone. For this purpose, pitometer surveys were carried out by the Municipality in collaboration with the centre to determine the coefficiency of friction in the case of some typical pipes and the ages of remaining pipes were found out from the records of the Municipality. Equivalent lengths were worked out reducing the system to a network of pipes having a uniform diameter of 8" and a friction coefficient of 100 in the Hazen-William Formula, to be in confirmity with the computer programme. Some successfully runs were made on the TIFR computor. Further analysis work is in progress.

Sewage Treatment

Colaba Sewage Treatment Plant

A detailed study of the new 1½ mgd Sewage Treatment Plant, installed by the Bombay Municipal Corporation at Afghan Church, Colaba, has been carried out. This sewage treatment plant is of activated sludge type and is provided with good facilities for sampling and other investigations. The plant was put into commission on 5th June, 1962.

Important items of chemical analysis, showing the performance of the Colaba Sewage Treatment Plant for the period June 1962 - March 1963 are given below :

COLABA SEWAGE TREATMENT PLANT

(Monthly Average Value)

(Results in ppm)

Month	Quantity treated MGD	B.O.D.			C.O.D.			Suspended solids		
		Raw sewage ppm	% reduction in settled sewage	Overall % reduction in final effluent	Raw sewage ppm	% reduction in settled sewage	Overall % reduction in final effluent	Raw sewage ppm	% reduction in settled sewage	% Overall reduction in final effluent
June 1962	0.736	–	–	–	66.49	38.3	72.4	–	–	–
July "	0.76	362.6	49.28	83.08	33.57	37	69.63	379.8	43.39	78.43
August "	1.05	224.3	40.7	87.8	39	34.25	79.95	303	76.0	82.1
Sept. "	1.11	206.2	46.85	89.23	42	43.38	80.28	306.8	54.0	84
October "	1.13	294.8	46.3	82.3	68.4	40.9	65.4	285.2	44.1	77.9
Nov. "	0.87	223.78	44.14	87.02	71.35	37.99	65.60	411.46	38.49	73.26
Dec. "	0.6	229.37	48.8	95.2	63.4*	38.1	66.3	360	54.7	85.3
Jan. 1963	–	–	–	–	–	–	–	–	–	–
Feb. "	1.07	190.7	43.3	95.9	62.2*	33.1	60.6	229.7	43.7	68.9
March "	1.07	223	43.0	90.0	65.0*	33.8	68.0	250	52	79.2

* 4 hrs. oxygen absorbed with $KMnO_4$

Chloride Tests :

Chloride tests were performed at the Colaba Sewage Treatment Plant with two-fold objectives (1) to determine whether there is significant difference between the chloride content of sewage at the Afghan Church Pumping Station and the sewage as it enters the treatment plant and (2) to find out the detention period which the raw sewage receives in the plant, taking advantage of the chloride which are believed to enter the plant from the sea during high tide periods. The sampling points were sump of the Afghan Church Pumping Station, raw sewage as it enters the Colaba Sewage Treatment plant and final effluent of the plant. The investigation showed that (i) there is no infiltration of sea water between the sump of the Afghan Church Pumping Station and inlet of the Colaba sewage treatment plant (ii) the detention period for bulk of the sewage varied from 4 to 8 hours while the theoretical detention period was 15½ hours.

Salt Test :

Salt test was carried out at the Colaba sewage treatment plant on 20.9.1962 with a view to determine the actual detention period in the primary clarifier and to see whether there is an even distribution of sewage as it spread out from the centre of the tank to the periphery.

One hundred kilograms of crude variety of sodium chloride was dissolved in 250 litres of water. The chloride value of the solution was 150,000 ppm. The solution was then introduced into the bifurcation chamber feeding the primary settling tank.

Six sampling points were marked along the periphery of the tank for sampling of the effluent and are at the inlet to keep a record of background chlorides of the incoming sewage. It was seen that a substantial quantity of sewage receives a detention period of only 50 minutes and sewage spread out evenly from the bottom centre to the periphery.

Experimental Pond at Colaba :

A small experimental pond of size 14.2' x 14.2' x 3.75' volume 756 cuft and approximate capacity 5,000 gallons was set up at Colaba on 8.5.62 to determine the yield of algae for different dilutions of sewage fed into it. It was found that the pond has a standing crop of approximately 2 lb. of dry algae after six days.

Sludge Digestion Tank :

A sludge digestion tank was put into commission on the 27th August, 1962. It has a capacity of 30,000 cu.ft. or approximately 2 lakh gallons. About 10,000 gallons of raw sludge are being pumped daily from the primary settling tank to the digestion tank where they receive a detention period of 20 days. The gas generated is only about 7000 cu.ft. daily although the quantity is gradually increasing as the digestion tank attains maturity.

The study of sludge digestion commenced in the last week of November, 1962. The moisture content of raw sludge was found to be between 97 and 98% and its volatile matter on dry basis varied from 27 to 46%. This must be due to infiltration of sea water. Otherwise, under normal conditions the moisture should be about 95% and volatile matter on dry basis about 60 per cent.

The quantity of raw sludge fed into the digestion tank was 10,000 gallons per day and the gas generated varied from 3,000 to 4,000 cu.ft. per day. The low gas production was perhaps partly due to accumulation of digested sludge in the tank.

The gas analysis indicated 33.5% carbon dioxide, 0.25% oxygen and remaining 66.25% mainly methane with small quantities of Nitrogen and Hydrogen Sulphide.

Sludge volume index test has been carried out on the mixed liquor as well as the return sludge. The range

of the former was 7.58 - 89.99 and that of the latter 24-150. This fluctuation was due to the throttling of return sludge pump to obtain a thicker sludge and also to the variation in the quantity fed to the aeration units.

Biological study has shown that both the return sludge and the mixed liquor have stalked cilicates and rotifers. Free swimming cilicates are relatively few.

Lovegrove Sewage Treatment Plant :

Approximately 100 million gallons of sewage come to this plant daily. The facilities for treatment include two primary clarifiers and each of them is designed for 15 mgd.

Khar Sewage Treatment Plant :

The plant consists of only one primary settling tank of capacity 2 mgd was put into operation in 1955. There are four pumps at Khar with a total capacity of 8 mgd. At present, however, the sewage is being treated from the Jai Bharat Pumping Station, Bandra, having two pumps of capacity of 0.86 mgd. each. On an average only about 1.5 mgd are being taken to the plant.

Versova Sewage Treatment Plant :

Here again the plant consists of one primary settling tank of capacity 2 mgd put into commission in 1959. There are two pumps with the capacities of 2.2 mgd and 2.16 mgd.

Ghatkopar Sewage Treatment Plant :

This is also a 2 mgd primary clarifier, put into commission in 1957. There are five pumps of the capacities 3 mgd, 2-5 mgd (2 Nos.) 1.5 mgd and 1.25 mgd. Normally, about 7 mgd come to the plants and is bypassed to the creek.

These sewage treatment plants have been studied as regards quality and quantity of sewage coming there and

their performance. The percentage reduction in BOD, COD and suspended solids has been observed in case of clarifier effluent, Khar, Duncan Stration clarifier effluent, Worli, and Dorr-Oliver Clarifier effluent, Worli.

H_2S Problem :

Most of the sewage treatment plants in Bombay have been experiencing trouble owing to the evolution of H_2S gas in digestion process. In the case of Khar sewage treatment plant mild steel uplake pipe of the digestion tank had to be replaced being completely corroded. The sewage treatment plant at Versova and Ghatkopar had, in fact, to be put out of commission due to the evolution of H_2S gas.

Radio-Isotope Test :

Radio-isotope tests were carried out for checking the capacity of the pumps and the uniformity of flows in the primary settling tanks at Lovegrove.

Industrial Wastes

Samples were collected for analysis from M/s Noble Paints and Varnish Co. (P) Ltd., Bombay, Dharmasi Morarji Chemical Co., National Rayon and Amarnath Nala.

Studies on pollution in the Ulhas and Kalu water stretch were carried out in collaboration with the Director of Public Health and the Deputy Director of Bombay Division.

The Director of Fisheries has been collaborated with, in the problem of Ulhas and Kalu water stretch, the main aspects being one of determining whether the pollutants are harmful to Hilsa and other fish in the Bessein Creek. Emphasis, therefore, was laid more on the Bio-assay aspect of pollution in this case.

A bio-assay test was carried out to find out the toxicity of Dharmasi Morarji Chemical Co., Acid sludge on

copepods, which form an important fish food organisms. It was found that 50% mortality took place with 24 hrs. in a dilution, containing 80 ppm of the water.

In addition to above, the following factories were visited along with the District Health Officer, Thana to collect information regarding their waste disposal problems. (1) Boehringer Knoll Ltd., (Chlorephenicol Manufacturer), (II) Roche Products Ltd., and (III) Colour Chemicals Ltd.

BORIVILI FIELD UNIT

1. Study of Smokeless Chullahs

The study of smokeless chullahswas undertaken with a view to achieve better utilization of fuel and also to evaluate the performance of various arrangements. Two types of smokeless chullahs, one having 3-pot arrangements and the other having 2-pot arrangements were studied under controlled conditions and their efficiencies studied. Various tests were carried out to compare the efficiencies of open chullahs (single pot system) and smokeless chullahs. It was found that if the aim was to heat only a single pot, there was no marked difference in the smokeless chullahs except for the fact that smoke nuisance would be avoided. However, if two or more pots are to be heated, it would be evident that smokeless chullahs will be at a definite advantage. As it is very often necessary in practice to have more than one pot simultaneously on a cooking range, this advantage is of much importance. Comparisons were also made with kerosene oil stove and it was found that for a the monetary value of fuel, the smokeless chullans gave on an average more total heat than the stove, if the dying heat were taken into account. In the case of kerosene oil stove, the dying heat phase is totally absent. The observations made in the current comparative study of a double and triple pot system also indicate that more heat is obtainable from latter arrangement. This does not mean that the number of pots can be increased indefinitely. It is a matter of utilizing the heat in the fuel gas with an optimum draft. Carpentary wastes of more or less uniform type was used as fuel for the experiments.

2. Study of Disinfection of Drinking Water Wells

Disinfection of drinking water wells by dipping porous double cartridges containing bleaching powder in the inner cartridge (Zdrovko's methods) was tried on the wells around Borivili. The results were found to be encouraging. The study was continued further.

3. Comparative Study of M.F. and M.P.N. Techniques for the Bacteriological Analysis of Water

Comparative study of Membrane in technique and most probable number technique was undertaken to know the suitability of the above technique in case of treated and untreated waters. In all 200 water samples both treated and untreated (Tap and Well water) were examined by both techniques.

4. Study of Pilot Cowdung Gas Plant

Study of anaerobic dung digestion on pilot gas plant having digester capacity of 325 cu.ft. and gas-dome capacity of 150 cu.ft. was undertaken with a view to arrive at an optimum loading of volatile solids in lb/day/cu.foot. If digester capacity at which the gas plant works with a maximum efficiency with maximum of gas production qualitatively and quantitatively, the effluent obtained is of a high manurial value. The main experiments were performed in ten periodic experiments starting from a minimum loading of volatile solids and gradually increasing the same periodically. All the important parameters of digestions were studied. The study was continued further.

POONA FIELD UNIT

Treatment of Water

Holkar Bridge Water Works

This water works is fed with the mixture of water from Kalas bund and Mulshi water via Cantonment water works. There are some difficulties found inherent in treating the mixture, namely, poor coagulation and short filter runs- sudden drop in the initial filtration rates. Samples of raw water, clarified water and filtered water were analysed chemically, biologically and bacteriologically. Mulshi raw water was found to have turbidity less than 30 ppm while raw water from Kalas bund was having turbidity from 70 ppm to 160 ppm.

Hardness of raw water from Kalas bund was from 150 ppm to 200 ppm, while Mulshi water was having hardness between 130 ppm to 150 ppm.

Biological examination revealed that raw water from Kalas bund shows MELOSIRA (1470 organisms/ml) which is very high and proved to be the cause of short filter runs. Mulshi raw water was having lesser number than that of the raw water from Kalas bund. Planktons in settled water have also been found to be the major cause of short filter runs. Melosira, Naricula, Gamphonema were prominent organisms present in clarified water but the filtered water showed increase in the count of Gamphonema and Naricula.

It has been found that the water treated with a dose of alum (2 grains/gal) gave a better clarification and settlement.

River Pollution Survey of Mula

Arrangements have been made for the supply of water to Poona city by the authorities in collaboration with the Tata Hydro-Electric Co. to let out water from Mulshi dam into the Mula river and to collect at Aundh village.

Thirty five sampling points were selected between Aundh village and bund gardens and samples from these were examined chemically, biologically and bacteriologically to assess the quality of water.

(1) From the sampling point (discharge from Ammunition Factory) the river water gives medicinal smell at almost all the points upto Bund Garden.

(2) Due to the discharge of the waste from the three drains from High Explosives Factory which were having pH between 3 to 5 the river water 50' down stream from each drain showed pH values between 4 - 5.

(3) The wastes from second drain of High Explosives Factory and Raja Bahadur & Motilal Textile Mills showed high values of sulphates, BOD solids.

(4) Sewage outfall at Aundh Bridge showed high values of COD, BOD and Solids.

Bacteriological analysis revealed that the coliform count was higher at Aundh Bridge, while at the Ammunition Factory shows lowest count throughout the stretch of the river under examination.

Biological analysis revealed high Algal count at some of the sampling points where the count was upto 25000/ml. The Zoo-planktons were of moderate quality and varied types were found.

Disinfection of Well Waters

Studies on disinfection of well water with Cartridge system were made with few wells in the city. Coliform counts and residual chlorine were determined during the period in which this system works satisfactorily.

Industrial Waste.

High Explosives Factory

Treated and untreated waste samples were analysed. Treated sample was colourless and dissolved solids had gone down from 1120.0 ppm to 80.0 ppm after passing through exchange resins. Further work on the regeneration and re-use of resins is in progress.

Khopoli Paper Factory Wastes

Result of analysis of the samples showed that the paper waste contains high turbidity, suspended solids, COD and BOD.

Arlabs Factory Wastes

This factory manufactures different dyes and the waste is mainly a dye waste and the wastes are mainly acidic, pyridine, alkaline, etc. Total industrial waste is about 40,000 gpd. This waste meets the river Neera at a distance of about 200 meters. The work regarding the characterization of these wastes is being continued.

Comparative Study of MF and MPN Methods

Fifty five samples have been examined during the period under review by MF and MPN methods. 18 samples showed MPN coliform count more than MF count while 16 samples showed MF count more than that of MPN.

Fifty two colonies with metallic sheene and 52 purple colonies were further identified by IMViC and BGB tests. It has been found that all the 52 colonies with metallic sheene were of coliform group while only 12 out of 52 pupple colonies belonged to this group.

EVAPORATION CONTROL PROJECT AT LONAVLA

To step up the progress of work on this project and for a better assessment of the achievements periodically, it was decided to divide the work in the following three phases :

i) Developing technique for applying and maintaining monolayers efficiently and effectively and evaluating the coverage.

ii) Improving techniques for gauging flows and evaporation losses for preparing an accurate water budget.

iii) Assessing the effect of the application of monolayers on the quality of water.

Pan Coefficient :

A study was made to determine the Conversion Factor (Pan Coefficient) for estimating the actual evaporation taking place in the lake at Lonavla.

Cetyl Alcohol in Powder Form :

The possibility of using Cetyl Alcohol in powder form alone or alongwith emulsion to cover the lake from the film was explored. The film developed from the powder indicated good pressures (mostly 40 dynes) but the film remained for a short time only. Besides, larger quantity of the powder was required than when used in the emulsion form.

Various techniques of spraying the Cetyl Alcohol were tried to chose the best for the project at hand .

In this connection a symposium on "Evaporation Control" was held at the National Chemical Laboratory from 17th to 20th December, 1962, where some of the delegates explained the advantages of using Cetyl Alcohol in powder form instead of in emulsion form.

Current Meters :

Current Meters were employed for measuring the discharge through the duct line emanating from Walwhan Dam. This study was conducted for comparing the actual discharges as registered by current meters against the Tata's record based on gate openings and the energy produced down at Khapoli Power House. This was expected to help making a precise water budget for the lake.

Level Recorders :

Two Level Recorders were also installed. The purpose of these level recorders was to record the fluctuations in the level of the duct line round-the-clock. From these recorders, the energy level of the flow in the duct line could be obtained which would be useful in calculating the velocity of the flow in the duct line. Besides, this would serve as an independent check on the functioning of the current meters.

Anemometers and Sunshine Recorder :

Three anemometers were installed; one by the side of the wind vane, another attached with the dispensing unit on the floating raft at the centre of the lake and third near the evaporation pans. These three anemometers spaced widely apart gave useful data on wind velocities and its patterns.

One sunshine Recorder was fixed on the duct line to record the number of hours in a day for which sunshine was available to the water surface.

DELHI ZONAL CENTRE

WATER TREATMENT

Efficiency of CPHERI Clariflocculator :

Samples of raw water and of the effluents from the CPHERI Experimental clariflocculator, which is subjected to treatment with varying dosages of various coagulants, were collected and analysed for the determination of coliform densities. Similar tests were conducted on the effluents of Paterson and Dorr's Oliver clariflocculator to obtain comparative data for assessment of efficiencies of these clariflocculators with reference to reduction in coliform density. Samples of raw water and effluents from these clariflocculators were also collected for the determination of no. of algae per litre towards a comparative study of algal densities.

The rectangular and circular units of the CPHERI clariflocculator have been tried at different flow rates, velocity gradients, doses etc. to observe their effects on removal of turbidity. Comparative tests were also made on Patterson's and Dorr's Oliver's clariflocculators.

Nirmali seed extract as a coagulant:

An extensive series of jar tests were carried out to investigate the characteristics of Nirmali seed extract as a coagulant.

The extract was prepared by first grinding the seed and then boiling in water for one hour. The extract was preserved by the addition of 1 m.l.

of conc. sulphuric Acid.

The effects of two following variables on coagulation and flocculation were studied: (i) R.P.M. (ii) Dosage of coagulant (iii) Flocculation time (iv) Settling time and (v) Raw water turbidity.

R.P.M. : It was observed that flocs were larger in size at 60 than at 80 and 100 RPM. However removal of clay turbidity was more effective at the latter RPMs. The residual turbidity of settled water was less at 80 and 100 than at 60 rpm.

Dosage : The polyelectrolyte was used in dosages of 0.5 to 2 mg/l for clarifying raw water containing 300-1300 mg/l turbidity. Increase in dosage was found to decrease residual turbidity of the settled water. However, when certain limit of dosage (depending upon the size and proportion of the suspended particles in raw water) was exceeded, coagulation was reversed and there was short increase in the final turbidity.

Flocculation time : Increase in flocculation time was found to improve floc-formation and the quality of the settled water. The optimum reaction time was found to be 15 minutes at 80 rpms.

Settling time : Flocs formed in the breakers rapidly settled down. The removal of floc was found to be maximum in the first minute and settlement was practically complete in 5 minutes.

Raw-water turbidity : The extract worked effectively as a coagulant when the turbidity of raw water exceeded 300 mg/l.

Clearing Nuts as a Coagulant :

The extract of clearing nuts was prepared by blending the crushed seed with water in a food blendor. The variables used in the jar tests were : (i) Dose (ii) rpm (iii) Flocculation time (iv) Settling time and (v) pH. The effect of common interfering bodies like sodium pyrophosphate and tannin on coagulation by alum and the polyelectrolyte was evaluated.

Investigation was also carried out on the effectiveness of the extract of deionized water as well as in water of varying mineral concentration. A suspension of kaolin, stabilized by the addition of pyrophosphate was used for this work. In some experiments the poly lectrolyte was successfully used as a coagulant adjunct to alum.

Copper as a co-agulant :

The characteristics of copper as a coagulant were studied both by jar tests and on the pilot plant. The material was used singly as well as in combination with soda. Raw water was given a dose of 10-30 mg/l of copperas and was flocculated in the laboratory for 10 min. Flocs were poorly formed in the above range of dose. The turbidity of raw water was reduced from 50 ppm to 30 ppm after clarification. Similar results were obtained when copperas was tried in the plant in place of alum. Addition of soda did not improve floc formation or clarity of the effluent.

Adjustment of pH in alum coagulation :

The effect of pH on coagulation of raw water by alum was studied and it was observed that adjustment of pH in the range 6-10 did not improve the efficiency of alum coagulation.

Application of new methods for water analysis :

In the last few years several methods have been developed for the estimation of cationic and anionic constituents in water using ion-exchange and spectrophotometry. The methods that have been adopted in the laboratory are listed below:

(i) Nitrate : by spectrophotometric determination of the yellow colour formed with brucine.

(ii) Nitrate : by ultra-violet spectrophotometry.

(iii) Sulphate : by titration with barium chloride with thorin as an internal indicator.

(iv) Phosphate : by photocolorimetric determination of the yellow colour formed with ammonium vanadomolybdate.

(v) Copper : by spectrophotometric determination of the violet colour formed with oxalylhydrazide - acetaldehyde.

(vi) Ammonium : by spectrophotometric determination of the blue colour formed with phenol and sodium hypobromite.

(vii) Chromium : by ultraviolet spectrophotometry.

Estimation of sulphate ion in water :-

Three rapid methods for the determination of sulphate ion in surface or well waters are being studied. They are : (i) $BaSO_4$ turbidimetric methods; estimation of turbidity at 380 m.u. (ii) Titration

with barium chloride using thorin as indicator.

(iii) Ion-exchange using Zeo Karb 225 as the cation-exchanger.

Estimation of Hexa-valent Chromium in water :-

An ultra-violet spectrophotometric method is being investigated for the determination of hexa-valent chromium in water and waste water. The interference of chloride, sulphate, phosphate, fluoride, nitrate, perchlorate, carbonate iron, copper, nickel, lead, and cadmium ions in the determination have been evaluated.

Survey of well waters in the Union Territory of Delhi :

A survey was undertaken to assess the nature and quality of water of the wells in the Union Territory of Delhi. The rural area of the territory was divided into 5 C.D. Blocks and it was decided to cover 20 wells from each of the blocks. Each sample was subjected to chemical, bacteriological and biological analysis.

Chemical analysis comprised tests of phenolphthalein and total alkalinity, total carbonate, non-carbonate, calcium and magnesium hardness, chlorides, sulphates, nitrates, nitrites, iron and fluorides. In bacteriological analysis, MPN of coliform was determined. Since, in quite a large number of cases, the coliform count was observed to be high, these were analysed for Enterococci also. Towards biological analysis, qualitative and quantitative study of the plankton in the wells was made.

Apart from this, samples from 20 selected wells were collected fortnightly and chemical and

bacteriological analysis was carried out to study seasonal variation in the quality of well water.

Distribution of coliform organism in faeces :

Strains of coliform organisms were isolated from various samples of faeces. Each strain after incubation and culture in lactose broth and in brilliant green bile lactose broth and plating on EMB Agar was subjected to IMViC tests. Based on these results, the types of strains of coliforms recovered from each sample of faeces were recorded.

INDUSTRIAL WASTES

Survey of Nazafgarh Nallah :

The survey has been undertaken to study the physico-chemical characteristics of waste water flowing in the nallah and to determine the extent of pollution, contributed by Industrial wastes.

Fish were reported to die in the nallah every year. Mortality has been mostly sudden and severe. The aim of the survey was to assess toxicological character of the wastes and quality of the receiving water upstream and down-stream at the point of confluence of River Jamuna and Nallah.

There are three important factories which discharge their effluents directly into the nallah, apart from other small scale industries. There are : (i) Textiles (M/s. Swatantra Bharat Textile Mills, New Delhi) (ii) Manufacturers of Caustic Soda, Chloride, Super-Phosphate, Aluminium Sulphate, Hydrogenated oil etc., (M/s. D.C.M. Chemical Works, New Delhi) and (iii) Insecticides (M/s. Hindustan Insecticides Ltd., New Delhi).

Apart from the discharges from these factories, the Nallah further receives sullage from a number of drains amongst which Motinagar, Bharat Nagar and Kingsway camp drains contribute the maximum.

Considerable information has been collected on the quality of wastes from the three factories :

DDT Factory : The factory manufactured 1-1½ ton of techbical DDT per day. The volume of waste water discharged is about 1,00,000 gpd.

The most objectionable feature of the waste was found to be its content of mineral acids which was observed to be between 2000-148000 ppm as CaCO3. The waste carried considerable amount of organics as would be evidenced from COD (dichromate) fluctuating between 2,000-5,000 ppm. The B.O.D. of the effluent was quite low (200-300 ppm). Traces of chromium and DDT present interfered with the BOD. Bacteriological examination amply proved the sterile nature of the waste.

The waste varied considerably in its composition particularly in reference to its acidic contents. The suspended matter was very low. The iron content varied from 20-80 ppm.

CM Chemical Works :

The factory discharges about 3-4 lakh gallons of waste water per day. The waste was a slurry of greyish white suspended matter (waste from acid digestion of bauxite) and occassionally had a yellow-brown colour. The pH varied in the range 2-10.

The effluent was found to be highly saline (chloride 2000-6000 mg/l). It contained considerable

amount of chloride and sulphate. Iron was present in appreciable amount. The maximum concentration of the metal encountered was 1400 mg/l. The BOD was conspicuously less. The di-chromate COD fluctuated in a too wide range (from nil to 4000 mg/l.)

The waste water carried a large amount of settleable and suspended matter, the percentage of settleable solids sometimes constituting 20% of the waste.

Ammonia was detected in the waste. In one sample it was present in a concentration of 2.5 mg/l (as N).

Swatantra Bharat Mill :

The mill processes coarse textile and discharges one lakh gallons of waste per day. The pH was mostly on alkaline side in the range of 6 to 11. The alkalinity varied from 300-885 mg/l. The effluent was moderately saline. The dichromate COD was in the range of 300-1600 mg/l and BOD varied between 150-900. The concentration of suspended solids in the waste was considerable and the dye and suspended organic matter carried in the effluent were found to be absorbed in activated carbon.

Pearle Cycle Factory :

The factory discharges about 15,000 to 20,000 gallons of waste water per day. The waste is disposed into sewers. The major proportion of the effluent originates from the rinse water from the plating mill of the Factory. The effluent contain chromium, nickel and cynide organic matter

is also present in the waste from the degreasing of metal parts. The water from the tubewell located inside the factory was also analysed. It was found to be very hard, saline and highly contaminated with chromium (1.5 mg/l Cr)

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OKHLA SUB-CENTRE OF DELHI ZONAL CENTRE OF CPHERI

Pilot-Plant Studies on Oxidation Ponds

The experimental oxidation pond units were operated at increased B.O.D. loading of 138.8 lb/day/acre for 15 days and of 206.5 lb/day/acre for 10 days, both in April, 1962. It has been found that as the loading is increased the pond efficiency is reduced, under the same conditions of light intensity, temperature detention time etc. The following organisms were identified during the period :

(i) Chlorella, the dominant alga; (ii) Euglena; (iii) Scene-desmus; (iv) Pandorina; (v) Chlamydomanas; (vi) Chlorogonium (vii) Ankistrodesmus (viii) Oscillatoria (ix) Spirulina; (x) Navicula. Ciliates were present in large numbers in the first unit.

During the month of May, 1962 the experimental ponds were operated at a B.O.D. loading ranging from 85 to 145 lbs/acre/day and the detention period was maintained at 2 to 3.7 days. A maximum B.O.D. reduction of 88.8 % was obtained with a BOD loading of 123 lb/acre/ day.

The weather during the first fortnight was generally cooler than it is normally, while the temperature rose high during the latter half of the month.

The photosynthetic oxygenation was very high during the entire month and the maximum number of algal species have been identified in all the three units of the experimental pond.

The highest dissolved oxygen observed in all the three ponds between 2 and 4 P.M. as follows:-

	Pond A	Pond B	Pond C
D.O.	35.1	34.8	30.0

The following organisms were identified - (a) Chlorella (b) Euglena (c) Phacus (d) Eudorina (e) Pandorina (f) Coelastrum (g) Pyrobotrys-spondylomorum (h) Chlamydomonas (i) Scenedesmus (j) Oscillatoria (k) Chlorogonium (l) Microcystis (m) Nitzschia (n) Ciliates.

Chlorella was the most dominant alga during the month while chlamydomonas, Pandorina and Chlorogonium showed a tendency to increase occassionally.

West Delhi Sewage Treatment Plant :-

Although this plant is designed to treat 12 mgd by the Simplex Surface Aeration Activated Sludge Process employing the High Intensity Mechanical Aeration, the plant is considerably underloaded.

When the plant has received only 108.97 million gallons, with an average daily flow of 3.63 mgd. and an average BOD of 135 mg/l , the BOD reduction was of the order of 94.5 per cent.

Okhla Sewage Treatment Plant :-

Five sets of samples from various stages of treatment of the plant have been examined for B.O.D. to compare the efficiency of activated sludge plant and the biofiltration plant.

Sewage Stabilization Pond at the B.V. Rural Institute, Bichpuri, Agra

A study was undertaken to evaluate the performance of the sewage stabilization process. The stabilization process was normal. The scum trouble had been reduced and the formation of sludge blankets observed during the winter months was absent. The sewage in the pond showed an oxygen content of 16.8 ppm and the effluent flowing through the channel at the distance of about 100 metres had an oxygen content of 6.8 ppm.

In the month of May 1962 the efficiency of the pond has been found to be very high and algal growth was good.

The following organisms were identified : (i) Chlorella; (ii) Chlamydomonas; (iii) Ankistrodesmus; (iv) Microactinium; (v) Euglena; (vi) Diatoms mostly Nitzschia and (vii) Rotifers. The BOD of the pond effluent unfiltered was 31 ppm.

The possibilities of constructing one pilot-plant oxidation pond on behalf of the Institute, in the vicinity of the sewage pumping station of Agra Municipal Corporation were explored alongwith the Executive Engineer, Public Health, U.S.G.E.D., Agra and the Engineers in charge of the sewage pumping station. They agreed to construct one small stabilization pond of 160' x 100'

Samples were collected from (i) Treatment Plant, Okhla; (ii) Treated sewage channel flowing towards Agra Channel; and (iii) Oxidation pond at Bichipuri, to study the performance of (i) and (iii) and the self purification in the channel.

ROHTAK FIELD UNIT

Rohtak Water Works which purifies about 20 mgd of water is fed with raw water from West Jamuna Canal. The raw water is then purified in the Geomillers' Purification Plant designed for a capacity of 1.8 mgd. About 0.2 mgd. are purified in the Pilot Plant. The sampling points of the Pilot Plant are : (i) Raw Water (before alum mixing);(ii) Clarifier No. 1; (iii) Clarifier No.2 and (iv) Filtered water.

The sampling points of the Geomiller's Plant are : (i) Raw water; (ii) Clarifier No.1; (iii) Clarifier No.2; (iv) Filtered; and (v) Chlorinated.

Samples are being examined for turbidity, alkalinity, pH value, chlorides, total hardness etc. to test the efficiency of the plants.

Bacteriological Analysis :

The samples collected from the above plants are also analysed bacteriologically to determine MPN/100 m.l. with lactose broth.

Samples received from various places of Punjab collected from wells, Tube-wells and other water supply sources :

Samples were examined for turbidity, alkalinity, sulphates, nitrates, fluorides, iron, pH value, chlorides, C.O.D. and B.O.D.

Samples received from Government Girl's Higher Secondary School, Rohana (Rohtak) was found to have high values of nitrates, total solids, chlorides, sulphates, total hardness etc., exceeding the permissible limits of drinking water supply.

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WATER SUPPLY

R.R.L. Water Supply Scheme :- The water treatment plant at Regional Research Laboratory to which raw water is delivered at the rate of one lakh gallons per day, has been put into commission and a regular programme of collecting and maintaining physical, chemical, bacteriological and microscopical analysis of water after different stages of treatment has been undertaken. The hydraulic performance of the various units also has been observed for further improvements. Preliminary tests indicated that the plant performance from point of view of bacteriological quality was not satisfactory. Detailed investigations were carried out to locate the cause of the unsatisfactory condition. Studies have been initiated on the following :-

(a) The use of various types of coagulants.

(b) The performance of the clariflocculator with different velocity gradients,

and (c) The use of different types of filtering media.

Experiments have been planned on the following aspects of Hydraulics of Rapid Sand Filters, namely-

(1) Study of loss of Head through Filter Bottom.

(2) Studies on the High Rate Back Washing.

(3) Studies on the Optimum Depth of the Supporting Media.

(4) Studies on the Under-drainage System of the Rapid Sand Filters.

(5) Studies on the Rate of Filtration vs. Clogging.

VIJAYAWADA WATER SUPPLY

As desired by the State Public Health Engineering Department, samples of the raw water from Krishna River near Vijayawada are being analysed to maintain a complete record of the variations in the characteristics of the water throughout the year. This data would be helpful in designing a suitable treatment plant for water supply to Vijayawada town. The work is in progress.

Analysis of the ground water, Vijayawada.

The Public Health Engineering Department are exploring the possibility of augmentation of water supply in the town by sinking more tube wells. Samples received from the State Authorities have been examined for physical, chemical and bacteriological characteristics.

Studies on the Short-circuiting and Basis Stability of Sedimentation Tanks have been undertaken and the work is in progress.

The problem of removal of coal dust from water, collected from the Singareni Collieries area in Andhra Pradesh has been undertaken at the request of the Superintending Engineer, Public Health.

SEWAGE TREATMENT.

Execution of the following pilot plants are under progress :

(1) Combined Unit for Primary Treatment of Sewage

(2) High-rate Activated Sludge.

(3) High-rate Digestion.

Hyderabad Sewage Treatment Works :

Studies have been undertaken to evaluate the performance of the existing sewage treatment works at Amberpet.

Data have been collected with a view to improve the efficiency of the treatment plant and suggesting a more suitable method for the disposal of sludge.

Sewage Treatment Plant for R.R.L. Staff Quarters :

Work regarding the selection of a suitable site for the treatment works, mode of conveyance of sewage and the disposal of final effluents has been undertaken.

Oxidation Pond for Tirupathi

It has been proposed to construct an Oxidation pond of size 30'x100' for conducting research and to arrive at the correct design criteria under local conditions. Such a pond was intended to serve as a demonstration plant for the State Public Health Engineers.

In response to this, one experimental Oxidation Pond of size 90'x20' (bottom) has been constructed at Amberpet with the cooperation of the state authorities who have also agreed to give necessary in-let and out-let connections.

NATIONAL INVENTORY

Data on 16 water supply schemes have been collected this bringing the total to nearly 55, and forwarded to Head Office.

INDUSTRIAL WASTES.

The problem of treatment and disposal of Industrial effluents from Sirpur Kagaznagar factory has been referred to this centre by the Director of Medical Services, Andhra Pradesh. Towards this, preliminary data on the capacity of the Paper Mill, Quality of water used, amount of liquid wastes available, the present method of treatment and difficulties etc. have been collected. In addition similar data is being collected in case of the Synthetic Rayon Factory which also produces considerable amount of liquid wastes. A comprehensive scheme based on this combined data would serve useful purpose in handling the waste disposal problem of Kagaznagar Factory Area.

Pilot Plant at Central Leather Research Institute, MADRAS :

A pilot plant for treating 2,500 gallons per day of tannery wastes has been designed by this centre, based on the Laboratory findings furnished by the CLRI, Madras.

Gangapur Sugar Factory (Aurangabad) :

Preliminary experiments to study the wastes disposal problems are being initiated.

Milk Wastes :- Detailed design drawings for the milk waste treatment plant are in progress.

Synthetic Drug Wastes :- Experiments are being conducted regarding the use of algae in the treatment of these wastes. Fish toxicity experiments on these wastes are also in progress.

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AHMEDABAD FIELD CENTRE

During the period under report, investigations on the following aspects have been carried out at the Centre. (a) Water Supply, (b) Stream Sanitation and (c) Sewage Disposal.

Over 3000 samples have been analysed chemically, biologically and bacteriologically.

Description :-

(a) Water Supply :

(i) Dudeshwar Water Works.

(ii) Odour Control and Fish Mortality in Kankaria Lake.

(iii) Stray Samples

(b) Stream Sanitation :

(i) River Sabarmati Survey.

(c) Sewage Disposal :-

(i) Raw Sewage from pumping stations & carriers

(ii) Solar drying beds.

(iii) Kakkad's Oxidation Ponds.

(iv) Single Unit Oxidation Pond (Pilot Plant)

(v) Multiple unit Oxidation Ponds at Pirana Sewage farm using domestic sewage admixed with Textile Mill Wastes.

(vi) Multiple unit Oxidation Ponds fed with purely domestic sewage at the Vasana Sewage Farm.

(d) Industrial Wastes :

WATER SUPPLY

Dudeshwar Water Works :

The flocculation studies at Dudeshwar Water Works showed that when the speed of paddle is 65 r.p.m. and alum dose is 60 mg./l, the best type

of floc was obtained. The water used for the experiment had the following characteristics.

Temperature	..	25-25.5°C
Turbidity	..	23-25 ppm
Phenolphthalene Alkalinity	..	15-20 ppm
Methyl Orange Alkalinity	..	330-350 ppm
Chloride	..	80 ppm
Oxygen consumed 4 hrs. (Tidys)	..	0.42-0.50 ppm.

STREAM SANITATION

River Sabarmati Survey :

A survey has been undertaken regarding stream sanitation of River Sabarmati. The Important results with respect to D.O., percentage saturation, chlorides, oxygen absorbed of the samples, has been obtained for each of the eight sampling stations covering a total distance of 15 k.m.

The stability test for the samples from River Sabarmati was also carried out and it was found that the last point of survey (one furlong below the entrance to the Sewage farm), the colour of the dye disappeared within 2 to 3 hours, which clearly indicates that the unstabilized sewage was being let in.

SEWAGE DISPOSAL

Raw sewage from pumping stations and carriers :

Studies on the Biochemistry of Flowing Sewage both in the old and new sewage farms have been carried out. A total of 98 samples were collected

before and after each of the three falls for examination during April 1 and May, 1962. The variation in the values of the BOD (5 day - 20oC) and oxygen absorbed from Potassium permanganate at the beginning of and end of the carrier was observed.

In Biological investigation, the dominant algae were found to be chlorella sp, Arthrospira sp, Oscillatoria sp., Chlorella pyrenoidosa, Arthrospira jenneri, Oscillatoria formosa etc.

Solar Drying Beds :

Sixty samples from solar drying beds were examined and the following are the results of analysis :

	Max.	Min.
B.O.D. (5 days - 20°C)	345	10
Dissolved Oxygen (ppm)	23.1	Nil
% Saturation.	316.9	44.5

Stabilization of Sewage in Kakkad's Series of Six Ponds :

Samples have been collected from Kakkad's Oxidation Ponds for Chemical, Bacteriological and Biological Analysis. The average reduction in BOD, DO, % Saturation and Oxygen absorbed are given as follows :-

CHEMICAL ANALYSIS

	Influent to the first pond	Effluent from the last pond	% Reduction
BOD (5 days at 20oC)..	271.5	70	74.2
D.O. (ppm)	Nil	2.5	Increase
% Saturation	Nil	42.3	Increase
Oxygen absorbed (Tidy's)	57.5	32.2	44

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There is an average reduction of 74.2 per cent in B.O.D. and 44 percent in Oxygen absorbed.

BIOLOGICAL ANALYSIS

The dominant algal organisms observed were chlorella sp, Merismopedia sp., Ankistrodesmus sp., and Euglena sp.

Single Unit Oxidation Pond (Pilot Plant) :

Nearly 1800 samples were collected from the Pilot Plant Oxidation Pond. Samples were drawn from the surface, middle and the botton at 250 ft.; 500 ft.; 750 ft., from the inlet and the final effluent. Samples were examined chemically, biologically and bacteriologically.

A summary of the average values at different points for the samples for the important chemical conditions are as follows :-

CHEMICAL ANALYSIS

	Inlet to the Pond	Final Effluent from the pond	Percentage Reduction
BOD (5 day at 20°C)	202.0	86.1	57.4
D.O. (ppm)	nil	4.4	Increase
% Saturation	nil	72.84	Increase
Oxygen absorbed (Tidy's 4 hrs.test)	58.0	34.5	41.4

There is an average reduction of 57.4 percent in B.O.D. and 41.4 per cent in the Oxygen absorbed.

BIOLOGICAL ANALYSIS

The dominant algal organism were found to be Chlorella pyrenoidosa, Chlorococcum sp., Pandorina sp., Ankistrodesmus sp., Arthrospira sp., Oscillatoria sp.

Multiple Unit Oxidation Ponds at the Pirana Sewage Farm :

Eight ponds were working in series with the mixed sewage (domestic and textile mill wastes) at the Pirana Sewage Farm. Samples were collected and examined for physico-chemical, biological and bacteriological conditions. The important results with respect to chemical and biological condition are given below :

CHEMICAL ANALYSIS

	Inlet to Pond I	Effluents from Last Pond.	Percentage reduction
BOD (5 days at 20°C)	196.3	72.5	63.2
Dissolved Oxygen.	nil	0.02	Increase
% Saturation.	nil	1.65	Increase
Oxygen absorbed	56.3	35.2	37.5

BIOLOGICAL ANALYSIS

The dominant algae were found to be Microcystis, Chlorococcum sp., Merismopedia tenuissima. The subdominant algae were Merismopedia sp., and Euglens sp.

Multiple Unit Oxidation Ponds at the Vasna Sewage Farm :

Eight ponds were working in series with the pure domestic sewage at the Vasna Sewage Farm. The important

important results with respect to chemical and biological analysis of the samples are given as follows :-

	Inlet to Pond I	Effluent from last pond	percentage Reduction.
Dissolved Oxygen	Nil	0.3	Increase
% Saturation	Nil	3.3	Increase
BOD (5 days at 20°C)..	141.6	109.1	22.7
Oxygen absorbed (Tidy's 4hrs.test)	47.4	34.4	27.6

There is an average reduction of 22.7 percent and 27.6 percent in BOD and Oxygen absorbed respectively.

There was practically no growth of algae in all the ponds. A few cells of Chlorella sp. Euglena sp., Merismopedia sp. were seen in some of the ponds only.

Studies on Anaerobid Ponds :

There are two types of anaerobic ponds,-one fed with a mixture of domestic sewage and industrial wastes (at Pirana), and the other fed with purely domestic sewage (Vasana).

The amount of purification effected in these two types of ponds is summarised as follows :-

Vasana Sewage Farm :

	Inlet	Outlet	Reduction
BOD (5 days at 30°C)	177.5	114.2	35.6
Dissolved Oxygen	Nil	Nil	Nil
% Saturation.	Nil	Nil	Nil
Oxygen absorbed. (Tidy's 4 hrs. test)	52.3	46.8	9.6

Pirana Sewage Farm :

	Inlet	Outlet	Reduction
BOD (5 days at 20°C)	182.3	89	51
Dissolved Oxygen.	Nil	Nil	Nil
% Saturation.	Nil	Nil	Nil
Oxygen absorbed. (Tidy's 4 hrs. test)	60.8	39.3	35

Industrial Wastes :

Wastes from the following Mills were analysed for B.O.D., Oxygen absorbed from $KMnO_4$ and solids (Total, Dissolved and Suspended).

(1) Paper Mill Wastes from Katol.

(2) Textile Mill Wastes from Kalol.

(3) Dairy Wastes from the Mil Dairy, Anand.

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BHOPAL FIELD CENTRE

WATER SUPPLY

Water pollution survey of Upper Lake :

The water supply of the town of Bhopal, Capital Project Areas and the Heavy Electricals Ltd., is derived from the Upper Lake. This vital source of water supply has been found to be polluted in many ways. The major contribution to the pollution load is from sullage water from Bairagarh township, nallahs in the vicinity, bungalows around, labour camps in the catchment area, washing of cattles and vehicles, bathing ghats and fishing in the lake. Taking this into consideration the pollution-study is being carried out at three places viz. periphery of the lake. catchment area and inside of the lake.

The measures to prevent pollution on the periphery are under execution. These preventive measures consist of development of area in the lake, basin on the periphery from Ret Ghat to Medical College Hospital and collection of effluent of septic tanks etc. of bungalows located on the edge of the lake.

Samples have been collected from 8 stations on the Upper lake and analysed regularly. The rangers of the chemical estimations from these stations are summerised below.

(except pH all values in ppm)

pH	7.6 - 7.7
DO	7.8 - 9.8
BOD	3.0 - 6.3
Chlorides	12.0 -15.5
P.A.	6.0 -11.5

		T.A.	132.0 - 165.4
		Total Hardness	57.7 - 67.4
Sol-ids		T.S.	137.6 - 157.6
		D.S.	113.6 - 126.4
		S.S.	19.3 - 30.3

Performance of Water Treatment Plants and Survey of the distribution system of Bhopal Water Supply :

The Water supply in Bhopal city and H.E.L. Township is 6.5 and 4 m.g.d. respectively, the former being managed by Municipal Committee and the latter by Heavy Electricals Limited. The upper lake, referred to above, is the source of this water supply.

There are four water treatment plants; viz. (i) Yacht club (3.5 mgd candy), (ii) pulpukhta (2.5 mgd candy), (iii) Idgah, (1.0 mgd candy) and (iv) H.E.L. (4 mgd Geomiller).

The biological and bacteriological analysis of water from various stages of the water treatment by these plants has been carried out to check the quality of water supply.

A survey of distribution system of Bhopal city has been conducted wherein the bacteriological quality and residual chlorine at the consumer's end were observed.

Survey of distribution system of Ujjain water supply :

The city of Ujjain has a water supply of about 6 mgd. There has been a lot of public agitation on the quality of water supply to the city and the consequent increase in water-borne disease and disorders. Hence, a need was felt to ascertain the quality of water in the distribution system. Towards this, a survey of various plants of the city

was conducted in collaboration with the Executive Engineer, Public Health Division, Ujjain.

Characteristics of water from various places of Madhya Pradesh :

A survey is being conducted in collaboration with the Executive Enginner, Public Health Division, Bhopal for studying the quality of water from different places in Madhya Pradesh, During the period under review 17 samples were analysed.

Survey of well waters in Bhopal city :

Several wells in Bhopal city have been examined for the following purposes :

(1)	Tube Well, AIR receiving Station ...	To locate the sources of Pollution
(2)	Open wells, Sultania Infantry Lines, Bhopal ..	To determine the quality of water- This investigation was conducted at the request of Defence Authorities.
(3)	Well in Chola village area, Bhopal	In connection with the infection of Guiena worms.

SEWAGE TREATMENT

There is no sewage treatment plant at Bhopal. The Capital Project area has its own sewage system. The sewage treatment plant is of the capacity of 1 mgd. It is a Biofilter treatment plant of Door-Oliver make.

There are two oxidation ponds, serving a population of 7,500 persons. The area of two ponds together constitute 4 acres. They have been designed to function at a BOD loading of 300 lbs/acre/day and a detention period of about 20 days. The ponds are so arranged that they can be operated in series as well as in parallel as desired and as per quantity of

the sewage. At present, only one pond is working.

Performance of Oxidation pond and trickling filter, Bhopal :

A comparative study was made from April 19, 62 to November 1962 on the Oxidation pond and Trickling Filter. This indicated that the Oxidation Pond has a better efficiency for BOD removal.

Performance of two sewage treatment plants in HEL Area was also observed by analysing influent and effluent for D.O. and B.O.D.

INDUSTRIAL WASTES

Straw-board wastes :

The water consumption of the factory is about 1.6 mgd out of which 0.4 mgd is recirculated water. Total effluent is about 0.8 mgd.

The existing treatment plant for the straw board factory consists of four hopper bottomed settling tanks. The sludge from these tanks is led to a sludge well under hydrostatic pressure wherefrom it is pumped into sluge drying beds. The effluent from the settling tanks is discharged into Bhairon Nala outside the boundary wall of the factory. The seepage water from the sludge drying leds also joins the nallahs along with the domestic sewage of the residential colony of the Mill. The designed capacity is 0.6 mgd.

The results of the chemical analysis of straw board wastes are presented below:

(except pH all in ppm)

Test	Range	
	Influent	Effluent
BOD	850-2200	600-1375

(Continued)

(Except pH all in ppm)

Test	Range	
	Influent	Effluent
Chlorides	140-500	110-260
TDS	1000-6600	350-5740
pH	7.1-11.0	7.9-9.9
Phen.Alk	0-1520	0-915
Total Alk.	800-7120	1020-5000
Total Hardness	720-1600	780-1100

Coagulation experiments were conducted on the straw board wastes to use alum as coagulant. It was seen that high dosage of alum was necessary for effective coagulation. It was possible to reduce suspended solids upto 80% with 180 ppm of alum dose after adjusting the pH-however, this proposition had to be discarded, being uneconomical due to exhorbitant cost of alum. Lime also could not be feasible as it was present in the effluent.

Some experiments on anaerobic digestion were also carried out and now it is proposed to try activated sludge process.

In addition to these investigations, pollution survey of river Kshipra was undertaken in March, 1963. Experimental observations also were made on Membrane Filter Technique for coliform organisms and Dairy wastes of Bhopal were analysed. The Centre intends to start the analysis of wastes from (i) Rayon Mills, Nagdha (ii) Nepa Mills, Nepanagar (iii) Straw board factory, Ratlam and (iv) sugar Mill, Sehore.

JABALPUR FIELD UNIT

This centre has been engaged in Chemical and Bacteriological Analysis of Water samples from wells, water reservoirs, Pariat tank, Umaria (Open channel at 4th Mile from Pariat tank) etc.

Natwara Project: Sanitary workshop has been opened wherein various designs of Latrine seats were kept for demonstration purposes as a part of rural sanitation programme.

Medical College Project: The NPK ratio of the compost of City Corporation Jabalpur, was found to determine its manural value.

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JAIPUR FIELD CENTRE

WATER SUPPLY

(i) At Bundi :

The problem of water supply, the odour and taste nuisance prevailing, and the methods of improvement for their removal were studied at Bundi.

Abundant growth of algae coupled with prolific multiplication of zoo-plankton in the sukhmahal lake created smell and unpleasent colour in the public water supply. Chemical and biological analyses of the samples towards purification of the water were completed.

(ii) At Hanumangarh:

The main source of water supply to the town is from a well of 10 feet in diameter and of depth of 192 feet. But it has been found that though the supply of well water was in progress the water level started rising and the auality deteriorated.

After examining the samples of well water, it has been found that the water from the nali just by the side of the town is finding access to the well probably through the Calcerious rocks. Also crack has developed in the lime brick masonary of which the sell is made of. It has been suggested that the well may be further bored up to a depth of about 40 to 50 feet as the water from the lower strata is good, and the water drawn therefrom.

(iii) At Sadradshahr:

It was reported that the water from certain wells in the Tehsil was the cause of death of animals in the area. The problem was studied in detail and it was found after examining the well-water that the water had high mineral contents and the cause of death of animals is not the well-water but other factors such a toxic weeds etc., which the animal might have taken while grazing on the field. The detailed report has been submitted.

(iv) At Sagalia:

During the course of survey of the underground water of the village Sagalia in Rajasthan it has been found that the water contains appreciable amounts of fluoride, (3.0 ppm). But the large intake of water has resulted in the wide spread of endemic fluorosis. The centre has developed a special type of Carbon from saw-dust which is capable of removing the fluoride, from water. Based on these findings in the laboratory studies, a full-scale pilot-plant of 6000 gallons per day has been proposed and all the details worked out.

(v) At Mount Abu:

Investigations were carried out to see whether water from Nakki Lake in Mount Abu could be used for drinking purposes. It was found that though the water was chemically safe, it was otherwise bacteriologically and biologically due to the

the abundant growth of free floating algae and high M.P.N. count of the Coliforms for the direct contamination of the lake water by small "nullah" discharging raw sewage from Raghunathji's Temple. Certain precautionary and treatment methods such as prevention of direct pollution of the lake by sewage, removal of soak-pits to a reasonable distance of safety, control of excessive submerged aquatic growths, prohibition of the bathing and washing clothes in the Ghats, efficient treatment in the filter house and provision of additional filteres, were adopted so that water could be supplied to the Public safely.

Jaipur Water Supply:

A complete check-up has been maintained on all the 70 sources of water supply to Jaipur city. Samples have been regularly collected and analysed both chemically and bacteriologically.

Rural Water Supply:

Public Works Department (Health) has chalked out a scheme for rural water supply to Udaipur district. The scheme is likely to be financed by U.N.I.C.E.F. We have analysed 150 samples from Bargaon block of Udaipur district which has enabled P.W.D.(Health) to finalise their proposals.

SEWAGE DISPOSAL

Oxidation Pond:

At Jodhpur sewage farm, Oxidation ponds have been designed to treat one lakh gallon and

50,000 gallons of sewage per day with two and four days detention period respectively.

After the performance of the ponds has been gauged at Jodhpur, the programme is likely to be extended to other places in Rajasthan.

Jai Mahal Lake Sewage Stabilization Pond:

Nearly half of Jaipur City's sewage is discharged to the Municipal Northern Sewage Farm. The sewage is partly utilized for broad irrigation and the remaining flows to Jalmahal Lake. Partly due to storage and sedimentation and mainly due to photosynthetic action of the algae the sewage is purified giving an effluent of very low B.O.D. The amount of self purification contained in Jalmahal sewage stabilization pond was determined from the analysis of raw sewage effluent from Jalmahal lake and water at a point about 2 miles down stream. Considerable reduction in BOD and coliform counts was observed.

Survey of Septic Tanks:

Four different types of septic tanks have been designed to suit tropical conditions. The septic tanks are under constant observations.

Sludge Analysis:

Sludge from the various sources was collected and analysed, special emphasis being on mineral analysis.

INDUSTRIAL WASTES

Rajasthan is comparatively a backward State as regards the development of Industries and other related fields are concerned. Most of the factories have not yet started and so the actual problem has not yet arisen. At the request of the Chief Engineer the overall problem of Industrial Waste at Kotah was assessed.

Soda-Ash Factory:

Laboratories studies revealed that useful chemical like Gypsum, magnesium chloride and sodium chloride can be profitably recovered from the waste. A detailed scheme has been worked out for the reclamation of effluent from soda ash industries (1000 gallons per day).

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KANPUR FIELD CENTRE

During the year 1962-63, the following investigations have been carried out:

Survey of Water treatment facility of Kanpur City:

The water treatment facility of Kanpur city was surveyed to study the efficiency and performance of different units of the water works. Eight sampling points extending over River Ganges, Canal, presettling tank, clarification units, mechanical filters, slow sand filters and reservoir were selected.

In the water works, about 30 mgd of water is treated of which 24 mgd is drawn from the Ganga river and 6 mgd from Upper Ganga Canal. Generally, these two different waters are mixed before treating the same. Chemical analysis of raw and chlorinated water was carried out regularly for the period April-December, 1962 and comprised of tests on Turbidity, Chlorides, Alkalinity 4 hour COD, Hardness (Calcium and Magnesium), Nitrates Nitrites, Free CO_2 Total, dissolved and suspended solids.

Survey of water quality of the open wells and tube-wells:

Survey of the water quality of different wells and tube-wells located in Kanpur city was started in July, 1962. The work could be done only for five months due to certain unavoidable reasons. The programme has been restarted and

data are being collected regularly every month. Efforts are also being made to carry out bacteriological analysis of water samples along with other tests.

Survey of city sewage of Kanpur:

Various samples of sewage have been collected and analysed regularly. The samples have been from the following stations:

(1) Permut sewage pumping station

(2) Guptarghat sewage pumping station

(3) Jajmow sewage pumping station

(4) Chamber for mixing sewage with Ganga water

and (5) Two kilometers down the channel carrying to sewage farm.

The observations made so far are summarised below:-

(a) The pH value remained mostly alkaline

(b) The chlorides were found to be in the range 58-3000 ppm

(c) B.O.D. fluctuate widely between 90-2450 ppm

and (d) Total solids average a little over 2000 ppm and the volatite solids were about 29% of the total solids.

It has been estimated that about 70% of the population of 1.0 million is supplied with filtered water, which comes to about 43 gallons per capita per day. About 24 mgd of sewage is pumped out by the Jajmow pumping station, out of which about 80% of the sewage is directly discharged into Ganga and 20% is diluted with about equal volume of

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Ganga water and is used in sewage farm.

The analysis of sewage, particularly at the Jajmow pumping station, indicates that high pollution load is carried by the sewage.

The programme has been reorganised to obtain data on daily volumes of flow in addition to characteristics of the city sewage. This work is in progress.

Characterisation of Tannery Wastes:

A survey of tannery wastes of M/s Cooper Allen Branch of B.I.C., Ltd., was carried out every month during the year 1962-63, mainly due to characterise the effluents emanating from different process adopted by them to manufacture finished leather from raw hides.

The major sources of effluents have been found to be from soaking, liming, deliming and bating, veg. tanning, chrome tanning and washing after tanning. The analysis of the samples of effluents was carried out from these sources as well as from the catch-pit (of M/s Cooper Allen) where the effluents from all the departments are collected and settled for about an hour before discharge into Municipal Sewer. A very high pollutional load, particularly in terms of suspended solids and B.O.D. as high as 3350 and 9083 mg respectively has been observed.

A study has been attempted to find out the degree of reduction of pollution load of different effluents by their controlled mixing and chemical coagulation. Sizable reduction in suspendd solids has been observed. There was,however, no appreciable reduction in the oxygen consumed value.

It is proposed to set up a pilot plant for secondary treatment of tannery wastes.

Apart from the foregoing investigations, the following short-term investigations have been undertaken during the year under review:

Matatila Reservoir, Jhansi :

Sampling and analysis of water from Matatila Reservoir at Jhansi were carried out regularly during the year 1962-63. This programme is in progress, and has been undertaken to advise the L.S.C.E.D., Jhansi, on suitability of the quality of water for their water supply project for Jhansi and Babina.

Trade Waste of M/s [illegible] Mills Co., Ltd.

The data on the characteristics of the effluents originating from different sections of the factory indicate that the effluents, in general, are highly alkaline, laden with oxygen consuming substances and are toxic, particularly, because of the presence of the coal tar, naphthol dyes and other dyes.

MADRAS FIELD CENTRE

The centre has been established on May 19, 1962. Not much laboratory or research has been carried out. The centre had to be closed down due to National Emergency and the consequent budget out from December 15, 1962.

Tanneries belonging to India Leather Corporation Ltd., were visited for an on-the-spot study of their problem of disposal of tannery wastes at one tannery and possibility of reclaiming water from the combined effluent at another tannery. The data regarding chemicals used, volume of wastes etc., was obtained and chemical analysis of the samples supplied was carried out. These were obtained with a view to design a treatment plant for tannery wastes.

Preliminary studies on East India B- Tannery effluents were undertaken. Samples of effluent were analysed for pH, Total dissolved and suspended solids and C.O.D. It has been found that separation of all acidic and all alkaline wastes in two different tanks and their mixing to obtain a pH of about 7.8 gives good floc formation and a much clearer effluent, having lower T.S. and 4 hr. oxygen consumed from $KMnO_4$.

LIBRARY, INFORMATION AND PUBLICATION DIVISION

The library of the Institute is located at the Headquarters at Nagpur and is organised on scientific lines.

It is mainly used for research and reference purposes. It has bibliographies on specific subjects, catelogues of important publications and indices of current literature. It caters to the research need of the zonal and field centres also. In addition to 165 journals on subjects allied to public health engineering for the headquarters, 12 journals for each zonal and field centre are subscribed. A comparative statement showing the addition of books and journals to the library is given below:

	As on 31st March, 1962	As on 31st March, 1963
Books and Bound Volumes	3552	4445
Journals at Headquarters	170	165
Journals at Field Labs.	13 (each)	12 (each)
Journals on exchange basis	13	20
Photostat copies & Reprint	532	617
Pamphlets	235	390

Facilities for preparing and reading microfilms are provided. Apart from this, bibliographies and short reading lists were prepared on

important aspects of water and sewage treatment and disposal of Industrial wastes.

Journal

The Institute publishes a quarterly technical journal "ENVIRONMENTAL HEALTH", formerly called "CPHERI BULLETIN". The journal has stepped into fifth year of its publication. The journal is sent on gratis to Chief Engineers, Superintending Engineers, Engineering Colleges and Research Institutes in India and abroad. A nominal annual subscription of Rs. 5/- has been fixed for the journal.

SYNOPSIS

SYMPOSIA

The Institute organised a symposium on "Treatment and Disposal of Industrial Wastes", at Kanpur, during 9-10 April, 1962. The symposium was inaugurated by Shri Mahabir Prasad Srivastava, Minister for Health and Social Welfare, Uttar Pradesh. About 100 Scientists and Engineers attended the symposium which was held in four technical sessions.

The papers presented at the symposium have been published in CPHERI Bulletin, Vol. 3, No. 2.

Technical Aid to Industries, Corporations and and Government Agencies:

Advice on matters within the preview of this Institute was rendered to various industrial organisations, municipal corporations and other

Government agencies. The enquiries included problems pertaining to water supply, sewage treatment, disposal of Industrial Wastes etc.

A large number of samples of Water, sewage and Industrial wastes were analysed on the request of various corporations and Industries. Details of the assistance rendered are given below:

TECHNICAL ASSISTANCE RENDERED

S.No.	Name of Party	Nature of Assistance Rendered
1.	Regional Dairy Officer, Government Dairy, Nagpur	Examination of Milk samples.
2.	Chief Engineer, Tank Factory Project, Madras	i) Advice on disposal of tank Factory sewage, Avadi. ii) Regarding sewage disposal works of Avadi.
3.	Vidarbha Maharashtra Sugar Syndicate Ltd., Khamgaon	Design for purification of the effluent high rate digestion plant for the production of methane gas.
4.	National Sugar Institute, Kanpur	Advice on specifications of Chemical effluents.
5.	Officer-in-Charge, Vijnan Mandir, Sehore M.P.	Advice on problems of contamination of local river water by sugar factory effluents.
6.	All India Radio, Bhopal	Purification of drinking water from bore-wells.
7.	Dairy Engineer, NDRI, Karnal	Advice regarding Mechanical treatment of disposal of dairy wastes.

S.No.	Name of the Party	Nature of Assistance Rendered
8.	M/s Wasan & Co., Agra	Suggestion of suitable plan for location of wells.
9.	M/s Leiner Knit Gelatine Co., Ltd., Jabalpur	Advice regarding treatment of effluent discharged from the factory
10.	Central Leather Research Institute, Madras	Regarding treatment of tannery wastes-Design of pilot plant
11.	Ahmednagar Municipal Corporation	Advice on Pimpalgaon Water treatment plant
12.	Controller R&P (Engrs) Ministry of Defence, New Delhi	Regarding chemical toilet as high altitudes.
13.	Engineer (Chief), Tata Engg. & Locomotive Co., Ltd., Jamshedpur	Standard list of the equipment required for bacteriological laboratory in water treatment plant.
14.	M/s Fertilizer Corporation of India Ltd., Namrur, Assam	Advice on design of branch/feeders/distribution mains for the water supply of industrial township.
15.	Deputy Director, Public HealthServices, Aurangabad	Advice on disposal of sugar mill wastes from Gangapur sugar mills.
16.	Executive Engineer, P.W.D., Anantapur	Advice regarding water supply in the Engineering college campus
17.	Delhi State Fisheries Advisory Committee, Delhi	Regarding pollution of river Jamuna- Fish Fauna
18.	Indian Institute of Petroleum, Dehradun	Advice on sewage purification
19.	Indian Aid Mission, Nepal, Khatmandu	Visit of site and advice on Khatmandu water supply scheme

S.No.	Name of the Party	Nature of Assistance Rendered
20.	District Health Officer, Guntur	Advice on water supply-Narasaraopet Municipality-Additional arrangement for water supply
21.	M/s Fertilizer Corporation of India Ltd., Sindri	Standards for Physical, Chemical and bacteriological qualities of drinking water.
22.	Chief Inspector of Factories, Hyderabad	Recommendations into alleged pungent smell in the Sir Silk Mills Ltd., Sirpur-Investigation.
23.	Director of Medical Services, Hyderabad	- do -
24.	National Aeronautical Laboratory, Bangalore	Regarding sewage disposal
25.	National Chemical Laboratory, Poona	i) Regarding sewage purification for NCL and staff quarters ii) Construction of Oxidation Ponds for NCL
26.	Superintending Engineer Public Health Engineering, Hindustan Steel Ltd., Durgapur.	i) Regarding pollution of water in the river Damodar during summer ii) Advice on sedimentation tank's working
27.	National Aeronautical Lab., Bangalore	Disposal of sewage at the estate of the Wind Tunnel Centre at NAL
28.	National Sugar Institute, Kanpur	Regarding effluent of Ion-Exchange process of cane juice clarification
29.	Deputy Commander, Works Engineers, Jabalpur	Regarding extension of Water Supply scheme at Amla
30.	M/s John Thompson(India) (P) Ltd., Calcutta	Treating sewage and demineralisation and softening of water

S.No.	Name of the Party	Nature of Assistance Rendered
31.	Indian Institute of Petroleum, Dehradun	i) Regarding sewage disposal arrangements by visiting the site. ii) Supplying drawings for oxidation pond accessories etc.
32.	Public Health Sub-Division, Hissar, Punjab	Sieve analysis of sand sample for E.S. & U.C.
33.	Sahayak Abhiyanta, Water supply & Drainage Divisions, Nagar Mahapalika, Kanpur	Chemical examination of sewage.
34.	Chief Engineer (PH) Hyderabad	i) Vijaywada Municipality regarding construction of sewage farm and extension of slum dwellers. ii) Supplying details on construction of oxidation ponds.
35.	Asstt. Engineer, Public Health Sub-Division, Madhya Pradesh, Rewa	i) Sewage disposal works at Indore. ii) Advice on oxidation pond to be provided at Indore sewage disposal works instead of sedimentation tanks.
36.	Asstt. Engineer, Public Health Sub-division, Gudur (A.P.)	i) Regarding sewage water disposal ii) Regarding treatment works -- Nellore sewerage scheme -- design particulars.
37.	Dr.Dinshaw N.Daruvalla, Bombay	Advice on plating wastes disposal
38.	Gram Panchayat, Sultanpur, Buldhana	Regarding improvement of public Health
39.	City Engineer, Municipal Corporation, Ahmedabad	Supplying literature on rural sanitation, like urban and semi-urban water supply, rural latrines etc.

S.No.	Name of the Party	Nature of Assistance Rendered
40.	M/s Lainex-Knit Gelatine Co. Ltd., Jabalpur	i) Advice on factory effluent disposal ii) Regarding the disposal of wastes from the factory
41.	Central Electro-Chemical Research Institute, Karaikudi	Advice on Chlorine manufacturing plant
42.	M/s Hindustan Photo Films, Ootacamund	Advice on sewage treatment for their township
43.	Executive Engineer, Public Health Works Division, Surat	Advice on construction of oxidation ponds for disposal works for Navsari Drainage scheme
44.	Municipal Engineer, and Commissioner delegate, Vijayawada Municipality, Vijayawada	i) regarding problem of augmentation of water supply for Vijayawada. ii) Improvement of Water Supply Scheme at Vijayawada.
45.	Public Health Sanitary Engineer, Research-and-Action Project, Pocampallee, Madras	Regarding studies of anaerobic digestion of night-soil
46.	The Mysore Iron & Steel Works, Bhadravati, Mysore	Pollution of river water Standards for Industrial waste to be discharged into rivers.
47.	Superintending Engineer, Public Health(West Circle) Hyderabad	Regarding treatment of wastes from integrated Milk Project Hyderabad.
48.	M/s Sarabhai Common Services, Baroda	Regarding specifications for discharge of effluents from industrial units into municipal sewers
49.	Director of Public Health, Hyderabad	Supplied drawing of lagoons for the waste treatment of the paper mills at Rajahmundry
50.	M/s Tata Iron & Steel Co., Ltd., Jamshedpur	Regarding construction of oxidation ponds for the factory.

S.No.	Name of the Party	Nature of Assistance Rendered
51.	Commander; Works Engineer, Deolali	Regarding purification of Specific tank effluents for discharging to river Dharna
52.	Army Attachee Army Embassy Chanakya Puri, New Delhi	Regarding disposal of human waste.
53.	S.D.O. Military Engg. Service, Shahajahanpur	Regarding treatment of M.S. steel tube for carrying tube water
54.	M/s Parelkar & Dellas, Bombay	Analysis of effluent sample
55.	B.O.D. Dhadgao	Instructions for installation of cow-dung gas plant
56.	Shri G.V. Bhagwat, Landscape Architect & Consultant Horticulturist, Poona	Disposal of Sewage water advice
57.	Chief Engineer, Southern Zone, Madras	Sewage disposal.
58.	Director, Mysore Engineering Research Station, PWD, Krishnaraj Nagar	Information for establishment of an engineering Research Institute in Public Health
59.	Chief Plastic Surgeon, Medical College Hospital, Nagpur	Problem of Scales in the sterilizers in operation theatre-advice.
60.	Chief Engineer, Jabalpur, Municipal Corpn., Jabalpur	Bacteriological analysis of water samples
61.	Sarabhai Commons Service Baroda	Analysis of effluent samples.
62.	Deputy Engineer, Bhal Tract Dholka	Bacteriological analysis of water samples.
63.	Managing Director, Boards & Papers (P)Ltd., Calcutta	Liquid waste from Straw board Mill-advice.
64.	Sarabhai Commons Services, Wadi Wadi	Facilities for training of staff in analysis of factory effluents.

S.No.	Name of the Party	Nature of Assistance Rendered
65.	Sub-Division Officer, Boring Work sub-Division, Aswara	Chemical/Bacteriological analysis of water
66.	Jaipur Milk Supply Scheme, Jaipur	Facilities for training of staff in the analysis of water
67. i.	Shri V.V.Deshpande, Overseer from Kalmeshwar	Training facilities in installation of CPHERI type Gobar Gas Plant
ii.	Shri L.G.Hase, Overseer from B.D.O., Nasik	-do-
iii.	Shri V.A. Beloni Sanitary Inspector from DHO, Palghat	-do-
iv.	Shri Y.S. Joshi Overseer from BDO Karanja	-do-
v.	Shri A.K. Dhanwalkar, Overseer from B.D.O. Sindewai	-do-
68.	Shri O.R. Rathe from B.D.O. Bhiwapur	Training in rural sanitation.
69.	Corporation of Madras	Sewage utilisation scheme-introduction of algae.
70.	Lucknow Polytechnic Abhiyantrik Upanivesh, Lucknow	Regarding sewage disposal.
71.	M/s Mithila Automobiles, Darbangha	Installation of Gobar Gas Plant.
72.	Shri Kothandaraman, St.Thomas Mount, Madras	-do-
73.	Shri G.M.Wadhnekar, Bombay	-do-
74.	Shri N.P.Singh, Hartanis	-do-
75.	Block Development Officer, Gadchiroli	-do-
76.	Shri Ram Sugar & Industries, Ltd., Bobbili	-do-

S.No.	Name of the Party	Nature of Assistance Rendered
77.	M/s Vidarbha Paper Mills Nagpur	Disposal of factory effluents.
78.	Civil Engineering Deptt., University of Roorkee	Regarding facility to PHE students to work on BOD correlation of time and temperature of incubation suiting to Indian conditions.
79.	Chief Engineer, (pH), Kerala	Regarding training of George K George, Senior Research Fellow (CSIR)- Design factors for stabilisation ponds- training in Botany, Bacteriology and Engineering.
80.	Indian Aid Mission, Khatmandu	Scientific assistance regarding finalisation of Khatmandu water supply scheme.

PAPERS PUBLISHED

Twenty six papers were published by the staff of the Institute in Environmental Health and other Journals as detailed below:

1. Arora H.C. Studies on Indian Rotifera Part I : Jour.Zool. Soc. Of India 14(1),33.44(1962).

2. Arora H.C. Studies on Indian Rotifera Part IV :Jour.Zool. f.Hydrobiol. 59(4),502-507(1963).

3. Apte, V.R. Dabadhgaon S.B., Deshpande W.M. & Deshpande V.D.: Rapid Methods of dissolved Oxygen; Env. Health, IV:202-206(1962).

4. Bhakuni T.S. and Sastry C.A.: Studies on Fresh and Used Anion Exchange Resin., Env.Health; V:61-69(1963).

5. Bopardikar M.V. : Manufacture of polystyrene Resins in India,Env.Health: V:82-92(1963).

6. Bopardikar M.V.: Public Health Engineering Education, Env. Health: IV: 163-189(1962).

7. Chaturvedi A.C. : Sludge digestion., Env. Health: IV 283-290 (1962).

8. Garber W.F. & Mohanrao G.J.: Certain Design and Control Factors in High-Rate Sludge Digestion, Env. Health; IV: 275-282 (1962).

9. Ganapati S.V. : A five Year Investigation of Almati Reservoir part II: Chemical conditions Env.Health IV: 124-132 (1962).

10. Krishnamoorthy K.P. & Visveswara G. Hydrobiological Studies with reference to sudden fish mortality: Hydrogiologia 21: 3 & 4, 275-303(1963).

11. Khan, K.R. Use of Algae for treatment of Synthetic Drug Wastes, Env. Health: IV: 193-201 (1962).

12. Kshirsagar S.R. Microbial Life Responsible for Digestion. Env.Health IV.156-160 (1962).

13. Lakshminarayana J.S.S. Algal Flora of Uttar Pradesh: Part II Chlorphycae, Chlorococeales Ultotrichales, Env.Health IV. 114-123(1962).

14. Lakshminarayana J.S.S. Algal Flora of Uttar Pradesh Part III Env. Health; IV: 298-303(1962).

15. Lakshminarayana J.S.S. Algal Flora of Uttar Pradesh Part IV: Env. Health V: 46-60(1963).

16. Mohanrao G.J.: Behaviour of synthetic detergents in sewage treatment Env.Health V: 19-30 (1963).

17. Mehta R.S.: Environmental Health of Armed Forces, Env.Health V:1(1963).

18. Pandit R.K. Socium Phosphate as Aid to Alum in Removal of Iron, Env. Health IV: 161-162(1962).

19. Pandit R.K. : Effect of Chlorination of Organic Constituents of Water, Env.Health:V. 93-100(1963).

20. Patil M.D. Srinivasan T.K. Seth G.K. and Murthy V.S.: Treatment & Disposal of Synthetic Drug Wastes, Env. Health : IV : 96-105(1962).

21. Rao, N.U. and Rao C.S.G. Membrane Filter Techniques in Bacteriological Examination of Water, Env. Health IV: 228-232 (1962).

22. Rajagopal G: A New Device for Automatically Measured Delivery of Fluids, Env.Health:IV: 207(1962).

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APPENDIX

STAFF

(As on 31st March 1963)

SCIENTIFIC AND TECHNICAL

DIRECTOR

1)	Shri R.S. Mehta	B.E.(Bombay) M.C.E.(Cornell) M.I.E.(India) F.Am.S.C.E.

ASSISTANT DIRECTORS

2)	Prof. M.V. Bopardikar	B.E.(Civil)(Bombay) M.R.San.I(London)
3)	Shri J.M. Dave	B.E.(Civil)India M.S.(San.Engg)U.S.A. M.P.H.(EnS)U.S.A.
4)	Dr. G.J. Mohanrao	M.Sc.,Ph.D(Bombay) Sc.D.(Mass.I.T.)

SENIOR SCIENTIFIC OFFICER (GRADE I)

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7)	Dr. A.K. Anwikar	M.P.H.,L.M.P.
8)	Dr. N.U. Rao	M.Sc.,Ph.D(Illinois)
9)	Shri C.V. Sabnis	M.Sc.,A.I.I.Sc. A.R.I.C.,M.P.H.
10)	Dr.C.A. Sastry	B.Sc.(Hons) D.I.I.Sc.,Ph.D. M.R.S.H., A.M.I.Chem.
11)	R.N.Chakraborty	B.Ch.E. Certificate in advanced Engg.
12)	Dr. B.D. Rawal	M.Sc.,Ph.D.
13)	Dr. N.N. Sharma	M.Sc.,D.Phil.
14)	Shri K.R. Bulusu	B.Ch.E.
15)	Shri S. Rajagopalan	B.Sc.
16)	Dr. J.S.S.Lakshminarayana	M.Sc., Ph.D.

17) Shri J.M. Tuli	B.Ch.E.
18) Shri P.S. Nagpaul	B.Sc.,M.A.(Maths)
19) Shri Y.S. Murthy	B.E.(Civil) M.Sc.(P.H.E.)

JUNIOR SCIENTIFIC OFFICERS

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23) Shri J.S. Gadgil	M.Sc.
24) Shri I.P. Bahri	M.Sc.
25) Shri R.P. Mishra	M.Sc.(Agrl).
26) Dr. W.M. Deshpande	M.Sc.,Ph.D.
27) Shri S.S. Rodgi	M.Sc.M.A.(Calif)
28) Dr. J.M. Khanade	M.Sc.,Ph.D.
29) Shri R.S. Dhaneshwar	M.Sc.
30) Shri M.V.Srinivasan	M.Sc.
31) Shri H.C. Arora	M.Sc.(Hons.)
32) Shri K.P.Krishnamoorthy	B.Sc.(Hons.) M.Sc.
33) Dr. M.G. George	M.Sc., Ph.D.

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34) Shri J.S. Jain	M.Sc.,B.S.(Civil Engg) (Illinois) M.S.(Civil Engg)(Calif) AMASCE, AMIE (India)
35) Dr. J.K. Bewtra	B.E.(Civil) M.S.(IOWA)(U.S.A.) Ph.D.(Engg.)(U.S.A.)

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36) Shri T.K. Srinivasan	M.A.,M.Sc.
37) Shri B.N. Pathak	B.Sc.,B.Sc.(Tech)

38)	Shri S.H. Godbole	B.Sc.(Hons.),M.Sc.
39)	Dr. K.L. Saxena	M.Sc.,Ph.D.

JUNIOR SCIENTIFIC ASSISTANTS

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41)	Shri S.S. Mudri	M.Sc.
42)	Shri P.K. Yennawar	M.Sc.
43)	Shri M.D. Patil	M.Sc.
44)	Shri M. Parabrahmam	M.Pharm.
45)	Shri T.S. Bhakuni	M.Sc.
46)	Shri S.K. Titus	M.Sc.
47)	Shri A.K. Sen	B.Sc(Hons.)M.Sc.
48)	Shri N.M.Parhad	M.Sc.
49)	Shri C.S.G. Rao	B.Sc.
50)	Shri R.K. Pandit	M.Sc.
51)	Shri N.S. Phadke	B.Sc.(Hons.)M.Sc.
52)	Shri L.N. Sharma	B.Sc.
53)	Shri P. George Jacob	B.Sc.
54)	Shri I.P.S. Prasada Rao	B.Sc.
55)	Shri E.M. Sheriff	B.Sc.(Hons.),M.Sc.
56)	Shri N.K. Kaushik	B.Sc.(Hons.),M.Sc.
57)	Shri V.R. Apte	M.Sc.
58)	Shri V.D. Deshpande	M.Sc.
59)	Shri A.Q. Khan	M.Sc.
60)	Shri M.S. Jog	M.Sc.
61)	Shri S.K. Srivastava	M.Sc.
62)	Shri G. Visveswara	M.Sc.
63)	Shri V.P. Thergaonkar	M.Sc.
64)	Shri P.V.R.C. Panickar	B.Sc.
65)	Shri D.P. Yadava	M.Sc.

66)	Shri M.R. Bodhmage	M.Sc.
67)	Shri V. Kothandaraman	B.Sc.
68)	Mrs. Indira S.Jayangoudhar	M.Sc.
69)	Shri V.R. Bhave	B.Sc.(Hons.),M.Sc.
70)	Miss Rekha Mitra	M.Sc.
71)	Shri A.L. Aparanji	M.Sc.

SENIOR TECHNICAL ASSISTANT

72)	Shri S.B. Dabadghao	M.Sc.
73)	Shri M.M. Agarwal	B.Sc.(Tech)
74)	Shri M.V. Badwe	M.Sc.

AUXILIARY TECHNICAL

CLERK OF WORKS

75)	Shri N.M. Narasimhan	Dip.in Licenciate in Civil Engg. A.M.I.E.

SENIOR MECHANICAL ASSISTANT

76)	Shri P.Y. Khanapurkar	Diploma in Elec. Engineering

~~77)~~

JUNIOR MECHANICAL ASSISTANT

77)	Shri H.L. Jaggi	Diploma in Mech. Engineering
78)	Shri G.T. Kale	Diploma in Mech. Engineering

JUNIOR TECHNICAL ASSISTANT

79)	Shri T.N. Pathak	M.A. Diploma in Library Science,M.O.L.
80)	Shri Thomas Joseph	B.Sc.
81)	Shri M.J. Patil	Diploma in Mech. Engineering.

LABORATORY SUPERVISOR

82)	Shri K.G. Varghese	B.Sc.

STORES SUPERVISOR

83) Shri G.L. Banerjee — B.A.

SENIOR DRAUGHTSMAN

84) Shri P.G. Govandi — Diploma in Civil Engineering

SENIOR GLASS BLOWER

85) Shri N. Narayana — Diploma in Glass Technology.

OVERSEERS

86) Shri L. Shantikumar — Diploma in Civil Engineering.

87) Shri G.K. Khetrapal — "

88) Shri S.G. Shaikh — "

89) Shri A.W. Deshpande — "

90) Shri S.K. Sharma — "

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ACCOUNTS OFFICER

93) Shri A. Venkatraman

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94) Shri N.S. Anand

95) Shri Mangal Prasad — B.A.

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96) Shri S.N. Nayyar — B.Sc.

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97) Shri R.N. Sharma — B.A.

ASSISTANTS

98) Shri Y.N. Murthy B.A.

99) Shri S.C. Khare B.A. LL.B.

100) Shri T. Rajagopalan B.A.

SENIOR STENOGRAPHER

101) Shri V. Desikachary

JUNIOR ACCOUNTANT

102) Shri M.A. Baig

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103) Mrs. I'Douza