Annual Report

1964–1965

CENTRAL PUBLIC HEALTH ENGINEERING RESEARCH INSTITUTE

NAGPUR

COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

ANNUAL REPORT

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PUBLIC HEALTH ENGINEERING

RESEARCH INSTITUTE

NEHRU MARG, NAGPUR

PREFACE

An account of the work of the Institute during 1964-65 is presented in the following pages. The Report covers in detail the progress of research activities on the fundamental and developmental aspects. Since its inauguration six years back, the Institute has been endeavouring to fulfil its objective of finding cheaper ways of treating water, sewage and industrial wastes, and trying to reduce the foreign exchange requirements in treatment plants. The year under Report is marked by increased developmental work and the research output has also expanded.

The Institute is maintaining close contacts with Industries both in public and private sectors, Public Health Engineering Departments of State Governments and other organisations The Municipal Corporations and other local bodies are taking considerable interest in the activities of the Institute and are passing on many of their problems to the Institute for solution.

A Refresher Course was conducted in Water Supply and Sewage Treatment for the benefit of the Executive Engineers of the neighbouring States and Garrison Engineers from the Defence Department. Symposia were conducted during Oct. 1964 on "Problems in WaterTreatment" and "Evaluation of Rural-latrine Design." A Special Session was held on "Water Supply and Waste Disposal at High Altitudes" for the benefit of the Defence Department personnel. The main purpose of this Special Session was to highlight this problem which has arisen because of the present tension on our borders.

Work on problems assigned during the National Emergency has made steady progress. On the rural sanitation problems,

increasing attention is being paid. A Model Rural Workshop was constructed recently in the premises of the Institute.

Work on oxidation ponds at the Headquarters, and at different Zonal and Field centres has yielded very important results. The Institute has developed a method for treating the effluent from Photo-film Industry by chemical treatment with alum followed by biological treatment with an acclimatised mixed culture of bacteria. In collaboration with the Bombay Municipal Corporation, trials are being made to develop a method for reclaiming and reusing tertiary treated sewage effluent for processing water in different industries at Bombay. During this year, good progress is also made in developing methods for tackling problems of Industrial Hygiene and Air Pollution.

The donation from the United Nations Special Fund has enabled to equip the Institute with the latest types of instruments. It is hoped that all those who are interested in solving their Public Health Engineering problems will refer these to this Institute and help it in achieving its object of improving the general standard of Public Health in India for the total happiness of the common man.

R. S. MEHTA,
Director.

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APPENDIXES

WATER QUALITY CRITERIA

1. Comparative study of suitability of iced and un-iced water samples for bacteriological examination of water

(PROJECT NO. 1.1)

There are two views about the bacteriological quality of water samples. According to one, the bacteriological quality of water samples does not change whether they are iced or not. But according to the other, the water sample should be iced. In India, there are very few Public Health Laboratories and they are far apart. Hence generally it takes a long time for the samples to reach the laboratory. It is very difficult to obtain ice in most of the places for sending the samples. This work was started to ascertain as to which view is more valid, under Indian conditions.

Work was already done on more than 100 samples of water from different sources using the MPN method for estimation of coliforms. The results of the work were reported in the Annual Report of 1963-64. Supplementing MF method to the MPN, further work is being carried out to study the effect of temperature and time on the bacteriological content of water samples. A few samples have been analysed and the work is in progress. Work will also be carried out on samples containing pathogenic organisms.

2. Utility of indigenous materials such as pulses in place of peptone for use in bacteriological media

(PROJECT NO. 1.2)

Media prepared for general use in bacteriological laboratory usually contain peptone which is at present imported. Peptone is very expensive costing Rs. 100/- per pound depending upon the brand.

Pulses like black-gram, Bengal-gram, red-gram are known for their high protein content. They are also cheap and easily available in this country. If these can be substituted for imported peptones, a large amount of foreign exchange can be saved.

Preliminary experiments were carried out in the Laboratory by substituting the imported peptone by these native proteins in order to test their suitability in the bacteriological media. These media compared favourably with the standard media containing imported peptone.

Work is in progress to standardize a method for the preparation of peptone from vegetable proteins, either by enzymatic digestion or by acid hydrolysis. The peptones thus prepared will be analysed, for their different amino-acid content and tested for their utility in different media by incorporating them singly or in combination.

3. Comparative efficiency of Lactose broth Vs. MacConkey broth in presumptive tests

(PROJECT NO. 1.3)

Lactose broth and MacConkey broth are being compared for their suitability as medium for the presumptive test. So far, about 50 samples of water from lakes, wells and rivers have been analysed. The results obtained indicate that MacConkey broth gave less false presumptive test.

4. Relative incidence and survival of coliforms and enterocci in polluted waters, soils, etc.

(PROJECT NO. 1.4)

Studies were conducted on the relative survival of coliforms and enterococci in domestic sewage and in feces obtained from healthy individuals. The initial object of the investigation was to find out the relative efficiency of Dilution Tube Technique and the Membrane Filter Technique for quantitative enumeration of fecal streptococci. Based on the results available so far, it is observed that invariably the MF technique gives larger counts for enterococci than the MPN method in case of sewage samples. But this consistency could not be observed when samples of feces were analysed. In other words, the MF counts were not found to be consistently higher than the MPN counts for fecal samples. It is believed that this may be due to uneven clustering of bacteria around undigested and partially decomposed food particles which do not give an even bacterial suspension in the decimal dilutions. Making a more homogenous bacterial suspension in dilutions by mechanical

shaking is being tried. It is proposed to analyse at least 25 samples of feces and sewage.

5. Bacteriological studies on plastic pipes

(PROJECT NO. 1.5)

The first phase of work on this project was completed and a comprehensive report was submitted to Indian Standards Institution. The bacteriological quality of water passing through the plastic pipes was found to be not inferior to that of the water passing through conventional ACC or C.I. or G.I. pipes. The second phase of the work will be started as soon as Alkathene and PVC pipes are received from the manufacturers.

6(a) Bacterial indicators of pollution

The work on this problem has been completed and the data is being analysed. Experiments carried out in about 500 fecal samples showed that *E. coli I* occurred in 80 per cent of the samples. So far, about 100 samples of sewage from different parts of Nagpur City have been analysed for their coliform spectra and the data is being studied.

6(b) Comparison of coliforms and enterococci in waters from various sources

One hundred and sixty eight samples from wells, 154 samples from river and 162 samples from sewage polluted irrigated canal were analysed for the incidence of coliforms and enterococci in natural waters. The canal and river samples showed positive correlation of 0.829 and 0.787 between the two groups of organisms. Well samples exhibited more scatter in data with positive correlation of 0.467. The geometric mean ratio of coliforms to enterococci (2.1) was lower in well waters than that for river (25.0), or sewage polluted canal water (16.7). The results indicate that, in case of well water, estimation of enterococci in addition to coliforms and *E. coli* is desirable to assess their true sanitary significance.

7. Limnological studies—Ecology of planktonic forms

(PROJECT NO. 1.6)

Extensive surveys of Gandhisagar and other sources of water in Nagpur were made. Work in connection with Kanhan river survey has been resumed from February 1965.

A stretch of about 14 km of Kanhan river is being surveyed. This stretch covers 8 sampling stations of good water with minor pollution factors and discharge of industrial wastes, particularly of paper mill wastes. The work covers chemical, physical and biological characteristics of water, a study of bottom fauna and a study of the nature of substrates. Further studies on the ecology and taxonomy are made of *Protozoa, Rotifers, Oligochaeta, Gastrotricha and Tardigrada* are being made.

As a result of this work, and also from samples collected from different water bodies of varying pollution levels, it was possible to evaluate pollution levels with reference to animals found.

Taxonomic studies of different forms of *Rotifers* gave very interesting results. Studies on photo-dynamics *Rotifers* have been completed. Detailed studies on their behaviour and ecology are also in progress.

Regarding the *Oligochaetes,* study of the ecology of tubificids is in progress.

A complete list of the various *Protozoans* occurring in different bodies of water has already been prepared out of extensive collections made.

8. Limnological studies of the lakes in and around Hyderabad

Four lakes, which form the sources of Hyderabad city water supply, have been studied systematically in order to find out the seasonal fluctuations in the characteristics of these waters which influence the treatment works.

Data collected for one complete year (1964) have been compiled in the form of a technical paper.

9. Factors influencing infestation of nematodes in Delhi water supply and its possible health hazards

(PROJECT NO. 1.7)

(a) Observations on the occurrence of nematodes in treated water from Chandrawal Water Works were continued to study their quantitative variations.

The usual chlorine dose and contact period did not kill all the worms in final water. Detention in balancing reservoirs did not sediment the immobile worms. Nematodes in the finish-

ed water were different from the worms inhabiting trickling filters.

Investigations are being carried out to study the possible build up of these worms in the filters. Also some observations are being made on the worms from the final water of Wazirabad Water Works.

(b) Since very little is known about the interferring organisms in Water Works in India, data were gathered from Chandrawal Water Works on the quality and quantity of the different types of organisms that interfere with the water works practices. The data are being processed.

10. Control of algae at the Wazirabad Reservoir by copper sulphate and its effect on fishes

(PROJECT NO. 1.8)

Laboratory studies on the efficiency of copper sulphate in controlling algae and its toxicity to a few fishes were carried out. The diatom *Synedra,* which was a nuisance alga in Wazirabad Reservoir, and other plankton organisms can be controlled by a dose of 0.5 mg/lit. copper sulphate with a contact time of 24 hr. TLm values obtained for *Puntius ticto. Labeo dero* and *Mystus tengara* were 2.4, 2.7 and 4.6 mg/lit. of copper sulphate respectively. A concentration of 1.0 mg/lit. or less of copper sulphate is not harmful to those fishes.

11. Raw-water characterization of River Ganga at Kanpur

(PROJECT NO. 1.9)

Survey of the Ganga river at Kanpur has been undertaken with a view to locate the sources of pollution, effect of the quality of the river water at different periods on the water treatment plants of the Municipal Corporation and the J. K. Rayon Factory, and to determine the self-purification characteristics of the river. A number of sampling stations throughout a 15 mile stretch o fthe river have been set up and the chemical, physical and bacteriological characteristics of the river water at these sampling points are being determined every month. The data collected so far, indicate that extreme pollution is occurring at a number of points along the bank of the river; and, as a result, water supply to some of the industries in the locality is greatly affected. The survey is being continued.

12(a). Raw water quality characterization of Khan and Kshipra river to assess its suitability as a source of public water supply

(PROJECT NO. 1.10)

The Survey was undertaken to assess: (i) the extent to which pollution is caused by the discharge of sewage from Indore city and the textile wastes from several industries on the banks of Khan in dry months: and (ii) the effect of over-all pollution quality of water in the river Kshipra at the intake at Ujjain. In the 40 mile stretch between Indore and Ujjain, the river has shown all the three distinct zones of pollution, self-purification and recovery. On completion of the survey, it is suggested that a special attempt should be made to reduce the pollution by treating sewage and the textile mill wastes right at the source of their origin.

12(b). Raw water quality characterization of Upper Lake at Bhopal

(PROJECT NO. 1.11)

The present work is directed towards assessing: (i) whether the quality of the water in the lake confirms to the standards suggested by ISI for use as a source of public water supply; (ii) the efficiency of the existing treatment plants in the reduction of bacteria in water: and (iii) the efficiency of the distribution system. The work on this project needs a motor boat. Attempts are being made to produce the same.

13. Application of tissue culture methods for concentration, detection and identification of entero-virses in raw water

(PROJECT NO. 1.12)

A simple tissue culture method (sample incorporation method) has been developed in this Laboratory for detection of viruses from drinking water. The method facilitates examination of large quantities of water in a single test. About 175 water samples from different sources such as river, well and consumer taps were tested by this method. It is observed that the incorporation of large quantities of water from different sources into the concentrated tissue culture medium does not adversely affect, the monkey kidney monolayer cell line.

14. Analysis of different samples for virus content

(a) One hundred tap water samples from different houses from the Poona city were examined for the presence of viruses by the use of monkey kidney tissue culture.

(b) Chemical, bacteriological, and virological analysis of 50 well water samples from different villages around Poona was carried out.

(c) One hundred and fifty rectal swabs from children below 15 years age, were examined for the presence of enteroviruses by the use of monkey kidney tissue culture.

15. Studies on evaluation of bacteriophages and other micro-organisms as possible indicators of virus pollution

(PROJECT NO. 1.13)

Laboratory scale experiments were conducted to determine optimum lethal dose of chlorine to coliphage and to find out percentage removal of coliphages from artificially polluted tap water by alum flocculation and sedimentation. Twelve sets of experiments were so far carried out.

16. Epidemiological survey of gastro-enteritis and infectious hepatitis

Epidemiological survey of gastro-enteritis and infectious hepatitis in Bombay was conducted at the request of the Health authorities. Patients suffering from gastro-enteritis and infectious hepatitis were interviewed. Raw water samples from the various reservoirs and tap water samples from different consumer taps were examined for the presence of coliform organisms and enteroviruses. While no enteroviruses were detected in these water samples, coliform bacteria were found to be present in all the drinking water samples including those collected from consumer taps.

17. Removal of virus pollution from naturally and artificially polluted water

(PROJECT NO. 1.14)

Laboratory scale experiments were carried out to determine the percentage removal of enterovirus from artificially polluted water samples by flocculation and sedimentation. A pilot plant of 24,000 g.p.d. capacity has been erected and com-

missioned at Enteric Virus Research Laboratory. Pilot plant studies will be conducted to find out the reduction in enteroviruses at every unit operation of water treatment plant.

18. Evaporation control by hexadecanol

(PROJECT NO. 1.15)

The CPHERI had conducted the evaporation control experiments in 1963 at Vihar lake, one of the water supply sources to the City of Bombay. The water spread area of this lake is 14,00 acres at its full surface level. It supplies at an average 24 mgd to the city.

The chemical used was commercial Cetyl-Stearyl Alcohol in the form of powder. During this period of experiments, water budget was prepared for a short period when the lake was quite dormant and the inflow and outflow quantities could be accurately budgeted. It was found that the chemical treatment during this period resulted in a saving of 20.5 per cent in evaporation losses and no complaints regarding potability of water were recorded.

Experiments are being conducted again this year at Vihar lake to check the results obtained earlier and to perfect the technique of dispensing the chemicals and maintaining the monomolecular film on the water surface. The conditions at the Vihar lake this year are more favourable and the results so far obtained are also very encouraging.

Besides the experiments being conducted directly by the CPHERI, the Director of this Institute has been given the responsibility of co-ordinating the work being done at various places in India on Evaporation Control after the retirement of Dr. Ramdas, Assistant Director, NPL, who was acting as a Co-ordinating officer of the Evaporation Control Research Committee. This Committee is functioning under the CSIR to assess the work on the Evaporation Control and to advise the research workers in this country.

19. Characterisation of raw water at Pulta Water Works with reference to salinity

(PROJECT NO. 1.16)

The data collected from the operational records were compiled. The raw water characteristics such as turbidity, salinity,

pH, alkalinity, etc. were determined. Further work is in progress.

20. Biological indicators of pollution of river Sabarmati Ahmedabad

(PROJECT NO. 1.17)

Work is in progress from the past four months. Chemical analysis of pure and polluted waters is being carried out Qualitative and quantitative studies of surface and bottom fauna were made. Further work is in progress.

WATER WORKS AND WATER TREATMENT

21. Jaipur water supply scheme

Jaipur city has a total consumption of 10 mgd of water. Out of this, 5 mgd is drawn from the Ramgarh lake, about 40 km away from the city. Water is pumped from this lake to Lakshman Doongri Water Works, where it is treated and supplied to the old city area. The eastern extension area, i.e., Bani-Park and New Colony is supplied by the Amanishah Headworks. About 3 mgd of water is withdrawn from 22 open wells and 6 bore wells in a day. The remaining areas of the city i.e., 'C' scheme, Gandhinagar, Bajajnagar, Adarshnagar, etc., are supplied water from 47 open wells and bore wells, which are spread over the respective localities. A survey of these wells was made and samples were collected in two seasons, starting from July to December, 1964. The first set of samples were collected and analysed between July and August and second between September and December. Routine analysis was done for pH, acidity, alkalinity, chlorides, calcium and magnesium, hardness, Cl, SO_4 and solids. It has been observed that out of 74 wells, 27 have got potable water and the remaining have water of non-potable quality. The survey will be extended for two more seasons before arriving at any conclusion.

22. Reduction in micro-organisms at different stages of water treatment at Chandrawal and Okhla Water Works

Before suitable standards for raw water for use in public water supplies are laid down, it is necessary to know the reduc-

tion in the bacterial load on each unit of the treatment system The work was started in July 1963, and completed in July 1964. Samples of water from different stages of treatment at Chandrawal Water Works were collected thrice a week and analysed for coliform and enterococcus MPN. The study of plankton reduction was also started in July 1963, at Chandrawal Water Works. The phyto-plankton and zoo-plankton reduction, starting from raw water to the final water, was studied once a fort-night.

23. Preliminary observations on Agra Water Works

Agra gets its water from River Yamuna which is highly polluted by cattle wading and by domestic wastes from communities upstream of Agra. The BOD of raw water was 14 mg/lit. as against 6 mg/lit. recommended in International Standards. The purification units comprise 7 mgd slow sand filters, 2.5 mgd old Patterson rapid sand filters, 5 mgd new Patterson rapid sand filters, and 10 mgd Geo-Miller rapid sand filters with clariflocculators. An additional 7.5 mgd water is pre-treated in horizontal baffle type flocculators. Jar tests conducted on raw water with 40 mg/lit. alum showed a considerable reduction in turbidity and organic matter but none of the sedimentation units showed good removal with 70 mg/lit. direct alum feed.

The old sedimentation tanks have no desludging arrangements. The settled sludge with high organic matter undergoes anaerobic decomposition and adds taste and odour to water. The filtered water showed high turbidity and organic matter and low dissolved oxygen. Effluent from rapid sand filters contained *Cyclops*, *Prestina longiseta*, *Rotifers* and enormous number of algae but the effluent from slow sand filters contained no zoo-plankton.

The chlorine demand of raw water was high but it gradually decreased as water passed through different stages of purification. 0.5 mg/lit. of copper sulphate added to raw water did not kill algae and Chironomous largae. Copper sulphate, 25 mg/lit. and chlorine, 17 mg/ lit. killed Chironomous larvae in six hours. There was a large accumulation of sludge in clear water reservoir, which contained *Prestina longiseta*, *ostrocod shells*, *Chironomous larvae*, *pupal cases* organic matter. The sludge gets pumped into the distribution system. Further

work is in progress. Based on this work, the Government of Uttar Pradesh has requested the institute to carry out similar studies on water treatment works in U.P.

24. Investigation on the performance of Jhalarapatan Water Works, Jhalawar—Rajasthan

Investigations were carried out in June 64, to determine the cause of 'milkiness' observed in tap water at Jhalarapatan. Studies indicated that it is either collectively or individually due to : (i) suspended silica in raw water; (ii) suspended organic matter in raw water; (iii) calcium bicarbonate instability in raw water; and (iv) calcium carbonate, contributed by bleaching powder. It is observed that the 'milkiness' can be removed by effective flocculation followed by filtration and by using gaseous chlorine instead of bleaching powder. Several recommendations were made to improve the water quality and to prevent recurrence of 'milkiness' in tap water.

25. Studies on the performance of water treatment plant at J. K. Rayon Factory, Kanpur

Studies were carried out during the year, with the object of working out suitable measures in the event of any difficulty arising out of change in the raw water characteristics at certain periods of the year. This Factory has been receiving raw water from the Ganga highly contaminated with tannery waste for the last one year. Although the finally treated water was heavily chlorinated, the residual colour of the water (due to the presence of tannin) was very high; and, as a result, the quality of the rayon yarn washed with this water was affected. The situation was aggravated recently by contamination of Ganga water with sewage from breach of a sewer in that area. For two or three days, the Factory pumped only raw sewage into their water treatment plant and, as a result, several staff members fell sick with gastro-enteritis and other ailments. The Kanpur Field Centre investigated the situation and advised for a stoppage of water treatment plant until the breach of the sewer was repaired, flow of sewage was diverted and every unit of the water treatment plant and distribution system were thoroughly cleaned, flushed and disinfected with chlorine. It has also been suggested that they could extend their intake point to the midstream over floating drums to get water of satisfactory quality.

26. Hydrobiological studies of Ajwa Reservoir and Nimeta Water Works, Baroda

The studies on the above were carried out during 1963-64 by Ahmedabad Field Centre. The colour of the water was found to be always greenish. Two series of samples were taken from the deepest place near the intake tower, once a month, one in the early morning and the other in the afternoon. In the months of July and September, a unique state of homothermal condition was noted. Substances of biological significance were poor. Macrophytic vegetation was abundant. Zoo-plankton organisms were found to be more dominant than phyto-plankton organisms. *Botrycoccus* sp., *Pediastrum* sp., *Trachelomonas* were the dominant plant organisms and *Rotifers, Crustaceans*, and *Cyclops* were the dominant zoo-plankton organisms. The water though clear, contained more organic matter in the bottom samples. The water was found to be fair in quality, bacteriologically.

At Nimeta Water Works, the variations, in the characteristics of raw water were studied along with the biological conditions in the sedimentation basins and in the filtered water samples from the six rapid sand filters. It was noted that there were large growths of *Spirogyra*, Sponges and Gastropoda clinging to the walls of the sedimentation basins. The filters were not working properly on all occasions. More numbers of animals as well as plant organisms were noted in the filtered samples than in the raw water. Towards the end of the year, nematodes and oligochaetes were found in filtered water in fairly large numbers. Pre-chlorination did not have any effect in reducing the density of the organisms. It was decided to chlorinate the filters by adding the available bleaching powder. Experiments with the above did not produce the desired effect as the available chlorine in the bleaching powder sample was practically nil. The following suggestions were made to the Municipality for the best maintenance of the plant.

(1) Since there were growths of microscopic vegetation which led to the growth of animal organisms, efforts must be taken to remove the growth. This can be achieved by stocking fish and periodical removal of the same. This may yield an income of nearly one lakh rupees per annum.

(2) As the raw water was very clear and its turbidity was as low as 25 mg/lit. for nearly six months of the year, alum addition was considered unnecessary. Break-point chlorination dose will be necessary to kill the *Rotifers* and worms. Apart from the above, the filter beds must be kept sterilized by chlorination after back-wash. A chloronome capable of delivering of 1.0 to 5.0 mg/lit. of chlorine will have to be set up for treating the raw water.

27. Studies on the performance of Mir Alam Water Treatment Plant, Hyderabad

Detailed investigations have been conducted in this plant with a view to find out better means of coagulation and sedimentation of raw water as those present a difficult problem to the authorities. It is found that there is very little removal of turbidity under the existing practices from the raw waters in the pre-treatment processes. The data collected have been compiled in the form of Technical Paper.

28. Role of zeta-potential in chemical coagulation

(PROJECT NO. 2.1)

The measurement of zeta-potential of colloidal particles involves the determination of the electrophoretic mobility of particles found in natural turbid waters. A Brigg's cell is indigenously made and is being tried for its suitability to measure zeta-potential. Further work is in progress.

29. pH adjustment for coagulation of suspended impurities in Yamuna water

(PROJECT NO. 2.2)

The coagulation of suspended impurities in Yamuna water is difficult when the turbidity is below 100 mg/lit. The coagulation necessitates high alum dose with little improvement in floc formation. Acidification has been practised in some countries to reduce alum dose and improve floc characteristics. A bench scale study was carried out for a period of two months. Acid concentrations from 20 to 120 mg/lit. were tried with different alum dose and velocity gradients. Based on these experiences, further studies were conducted on pilot plant scale to assess the feasibility of acidification on a commercial scale. Two circular clariflocculators were used, one as control and

the other with different doses of acid and alum. In general, no improvement is observed in flocculation and turbidity removal even at a very high dose of acid.

30. High rate filtration studies

(PROJECT NO. 3.1)

The following studies are being conducted on filtration: (a) different media for filtration; (b) effective size and uniformity co-efficient for different media and different rates of filtration and efficiencies. The necessary equipment has been installed for the above studies. Preliminary work using sand as filter media has been carried-out which will later be used in pilot plant studies.

31. AKX biflow filter studies

(PROJECT NO. 3.2)

AKX biflow filter has been used successfully and efficiently in some foreign countries. It is, therefore, proposed to set up a pilot plant inNagpur to study the efficiency of this unit as compared to conventional filters. A site near Kanhan Water Works has been chosen for this purpose tentatively.

32. Design requirements of municipal diatomaceous filters

(PROJECT NO. 3.3)

(i) The experimental diatomaccous filter is being ordered under the UNSF Programme, so that the same could be manufactured in this country; (ii) different samples of diatomaceous earth are being tested for their suitability as filter media.

33. Design of a mobile filter for Defence purposes

(PROJECT NO. 3.4)

One pressure filter is under construction at Lakshminarayan Institute of Technology, Nagpur, for the study. The filter is made out of M. S. sheets.

34. Rate of filtration and filter run studies on filters of Chandrawal Water Works, Delhi

(PROJECT NO. 3.5)

The purpose of the project is to evolve a simple filter washing procedure to reduce wastage and to improve the qua-

lity of treated water. Studies are being carried out: (i) to find the optimum effective size of sand; (ii) to find the suitability of surface wash; and (iii) to establish correlation between algae count and length of filter run.

35. Water treatment plant at RRL Hyderabad

(PROJECT NO. 3.6)

The raw water which is being treated at the RRL treatment plant has very low turbidity (about 40-50 mg/lit.) It is found that this water is very difficult to coagulate with alum doses ranging from 0.2 to 0.4 gr/gal. Extensive experiments have been undertaken to work out the economics and feasibility of applying higher doses of alum with or without the use of coagulant aids, especially, activated silica. Jar-tests have revealed that dose of about 3 gr/gal may be effective for better coagulation. With the application of higher doses of alum, the pH of the raw water is reduced from 8.4 to 7.8 which is within permissible limits.

Another set of experiments conducted using activated silica have revealed that the same efficiency can be obtained by a lower dose of alum say 1.5 to 2.0 gr/gal along with about 4 mg/lit. activated silica. The other variables such as the overflow rate, the detention period and the velocity gradient remain the same.

36. Characteristics of ion-exchange resins developed by NCL, Poona

(PROJECT NO. 4.1)

This Institute received samples of two polystyrene type ion-exchange resins from NCL, Poona, and the same have been tested for demineralisation of water. It has been found that the resins are quite good in quality. The cation exchanger is of high capacity strong acid type whereas, the anion-exchange is of a medium capacity strong base type.

A mono-bed unit (in which both cation exchanger and anion exchanger are taken in one column) has been designed and fabricated. The quality of the finished water is quite good and showed a conductivity of 0.15 to 0.3 microhoms. The unit has a capacity of about 30 litres per regeneration cycle. It could treat water with total dissolved solids 250 mg/lit. so as to give

30 litres in about 6 hours. Regeneration and rinsing take about an hour.

It is proposed to study the suitability of indigenously developed ion-exchange resins for tertiary waste treatment using micro-reticular resins ahead of conventional beds to remove organic load.

37. Solar still design criteria

(PROJECT NO. 4.2)

This can be used in the conversion of salt water into potable water by the use of solar energy. The method is well-suited in places like Rajasthan where community to be served with water is comparatively small and where abundance of sunlight is available. For this study, a solar still model having a floor area of 18 sq ft was constructed at a cost of Rs. 500/-, and various experiments were conducted. Now it is observed that for the winter months, the average rate of distillation is about 0.5 gal/day at 50 per cent efficiency of the model. This is only tentative. Further studies are in progress.

38. Defluoridation studies

(PROJECT NO. 5.1)

(a) A new material has been prepared by treating dry saw dust with concentrated sulphuric acid. The material, after processing further, found as efficient fluoride removal. In a few preliminary experiments, different indigenously available cation exchangers, e.g. cashew nut shell liquid resin (Waso 14), carbion (a sulphonated coal), polystyrene cation exchange (sulphonic type) and sulphonated saw dust were tried for defluoridation and have been found to possess a fluoride removing capacity of respectively 875, 700, 900 and 1600 mg/kg of the material. The sulphonated saw dust has further been studied for fluoride removal under different conditions of varying pH, dissolved solids, fluoride concentration, etc. Further studies are in progress.

(b) Reports were received on cases of endemic fluorosis in some village of Nagpur district of Rajasthan. A survey was made and water samples were collected from Ramsia, Jaswantpura, Sagalia etc. The samples were found to contain fluorides up to 14 mg/lit.

39(a) Disinfection of wells in rural areas

(PROJECT NO. 6.1)

Bleaching powder mixed with predetermined quantity of a particular type of sand was taken in an earthenware pot having an orifice at the bottom. Another pot filled with sand alone was placed in this pot. The pot was hung in a well with 8 ft dia. and 30 ft water depth. It was observed that 400 gm of bleaching powder (25 per cent available chlorine) yielded a residual chlorine of 0.3 to 1.5 mg/lit. for 13 days.

(b). Bleaching powder chlorine cartridge for rural well water disinfection

(PROJECT NO. 6.1)

A cheap and continuous method for disinfecting well water has been devised. The method consists of using bleaching powder in an earthenware inner pot which is put in a bigger pot. The chlorine diffuses out through the holes provided in the pots. The method is being studied for its utility in different wells, and with different well waters since the chemical nature of the water is found to affect the effective period of chlorination by blocking the holes.

40. Comparative efficiency of iodine and chlorine for bacteria and helminth destruction

(PROJECT NO. 6.2)

Though chlorine is highly bactericidal, its activity is largely influenced by ammonia and pH. Compounds of iodine which release elemental iodine have been suggested as better emergency disinfectants, since activity of iodine is less affected by change in pH and ammonia concentration.

Work has been undertaken to find out the effective dose of chlorine and iodine for disinfecting water polluted with 4 per cent of sewage. This concentration has been selected as a representative one of badly polluted water in the field. The effective dose of chlorine and iodine is being compared at different pH, temperature and against different enteric pathogens.

41. Disinfection of rural well water by carboy method

(PROJECT NO. 6.3)

A simple device for automatic chlorination of small wells has been finalised. A pocket kit for estimation of residual

chlorine has been perfected and distributed to municipal bodies. The kit has been found to be faultless and an indispensable aid to the sanitarians in urban and rural health administration.

WATER DISTRIBUTION

42. Carrying capacity of rising mains and distribution mains of Delhi Water Works

(PROJECT NO. 7.1)

Studies on the existing pumping capacities and the carrying capacities of the rising mains and distribution mains in Delhi have been started to suggest modifications in the system. The ratios of peak hourly demand and effective storage capacities to average hourly demand for communities with different standards of living and varying proportion of domestic, industrial and commercial use have been determined. The average hourly demand for 24 hr in three consecutive days of each month is computed for 12 months in 1961, 1962 and 1963 from the flow recording charts. The peak hourly demand relative to the annual average ranges between 1.68 and 2.63 and the maximum effective storage capacity required for balancing diurnal fluctuation ranges between 3.34 and 6.64 times the annual hourly demand. Computations have been completed for 10 distribution mains.

The carrying capacities of rising mains from the water works to balancing reservoirs have been calculated on the basis of these observations, and modifications suggested to supply sufficient water in next summer.

The work on determining the performance of pumps and field determination of pressure and discharge to obtain the effect of aging on the carrying capacity of mains shall be started soon.

43. Distribution system analysis of Nagpur water supply

(PROJECT NO 7.2)

It is proposed to study the effectiveness and the efficiency of the net-work system of Nagpur city and the work has been started in Shankar Nagar where the pressures at the house connections are observed to be on the lower side in the order

of 10-13 psi. About 30 per cent of the area has been covered. The work is in progress.

44. Pressure survey of water supply in Vijayawada—A.P.

Pressure survey of the distribution system of the Vijayawada Water Supply Scheme has been carried out with a view to locate the defects in the existing distribution system and to suggest remedial measures. This work has been completed and a Report submitted.

45. Package plant for water treatment on scale model for 1000-5000 gph for small and medium size communities

(PROJECT NO. 7.3)

One plant is designed and put up into operation at E.V.R. Laboratory at Poona. The plant is designed for a population of 500-700 The capacity of the plant is. 1000 gal/hr.

SEWAGE CHARACTERISATION

46. Characterisation of the grit in sewage

(PROJECT NO. 8.1)

Grit, if not properly removed from sewage, causes excessive wear and tear of pumping machinery and other moving mechanical parts. Difficulties are also experienced while removing sludge through pipes from sedimentation tanks. Due to accumulation of grit in digestion tanks, the frequency of cleaning is increased and efficiency of operation also reduced. Hence proper and efficient removal of grit from sewage which depends on sound design of the unit will go a long way in reducing the maintenance cost of sewage treatment units.

Experience in the U.S. has indicated that a grit chamber designed to remove particles of 0.2 mm size removes most of the grit that causes trouble in sewage treatment. Based on this experience, grit chambers are designed to remove particles of the size 0.2 to 0.25 mm. This requires maintenance of a constant velocity of sewage flow through the grit chambers. Based on Shiedl's experiments, the critical velocity that has to be maintained in the grit chambers to remove particles of size say

0.2 mm with a sp. gravity of 2.65 at a sewage temperature of 60° F has been determined at 0.75 ft/sec. Giving some allowance for turbulence of flow, etc. in the grit chambers, the velocity is maintained at about 1 ft/sec and this has become a standard practice.

But the quality and quantity of grit obtained in India is not the same as that obtained in U. S. due to the different living habits, etc. For example, in Indian homes, lot of ash is being used for cleaning utensils. Hence characterisation of grit obtained in India will be of much use in placing our designs on a more scientific basis.

To start with, a small colony has been chosen for the grit characterisation studies. Samples of grit are collected and analysed for size distribution, sp. gravity, volatile matter, etc. An automatic flow recording device to record the flow through the grit chamber has been fabricated and the same has to be tried in the field.

It is proposed to characterise the grit obtained from the colony during several seasons of the year. Simultaneous work on grit characterisation will be carried out at different Field Centres. After obtaining necessary data, it has to be seen whether any radical change is necessary in the design practice followed hitherto for grit chambers for Indian conditions.

47. Investigations into BOD values at 37°C, 30°C and 20°C

(PROJECT NO. 8.2)

(a) Studies on BOD values at different temperatures were undertaken with a view to correlate these values with the Indian temperature conditions. The average water temperature in India ranges from 30 to 32°C normally. Hence it is thought worthwhile to investigate this important point which ultimately may result in discarding the refrigerated incubators which are costly. This work was taken up from January 1965 and is in progress at Headquarters.

(b) Effect of temperature and incubation period on B.O.D. of sewage

The effect of temperature and incubation period on BOD of Okhla raw sewage has been studied by running tests for ten

days at different temperatures. A temperature range of 12-40°C in two to three degree increments was covered while repeating 2 to 3 observations at each temperature. In all, 47 observations were taken. The data is being processed for : (i) the value of rate constant 'k' at one temperature; (ii) effect of temperature on 'k' value; (iii) effect of temperature on ultimate carbonaceous oxygen demand; (iv) stage at which nitrification starts; and (v) immediate oxygen demanded. The experiments will be continued in order to determine per capita BOD and also BOD values at 20, 30 and 37°C.

48. Investigations on BOD (5-day) value per capita contribution in Indian sewage at 20 and 37°C

(PROJECT NO. 8.3)

The per capita values of BOD normally refer to 5-day. BOD at 20°C of the per capita flow of sewage in terms of 5-day BOD at 20°C of the standard sewage. The per capita values of 0.12 and 0.18 lb used are mostly based on American and British Standards. Under Indian conditions, the per capita values have not been verified. If typical values are known, they will largely help in the design of sewage treatment plants. To verify the per capita BOD contribution at 20°C/37°C, this project was undertaken in July 1964, and is under progress. So far, the results indicate that the per capita value at 20°C ranges from 0.04 to 0.12.

WATER POLLUTION AND STREAM SANITATION

49. Assessment of pollution at Wazirabad in 1964

After heavy rains in 1964, overflow from Najafgarh drain and washings from Badli dumping grounds started entering Wazirabad intake for Delhi water supply. The physical, chemical and bacteriological analysis was carried out daily for one month on raw water and treated water to keep the water works staff aware about the change in water quality. The free residual chlorine was checked frequently in the distribution reservoirs and the Corporation was advised whenever chlorine

boosting was desired. The treated water was also tested for known entero-viruses on three occasions.

50 (a) Preliminary studies on the quality and the effect of industrial wastes on Najafgarh nullah

The Najafgarh drain, carrying a mixture of accumulated flood water, sullage and industrial wastes, discharges into river Yamuna downstream of Wazirabad barrage. As there are a number of riparian owners and a water works downstream at its confluence with river Yamuna, need was felt for a survey of the industrial and domestic discharges into the drain and a study of the effect of this load on river Yamuna. The drain and the river were surveyed 11 times when the flow through the drain and the river was low and the data have been processed. It is concluded that the various chemical characteristics investigated were well within the permissible limits downstream at confluence points and hence the drain does not render the river unsuitable during summer season. The effect of toxicants and biologically undergradable organic matter was not covered in study.

(b) Quantitative biological assessment of pollution

It is planned to study the pollutional effect of Najafgarh nullah on river Yamuna. The proposed study will cover the quantitative estimate of the benthic in ertebrates in different polluted zones after the confluence of Najafgarh nullah with river Yamuna. A comparison of the forms existing upstream the Wazirabad barrage will also be made. Duration of the project would be 1 year.

(c) Self-purification in Agra Canal

The excess sewage and the effluent from Okhla Sewage Treatment Plant is discharged in Agra Canal during summer and winter seasons. Samples collected from 12 stations were analysed for BOD, oxygen consumed, nitrite, ammoniacal nitrogen, alkalinity, chlorides and solids. Estimation of coliforms and enterocci organisms were also made in each sample. It was observed that the sullage and sewage discharge upsets the oxygen balance in Canal water but the Canal starts regaining its normal conditions within 82 minutes after receiving this discharge. The reaeration coefficient., velocity of flow and mean

depth were determined, which show good correlation. Bacteriological studies show a sudden increase in coliform and enterococcus MPN, which is followed by rapid decrease in their MPN. It is interesting to note that enterococcus MPN show rapid decrease than coliform MPN.

51. Characterisation of dairy wastes

(PROJECT NO. 9.1)

Dairy and whey wastes are made synthetically in the Laboratory. Investigation on anaerobic digestion of whey waste is in progress.

52. Characterisation and treatment of distillery wastes

(PROJECT NO. 9.2)

A pilot plant for treatment of 5,000 gpd distillery waste by anaerobic digestion followed by treatment in trickling filter has been designed by Kanpur Field Centre in collaboration with M/s Dorr-Oliver, INC, Bombay, Messers Dyer Meakin Breweries Ltd., Lucknow, have offered a site within their factory premises for installation of the pilot plant.

53. Recovery of potassium salts from distillery wastes by atomised suspension technique

(PROJECT NO. 9.3)

A pilot plant is being designed and the possibility of installing it in one of the distilleries in U. P. is being explored.

INDUSTRIAL–WASTE TREATMENT

54. Characterisation of pharmaceutical and antibiotic wastes

(PROJECT NO. 9.4)

Antibiotic wastes from the Hindustan Antibiotics Limited were characterized and the results compiled. Further work is in progress.

55. Polyvinyl factory wastes

M/s Rajasthan Vinyal Corporation, a subsidiary of Delhi Cloth Mills has set up a factory at Kotah. It has two units,

caustic soda factory and the polyvinyl chloride plant. A study of the problem at Jaipur Field Centre revealed that the effluent contains free residual chlorine up to 200 mg/lit. and traces of formaldehyde. The effluent is discharged by the Factory into a small stream, which is a seasonal nullah called Khunsua nullah. As a result of the disposal of waste into the stream, which has very little flow in summer, it causes death of fishes, hinders growth of crops and is a nuisance to people who use this stream for bathing, washing etc. The problem was carefully studied and a report submitted.

56(a). Characterisation and treatment of paper mill wates

(PROJECT NO. 9.5)

(i) *Characterisation :*

Three grades of effluents are involved in the paper and pulp mill of 200 tons/day capacity at Orient Paper Mill, Brajrajnagar. Grade I is mostly cooling water and is kept in a closed cycle. Grade II effluent is discharged from the paper machines. It is a high volume effluent with a pH of 7.0 to 8.5, a BOD of 70-150 mg/lit. and suspended solids of 400-600 mg/lit. This effluent is passed through save-alls and cinder beds to reduce its suspended solids content and re-cycled through the barometric condenser. It is also used in pulp making, washing and diluting operations. Over and above, the effluent used for re-cycling, about 12.5 MGD is let out into the stream.

Grade III effluent (about 7.5 MGD) consists of drippings and drains of pumps, glands and stock preparation chests, some effluents from the bleaching section and some effluents from the causticising section. Its pH is between 8.0 and 11.5. Its BOD is 300 to 625 mg/lit.; COD, 1,200-3,000 mg/lit.; and 4 hr oxygen absorption, 525 to 1,400 mg/lit. It has a colour of 2,500-3,200 units on the platinum cobalt scale.

Treatment of anaerobic lagooning of paper waste (Grade III)

Waste water (Grade III) has a high pH, colour, COD and a considerably high BOD. Anaerobic lagoon experiments are being carried out in Winchester bottles at 37°C using digesting cow-dung as seed and diammonium hydrogen phosphate

as a nutrient adjunt. The seed is slowly acclimatised to the waste by keeping a detention time of 20 days to start with and gradually reducing to 5 days in the course of 3 months.

It was found that the pH was reduced from 9 to 10 to a range of 6.8 to 7.5 during digestion. Gasification was good and BOD reduction was between 18 and 25 per cent for the detention time of 7 days. In spite of pH reduction and good gasification, the effluent oxygen absorption values were found to be more than the influent. Reasons for this discrepancy are being investigated and efforts are being made to find a better criterion for the destruction of organic matter.

Aerobic treatment of paper waste

Experiments are being carried out to find the biological treatability of the waste by activated sludge process using mixed bacterial culture. Activated sludge is being acclimatised to the wastes.

57. Characterisation and treatment of straw-board factory wastes

(PROJECT NO. 9.6)

(a) *Anaerobic digestion of straw-board sludge cooker liquor*

Laboratory studies were carried out on anaerobic digestion of straw-board sludge. With a detention time of 30 days, 4-5 volumes of gas were produced per volume of sludge having 6 per cent solids concentration. Experiments have been started to digest strawboard sludge along with the cooker liquor since the latter was found to give 40 volumes of gas per volume of the waste. A mixture of straw-board sludge and cooker liquor in the ratio of 5:1 is found to give about 20 volumes of gas per volume of the mixture having solids concentration of about 6 per cent for a detention time of 30 days. At present, optimum detention time is being determined. It is proposed to study the effect of solids concentration, temperature and mixing on the digestion.

(b) *Characterisation and treatment of strawboard factory wastes at Bhopal*

A straw-board factory discharges approximately 0.7 mgd of polluting waste in a nullah which ultimately finds its way into river Patra at Bhopal. It has a BOD of about 3,000 mg/lit.

and it is necessary to reduce it to below 30 mg/lit. before it is discharged in the nullah. When it is partially settled to remove the settlable suspended impurities before final discharge, the effluent had a BOD of 1000 mg/lit. The present experiments are framed to achieve the object of reducing BOD to 30 mg/lit in the effluent. The pilot plant comprises of 6 lagoons in series, half the number being under aerobic condition. Preliminary observations on the anaerobic ponds indicate an approximate reduction of 80 per cent BOD from the settled effluent. The effluent needs to be further improved. Aerobic ponds have been started recently and it is anticipated that a further reduction of at least 80 per cent of the remaining BOD can be achieved and that the final effluent will not have a BOD of more than 30 mg/lit.

Experiments were also conducted on a laboratory scale to study the digestability of cooker liquor. The liquor had a 5-day BOD of 30,000-45,000 mg/lit. The samples were subjected to the following tests: pH total and suspended solids. A reduction of about 70 per cent in volatile matter was observed after digestion. The gas production measured at room temperature (25-30°C) was about 20-60 volumes per volume of waste fed per day. Studies showed that no additional nitrogen is required to support biological processes in the digester. It was also observed that no buffering was required. Overloading of the digester was tested by fall in gas production, lowering of pH, increase in volatile acid concentration increased percentage of carbon dioxide in gas, increased ammonia concentration in the liquor, and excessive scum formation.

(c) *Characterisation and working out method of paper board effluent at Allahabad*

The problem of treatment of effluent from M/s Bharat Straw Board & Paper Mill Limited, Allahabad, was further investigated. The Factory presently manufactures unbleached paper board. Waste papers are disintegrated and converted into pulp with plain water in beaters, and the pulp goes to foudrinier type machine, where it is converted into paper board. Out of the two machines run by the Factory, one machine was losing more pulp in the effluent because of defective travelling wire mesh. The effluent from this machine had high concentration of suspended solids and BOD. Experiments, by filtering the

effluent through different size screens showed that considerable amount of pulp could be recovered by a 72 mesh screen. Although 100 mesh screen showed better removal of pulp, clogging of the mesh occurred and therefore, preference was for the former. Settlement of the raw waste for 4 hr. showed greatest percentage reduction in suspended solids. BOD was also reduced significantly.

Earlier experiments with lime at different concentrations showed that at a concentration of 400 mg/lit., about 98 per cent of suspended solids and about 53 per cent of BOD of the effluent could be reduced. However, the experiment, is being continued to confirm the most satisfactory method of treatment and disposal of this effluent.

58. Characterisation and treatment of textile wastes

(PROJECT NO. 9.7)

Wastes from different sections of a textile mill (Empress Mills, Nagpur) were collected fortnightly and following studies were made :

i. Characterisation

ii. Treatment

iii. Recovery of alkali from kier-waste

(i) *Characterisation :*

Kier wastes, wash liquors and the composite textile wastes of a cotton textile mills, carrying desizing, kiering, bleaching, mercerising and dyeing operations have been analysed.

Kier wastes, the most polluting item, had a light to dark brown colour total solids, from 4,500 to 13,600 mg/lit.; suspended solids, from 120 to 530 mg/lit.; ph, about 12; phenolphthalein alkalinity, from 2,200 to 3,700 mg/lit; BOD, from 280 to 1,500 mg/lit.; COD from 1,000 to 6,200 mg/lit.; 4 hr. oxygen absorption from 170 to 3,100 mg/lit.

(ii) *Treatment-of kier waste liquor :*

Kier waste is moderately high in organic matter and strongly alkaline. This waste was selected for its treatability

by biological methods. Anaerobic lagooning was chosen as the method of treatment. Laboratory experiments were started in Winchester bottles of 2.5 litres capacity, taking 2 lit. of digested cow dung as seed material. The experiment was carried out at 37°C. A detention time of 20 days was given initially and subsequently reduced to 4 days.

Since the waste is deficient in nitrogen and phosphorous, diammonium hydrogen phosphate was added to keep BOD: N ratio of 20:1.

As the waste was highly alkaline, it was neutralized to pH 7 with HCL before adding to the bottles. Changes in pH, gasification, alkalinity, and oxygen absorption from $KMnO_4$ were studied daily for both effluent and influent. In the initial stages, it was observed that the oxygen absorbed values of the effluent were more than those of the influent. However, slowly the oxygen absorbed values for the effluent decreased while those for the influent remained almost constant. It is now observed that there is 30 per reduction in the oxygen absorption values. The work is being continued.

(iii) *Recovery of alkali from kier wastes :*

Kier waste contains about 0.5 per cent hydroxide and normal carbonate alkalinity as $CaCO_3$. The recovery of the alkali is being tried by means of dialysis using cellophane bags.

(d) A textile machinery factory (N.M.M.) located near Thana, used to discharge its wastes containing cyanides from plating and hardening baths in a nearby nullah. Reports were received of death of cattle that consumed water from the nullah and both the Government and the factory approached the Institute for solution. Laboratory studies were therefore carried out to treat their wastes containing cyanides. They also had the problem of solid cyanide wastes resulting from the chippings from the dry baths. Originally it was thought that these can be burried in shallow trenches after which the cyanides would get oxidised through natural decomposition and decay. However, since the pollution of ground water was feared, another method was evolved for oxidising the same by using bleaching powder. An interin report on the subject has been prepared.

59. Studies on recovery of zinc from viscose rayon waste Kanpur

(PROJECT NO. 9.8)

Among the different types of effluent arising from the manufacture of viscose rayon, the spent spinning bath wastes (from the centrifuge of the spinning machine) contain the highest concentration of zinc. Although the daily volume of this waste is very small, its pH is 0.6; acidity, 36,000 mg/lit as CaCo3; and zinc content, 3,600/mg/lit. On the basis of the survey, carried out in the J. K. Rayon Factory, Kanpur, it was estimated that about 75 per cent of the total zinc consumed is wasted daily with this effluent.

Studies carried out in the Laboratory showed that almost 99.5 per cent of the zinc in the effluent can be precipitated and recovered by controlled treatment with alkali to pH 9. But since neutralisation with caustic soda would be very expensive, neutralisation of the effluent was partly done by calcium hydroxide to a particular pH and then by caustic soda to the desired pH. The precipitated zinc hydroxide was separated and redissolved in sulphuric acid to form zinc sulphate which may be re-used in the process.

Preliminary cost calculations show that the process of recovery of zinc from viscose rayon waste would be economical and that foreign exchange could be saved to an appreciable extent, since zinc is imported in this country.

60. Characterisation of plating mill wastes

(PROJECT NO. 9.9)

Waste samples from various chromium and nickel plating mills in Delhi, Punjab and U. P. have been analysed for the concentration of toxic components like chromium, copper, cadmium, cyanide and boron.

61. Treatment and disposal of synthetic drug wastes

(PROJECT NO. 9.10)

A plant manufacturing varied synthetic drugs, especially sulpha drugs, is being set up on the outskirts of the city of Hyderabad. The wastes from such a plant are known to contain about 130 chemicals, both inorganic and organic in nature. Some of the organic chemicals are known to be highly toxic.

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The topography of the area is such that the effluent from this drug plant would drain into one of the city's fresh water lakes. The soil around the Factory is also known to be quite porous. If the wastes are discharged on to land, they are likely to contaminate ground water. For these reasons, the wastes will have to be treated before they are discharged.

Experiments conducted at Hyderabad Zonal Centre of the Institute had indicated that about one half of the waste (300 cu/m per day) comprising mainly of inorganic constituents could be treated by neutralisation with lime followed by washing the sludge two or three times after which the supernatant could be discharged into city sewers. The sludge from such neutralisation could be dried in the open drying beds. It has been found that the resulting supernatant would be harmless to the sewer material when discharged into the nearest sewer with the dilutions available at the sewage treatment plant. The supernatant contains sulphanilic acid to the extent that when discharged into the city sewage treatment plant gives rise to a concentration of 10 to 20 mg/lit. This concentration of sulphanilic acid had been found to have no inhibitory effects on the biological treatment of sewage. This method of treatment of the wastes from this particular block has reduced the volume of the factory effluent to be treated to one half of its original volume.

Further work to treat the remaining wastes by chemical and biological means is in progress.

62. Treatment and disposal of liquid wastes from L.T.C. plant and anaerobic and aerobic lagooning of industrial wastes

(PROJECT NO. 9.11)

Aqueous liquors from coal carbonisation plants are known for their high oxygen absorption (O.A.) values and for their toxic components. Treatment of these wastes to a safe limit has been made difficult due to high concentration of phenols and free and fixed ammonia. The raw waste liquor contains about 4000-6000 mg/lit. of phenols, 9000 mg/lit. of free ammonia, 3000 mg/lit. of fixed ammonia and the oxygen absorption value ranging from 25,000-30,000 mg/lit. In addition to these, other major components are thiocynates, thiosulphates, cyanides, chloride and sulphates.

Since it is difficult to grow algae in such highly toxic wastes, suitable dilutions of these wastes were taken and algae were acclimatised. It was possible to grow algae when the phenolic waste was diluted 11 times. This indicates that the waste is amenable for treatment with algae.

Activated sludge method of treatment of these wastes has been undertaken in the Laboratory. Different concentrations of the waste dilutions have been tried and 90 per cent reduction in (O.A.) values has been achieved with 1.5 per cent concentration of the waste. The percentage reduction with (i) 200 mg/lit. of pure phenol is about 85-95; (ii) 250 mg/lit. of thiocynates is of the order of 90-98; and (iii) 250 mg/lit. of thiosulphate is in the range of 90-95. Algae were grown in the composite mixture of the effluents from pure phenol, thiocynates, thiosulphates and growth was prolific within 4 or 5 days.

Isolation of bacteria and fungi grown in the phenolic waste sludge is under progress. *Pseudomonas*, a known phenolic degrader was already isolated. These isolates will be used to degrade the high phenolic concentrations of the coal carbonization wastes by bio-degradation processes.

Further studies with increasing concentration of raw liquor are under progress.

63. Treatment of high explosives factory waste

(PROJECT NO. 9.12)

(a) The samples from three drains carrying wastes of the Factory near Poona, to Mula river, were analysed. Laboratory scale experiments were conducted to treat the acid factory waste by the use of ion-exchange resins, activated charcoal, chlorine and lime.

(b) The wastes from Bhandara High Explosive Factory (Maharashtra State) mainly consists of nitroguanidine calcium nitrate and calcium sulphate, besides methanol in traces, laboratory experiments so far carried out indicated that oxidation pond treatment can be successfully employed provided the wastes are supplimented with a carbon source to the tune of 200 mg/lit. in the form of sodium bicarbonate. The carbon source could also be supplemented by maintaining sewage and wastes in the ratio of 1:4. In all these experiments, pH 8.0 was found to be ideal for photo-synthetic oxygenation. Bench scale

experiments have indicated that the efficiency achieved could be as high as 80 per cent.

64. Effluent from tyre factory in Rajasthan

(PROJECT NO. 9.13)

Effluent samples from Dunlop Tyre Factory, Ballabgarh were characterized. They were found to have high COD.

65. Treatment of tannery wastes by activated sludge process at Kanpur

(PROJECT NO. 9.14)

The Laboratory studies on treatment of composite and settled tannery wastes (from vegetable tanneries) were continued during the year. Last year, it was observed that synthetic sewage (as diluent) did not give very satisfactory results, hence raw sewage was used as a diluent for tannery waste. The tannery waste sewage mixture (in the ratio of 1:4) was aerated in presence of varying concentrations of mix liquor suspended solids (MLSS ranging from 1,500 to 6,000 mg/lit.) for a period ranging from 6-16 hr with feed BOD ranging from 600 to 1,300 mg/lit. It was observed that, during summer, the reduction in BOD was to the extent of 85 to 90 per cent with 6 hr aeration at a MLSS concentration of about 3,000 mg/lit. The BOD of the raw waste and that of the effluent varied respectively from 900-1,200 mg/lit. and 180-220 mg/lit. During the winter, the same or better percentage reduction of BOD could be maintained only by extending the aeration period to 8 hr, and MLSS concentration to 4,000 to 5,000 mg/lit. The BOD of the raw waste was on an average 900 mg/lit., while that of the effluent varied from 40 to 100 mg/lit.

It was also observed that the colour of the settled effluent greatly diminished by increasing the settling time from 2 to 4 hr, thereby maintaining a prolonged contact of the supernatant with the settled sludge. On the basis of the encouraging results obtained in the laboratory, a pilot plant is being designed for installation and study of the process on a large scale.

65(b) Pilot plant for treatment of tannery wastes at CLRI, Madras

(PROJECT NO. 9.15)

A pilot plant to treat about 2,500 gallons of composite waste for the pilot tannery of C.L.R.I. has been constructed and

is being operated by the C.L.R.I. The Hyderabad Zonal Centre is collaborating with the authorities in collecting necessary technical data for the evaluation of the plant performance.

66. Anaerobic and aerobic lagooning studies of industrial waste

(PROJECT NO. 9.16)

The amenability of paper mill wastes by lagooning is understudy. For this purpose, the liquid wastes from Orient Paper Mills, Brajraj Nagar are subjected to treatment with algae in: (i) raw waste form; (ii) admixture with domestic sewage: and (iii) aerobic lagooning of the effluent from an anaerobic lagoon. The preliminary studies indicated that considerable reduction in the oxygen absorbed values and BOD can be achieved by this method when mixed with raw domestic sewage. The pH values of the raw waste, 25 per cent waste diluted with raw sewage and the effluent from anaerobic lagoon varied from 8.1 to 8.8, 8.3 to 9.6 and 8.7 to 9.2 respectively. The percentage reduction in the 3 min and 4 hr oxygen absorbed values and BOD are given in the following table.

	Percentage reduction in		
	Oxygen absorbed value		Biochemical oxygen demand at 20°C
	3 min	4 hr	
Raw waste	48	32	68
Raw waste 25% + 75 raw domestic sewage	76	54	70
Effluent from anaerobic lagoon	46	20	78

Probably the lesser reduction in the raw waste is due to the deficiency of nitrogen which is essential for algal growth. Percentage reduction in the COD for raw waste and 25 per cent dilution are 19 and 7 respectively.

Laboratory studies carried out with 4 days detention period on the raw waste have shown a reduction of 70 per cent and 60 per cent in the 3 min and 4 hr oxygen absorption values.

Further studies supplementing the raw waste with external nitrogen source and other dilution will be undertaken in due course.

67. Bio-assay studies with reference to industrial wastes

(PROJECT NO. 9.17)

Toxicity studies with synthetic photographic wastes were continued. The photographic industry has 3 major wastes, viz., the emulsion waste, laboratory effluent and white water.

Toxicity studies with reference to emulsion wash water which contains free ammonia have been completed. Synthetic waste was prepared in the Laboratory and the tests were carried out using specimens of *Barbus ticoto, Puntius Puntius,* and *Cirrhina mrigala* of standard sizes.

Studies on toxicity of Laboratory effluents have also been completed. Experiments on the toxicity of white water are in progress.

In all the wastes, in addition to the toxicity of the waste as a whole, the particular chemical responsible for the toxicity has also been studied.

68. Treatment of the photographic wastes

(PROJECT NO. 9.18)

Industrial effluents

(a) Efforts are being made to treat the industrial effluents coming from the Hindustan Photo-Film Industry, Ooty, manufacturing raw movie film by chemical and biological methods, so as to make it innocuous before discharging into a nullah.

Wastes expected from the factory can be classified into 3 different types, viz., (i) Emulsion wash water (containing mostly inorganic salts); (ii) white water (consisting of organics, chemicals and cyanine dyes); and (iii) laboratory effluent containing inorganic and considerable amount of metol and hydroquinone, in the proportion of 28:2:15.

(b) *Bio-assay experiments:*

Fish toxicity studies pointed out that laboratory effluent was the most toxic and white water the least toxic. The toxicity of emulsion water (most voluminous of the three) was pinpointed to its free ammonia content and can be significantly removed by lowering or by bubbling the waste concerned so as to remove free ammonia. The results are given below.

Name of the effluent	TLm values for 48 hr	Causative factor
1. Lab. effluent	1%	Hydroquinone
2. Emulsion wash water	5%	Free ammonia
3. White water	10%	
4. Raw composite	5%	

(c) *Chemical coagulation:*

Composite waste was then treated chemically by adding different coagulants like aluminium sulphate; ferric chloride; ferric chloride and lime; ferrous sulphate and lime for reducing COD. BOD and colour.Coagulation studies pointed out that aluminium sulphate at an optimum level of 500 mg/lit. can reduce toxicity and colour by factors of 4 and 2 respectively. Reduction in COD and BOD, however, was not satisfactory. Coagulation brought about reductions of 40 and 28 per cent in COD and BOD respectively.

(d) *Aeration studies:*

Studies on the laboratory effluent (highly toxic) above using acclimatised mixed bacterial culture showed that it could be treated satisfactorily up to a concentration of 30 per cent bringing about 66 per cent reduction in COD .

Experiments to acclimatise the mixed bacterial culture to progressively increasing concentrations of raw composite as well as treated composite (alum coagulated) samples are in progress.

DEFENCE PROBLEMS

69. A demineralising-cum-water purifying catridge

(PROJECT NO. 4.3)

Removal of toxic metals, viz., arsenic, cyanide, lead and chromium (hexavalent) was tried with mixed ion exchange resins and it has been found to absorb the metals completely. The volume of the ion-exchange resins taken was 10 ml for cation exchanger and 15 ml for anion exchanger and both the resins were mixed intimately. The mixed resin bed rests on a shallow bed (about 1"-2" height) of "Hykol-X". The initial concentration of toxicants was 10 mg/lit. each in distilled water. Generally the above volume of resin treats about 3-5 lit. of water. There is no exact ready method of detecting the leakage of these metals in micro-quantities, and efforts are being made to find out an easy method for detecting the same.

70. Toilet for high altitude regions

In compliance with a request from the Defence Ministry, a toilet, proofed against freezing in the field of action in high altitude regions, has been designed.

SEWERAGE SYSTEMS

71. Velocity studies in sewers at Nagpur

(PROJECT NO. 10.1)

In different parts of India, the design practice for the sewer system is different, and generally, it is aimed at to provide a self-cleansing velocity of 2 ft/sec for the main sewer and 3 ft/sec for the branch sewer.

But the common complaint in a sewered locality is the clogging up of sewers because of lack of precision of self-cleansing velocity in the sewers. Hence, the need arises to investigate factors affecting the maintenance of self-cleansing velocity in the sewer, and to finally arrive at the effective self-cleansing velocity in sewers as per Indian conditions. This will ultimate-

ly save the cost of excavation, if gradients steeper than necessary are used.

For this purpose, it was decided to split up the work as field studies and laboratory studies. The Institute is collecting data at different places of the country through its Field Centres.

Shankar Nagar, a sewered locality at Nagpur, was chosen and the velocity of flow, at different times of the day, has been measured and they are found to be on the lower side and deposition of solids was also observed. More data is being collected to arrive at a definite conclusion.

SEWAGE TREATMENT PROCESSES

72. Imhoff tank-pilot plant studies

(PROJECT NO. 11.1)

The modern trend of treating domestic waste by anaerobic process followed by aerobic lagoons has created new interest in Imhoff tanks. Imhoff tank followed by oxidation pond may prove an ideal treatment for wastes from small communities. With a view to study the possibility of improving the efficiency of operation of Imhoff tank and its economics as compared to separate clarification and digestion, it was proposed to construct a pilot plant. The pilot plant designed to treat 7,500 gal/day of domestic sewage is under construction in the Institute's premises and is expected to be ready in 1965-66.

73. Efficiency of primary settling tanks at Okhla Sewage Works

The efficiency in BOD and suspended solids removal in new primary settling tanks is being studied at Okhla Sewage Treatment Plant. The samples are collected at different loading rates to obtain a relationship between the loading rates or detention time and the efficiency of BOD and suspended solids remival. The sludge from primary settling tanks for fixed solids is analysed to get an indication of the grit not removed in grit chambers and ultimately reaching the digesters. The work is in progress and, in all, forty samples have been analysed. The effect of *Nirmali seed* in improving upon the efficiency of BOD and suspended solids removal is also being studied.

74. Studies on night-soil digestion

(PROJECT NO. 12.1)

The factors influencing digestion of night-soil were studied on the laboratory scale. Based on these results, a pilot plant has been designed and is being installed.

75. Digester-loading studies

(PROJECT NO. 12.2)

A plant scale digester loading study was conducted at Lovegrove Sewage Purification Plant of the Bombay Municipal Corporation at Worli by gradually increasing the sludge volume load, and observing the effects on the quality of the supernatant liquor, digested sludge and the gas generated. After about 8 months of study, it was observed that the present volume-loading rates of these digesters can be safely increased by 1.5 times. In other words, the detention period of 21 days can be easily reduced to 14 days. Thus these digesters will be able to accommodate 50 per cent extra sludge volume load and hence no additional units will be required to be built when the rest of the plant will be extended. It was observed in this study that the sludge at Love grove had less volatile matter in it and hence the organic load on the digester remained well within limits although the sludge volume load was increased. These results were sludge volume load was increased. These results were communicated to the Bombay Municipal Corporation for their guidance.

Modifications to the digesters at Colaba Sewage Treatment Plant are being made to enable the digesters to be operated in series as well.

76. Pilot plant high-rate digester at Hyderabad

(PROJECT NO. 12.3)

The design and estimates of the pilot plant have been finalised. Construction work on the various units such as grit chamber, sedimentation tank, sludge thickner and the digester has been taken on hand. The plant is expected to be ready for operation within the next 3 to 4 fonths when regular data on its performance will be collected. This work is being undertaken in collaboration with the Municipal Corporation of Hyderabad who is also sharing the cost of this plant on 50-50 basis.

77. Studies on various media in trickling filter for waste water treatment

(PROJECT NO. 13.1)

A small pilot filter is being set up. Media like: (i) stones; (ii) clinker; (iii) coke; and (iv) plastic materials, etc. will be investigated.

78. Plant study and operation of a bio-filter at Dharavi, Bombay

(PROJECT NO. 13.2)

Literature study has been made and discussions have been held with the Municipal officials connected with this plant.

79. Studies on the fauna and flora of a trickling filter at Okhla

Trickling filters support an unusually complex assemblage of organisms. It is expected that these organisms will show certain seasonal changes in quality and quantity depending upon various factors. In Delhi, where the variation in temperature is marked, the trickling filter population would show periodic changes. The present knowledge of the fauna and flora of the trickling filter being very meagre, an attempt was made to identify the different forms and their seasonal succession in top layers for a period of one year. Analysis of the data is in progress.

80. Re-use of secondary effluent

(PROJECT NO. 14.1)

Laboratory experiments for finding out the suitable type of tertiary treatment to the secondary effluent at Dadar Sewage Purification Plant, Bombay were completed, and the results communicated to the Bombay Municipal Corporation. They were advised to install a pilot tertiary treatment plant on the basis of laboratory work and the plant is now under construction to try the methods suggested Experiments conducted in this respect had indicated that although suitable improvements can be made in the physical and chemical quality of sewage effluent, it is still not advisable to use it for domestic purposes. It can, however, be used in industries other than food and beverages and for lawn sprinkling.

The Municipal Corporation was also supplied with a scheme for the distribution of these supplies giving the sizes of the pipes, pumps, etc. A detailed report of this work has been prepared.

81. Brush aeration oxidation ditch studies

(PROJECT NO. 14.2)

Laboratory experiments conducted with a view to developing criteria for the design of oxidation ditches for Indian sewages indicated that when campus sewage enriched with fecal suspension to a 4 hr O.A. value of 120-150 mg/lit. was treated in a 100 lit. capacity lab. model with a detention time of 3 days, reductions in 4hr O.A. values were 49, 85 and 91 per cent respectively at speeds of 70, 100 and 120 rpm.

Four months operation of the lab. model using sewage with 4 hr O.A. values of 110 to 125 mg/lit. and BOD of 250 to 385 mg/lit. indicated reductions of 90-91 per cent in O.A. values; 90-93 per cent in BOD, 94-96 per cent in COD and about 97 per cent in suspended solids. Mixed liquor suspended solids were from 3,500 to 4,500 mg/lit. and sludge volume index was about 50. Experiments with lower detention time are in progress.

A pilot plant to treat 6,000 gallons at 3 days detention period has been constructed on campus and is ready to be operated.

82. Pilot plant oxidation ponds at Nagpur

(PROJECT NO. 15.1)

Both Bezonbagh and the Institute campus ponds have given satisfactory performance during the period of study. They showed 80-85 per cent reduction in BOD on 5 days at 20°C.

Three one acre oxidation ponds at Bhandewadi were put in operation from 11-2-65, Parameters such as pH D.O. BOD and algal numbers were taken up for investigation. In order to obtain a better perspective in the mode of working of the oxidation ponds and further to facilitate the development of proper design criteria, the following aspects regarding the oxidation ponds have been studied.

(a) *Occurrence, growth and feeding habits and control of Moina dubia Gurney and Richards in Oxidation ponds: The Moina* blooms were common in Bezonbagh ponds, mostly from November to February. It was observed that temperatures ranging from 28°C to 31 C and pH 7.5-8.2 were favourable for their growth. They were found to graze on algae and deplete the algal blooms from the ponds. An increase in pH level (9.0-9.5) owning to the addition of lime in limited dosages controlled the *Moina* blooms. Methods of culturing *Mo na dubia* in hatcheries for fisheries development are suggested. The results obtained in this study have been published.

(b) *Mosquitos Chironomid larvae in Oxidation ponds :* Studies on the incidence and breeding of mosquitos in oxidation ponds at Bezonbagh and in the Institute's premises revealed negative results. However, *Chironomids* larvae and flies were abundant in the shallower regions (near the bank) of these ponds. To ascertain the role of *Chironomids* in the oxidation ponds, studies on the ecology and bionomics of these organisms were taken-up. The results obtained so far would indicate that:

i) *Chironomid* tentans can feed and grow on *chlorella;*

ii) they can exist under high pH (9.8-10.5) and dissolved oxygen concentrations (17.5 ppm-21.6 ppm);

iii) the larvae are essentially benthic forms;

iv) there are definite indications that they bring about some stabilization of organic matter and the amount of organic matter stabilized is in proportion to the number of larvae present.

(c) *Fungi and their role in the stabilization of sewage :* Using Czapek Dox agar, Martins medium, Glucose--Asparaginate medium and nutrient agar, fourteen fungi belonging to the genera *Fusarium, Mucor, Curvularia, Rhizoctonia, Neocosmospora, Penicillium, Asperigillus, Cladosporium, Dicoccum, Oaspora and Trichoderma* were isolated. Some are fom sewage while others are from sewage polluted soils. *Streptomyces,* an actinomycete was isolated from the oxidation pond soils. Surprisingly, so far, no pathogenic fungus could be isolated. The role of these fungi in the

stabilization of sewage and their relationships with the other biota of the oxidation ponds are under study.

(d) *Qualitative and quantitative estimation of enteroviruses with reference to Nagpur sewage :* With a view to estimate the qualitative and quantitative occurrence of entero-viruses in Nagpur sewage, and to evaluate the performance of the oxidation-pond method of sewage treatment in the elimination of these viruses, attempts are being made as a first step to perfect the sampling technique for a representative 'catch' of the viruses.

The following techniques are under comparative study:

i) conventional swab method;

ii) composite sample obtained by a 24 hr automatic sampler is passed through an anion exchange resin and viruses are eluted three times with Beef extract broth. For a quantitative estimation of infective viral units in different samples of sewage, plague technique with monkey kidney cell line is being tried.

Attempts have been made to obtain different cell lines, viz. : (i) Chick embryo fibroblast; (ii) Hella; (iii) Human embryo kidney; and (iv) Human embryo lung fibroblast.

Studies are being made to get acquainted with Florescent Anti-body Technique for the identification of viruses.

(e) *Development of fish culture by oxidation pond effluent :* This work was taken-up recently on a laboratory scale, *Cyprinus Carpeo Communis* a common food fish of fresh waters around Nagpur was chosen for preliminary experiments.

(f) *Harvesting of algae from oxidation pond effluents :* Harvesting of algae by centrifugation is a costly process. Hence, flocculation and sedimentation methods are being tried to develop a cheaper method, A pilot micro-strainer is proposed to be installed at Bhadewadi for harvesting of algae.

(g) *Microbiology of oxidation ponds :* Laboratory experiments on the viability of *E. coli* in presence and absence of algae were carried out at a room temperature (30°C-40°C) and at controlled temperature (26°C $\pm$ 2°C). Results indicated that *E. coli* were completely eliminated in the presence of algae with a corresponding reduction of 75 to 90 per cent BOD. In the

absence of algae, their numbers were not reduced to any significant extent even after 18 days. Interestingly enough, B. Subtalis counts were not reduced although there was a BOD reduction of 83 per cent. It was found that the reductions in *E. coil* were greater at room temperature than at controlled temperature. *E. coli* were eliminated completely in 7 days in an unbuffered system (pH rose to 10.4) while they were reduced to a such less extent when the system was buffered to pH of 7.5. The influence of pH on the viability of *E. coli* in the presence of algae is being studied further. A laboratory model of an oxidation pond has been set-up for the study of viability of intestinal pathogens. To study the antibactoral activity of algae bacteria-free cultures of algae are being developed.

83. Pilot plant oxidation pond at Ahmedabad (Pirana Farm)

(PROJECT NO. 15.2)

The important changes effected during the year in the above pond were: (1) the removal of the dyke and increasing the depth of the pond from 3-4 ft to 5 ft. This would increase the storage capacity of the pond. The results of the important chemical conditions are summarised below :—

(a) Dissolved Oxygen

	Inlet	250′	500′	750′	Final outlet
Max.	Nil	7.03	7.9	9.3	6.7
Min.	Nil	Nil	Nil	Nil	Nil
Mean	Nil	1.9	1.2	2.5	2.03
(b) % Saturation					
Max.	Nil	99.4	117.6	130.6	94.7
Min.	Nil	Nil	Nil	Nil	Nil
Mean	Nil	24.3	25.4	31.1	28.0
(c) BOD (5-days 20°C)					
Max.	270	208	161	160	160
Min.	127	45	33	61	33
Mean	194	121	87	81	65
(d) Oxygen ab. test (Tidy's)					
Max.	79.3	75.5	71	67	66.5
Min.	32.5	33.3	25.6	31.4	26.2
Mean	54.1	30.3	48.3	48.0	41.4

There was a reduction of 66.5 per cent in BOD and 18.4 per cent in oxygen absorbed. There was a maximum D.O. of 2.5 mg/lit. at 750 ft distance.

83 ½. Multiple cell oxidation pond series at Pirana Sewage Farm and Vasan Sewage Farm

(PROJECT NO. 15.3)

Ahmedabad Corporation has called for tenders to treat the entire sewage from the city by conventional method. The cost of the treatment was estimated to be Rs. 250 lakhs. It has been shown by this Institute that the BOD of sewage from the city is reduced from 300 to 150 mg/lit. by natural purification due to its flow in channels with gradient. It may be possible to reduce the cost of treatment considerably by setting up aerobic lagoons and increasing the loading to more than 300 lb/acre/day, thus reducing the area required. Work in this direction is in progress.

The pilot plant oxidation pond was connected with the rest of the 13 ponds working in series and they have started functioning regularly from November, 1964. The series of ponds were not functioning very well at the beginning as the sewage flow was not proper.

84. Studies on oxidation pond at Hyderabad

(PROJECT NO. 15.4)

The aim of this project is to obtain fundamental quantitative data for the economical and efficient design of the oxidation pond and its operation. For this purpose, the studies have been divided into two groups, viz.:

(i) Prototype studies;

(ii) Model studies.

Prototype studies

Very little progress was made on the studies during the period under review.

Model studies

Considerable progress was made on these studies during the period under review and the data so far collected have been compiled in the form of a short technical paper which was dis-

cussed at the Symposium held at Simla organised under the Central Board of Irrigation and Power. Further work on this aspect is being continued. This project is expected to be completed shortly when the entire data will be compiled.

The present sewage treatment plant at Hyderabad consists of a balancing tank followed by septic tank. These units are overloaded. In order to demonstrate the advantages of oxidation pond treatment, a pilot oxidation pond was put up.

85. Oxidation pond at Jaipur

(a) Jalmahal lake as a natural sewage stabilization pond is situated on the northern side of the city and acts as a sewage stabilization pond. A part of the city sewage is used for irrigation purposes and the remaining (approx. 1 million gallon) sewage enters into the lake every day. Here the sewage gets purified under natural condition; and is acting as natural stabilization pond at present. Study on the reduction of organic and bacterial loads and on the chemical composition was started regularly from January 1964 onwards. Eleven samples were collected and analysed for chemical composition and 8 samples for bacteriological analysis. It was observed that the concentration of salts (Magnesium, chlorides and sulphates) was more in the summer season, viz., May, June, and July. Because of heavy rains, the lake was heavily flooded with rain water this year, which resulted in heavy dilutions of sewage.

(b) Studies for the selection of a suitable local species of algae, which could be introduced in the oxidation ponds are being carried out in the Laboratory with a view to study their physiology. Bench scale experiments to study the detention period of sewage in oxidation pond with the local flora have also been set up. In addition, samples were collected from the local lakes for culturing them in the Laboratory with the ultimate aim of using them in oxidation ponds for the purification of sewage.

86. Oxidation ponds at Jodhpur

(PROJECT NO. 15.5)

The oxidation ponds were under regular observation from the month of August 1964. Samples were collected on 9-8-1964, 9-12-64, 21-12-64, 29-1-65 and 2-2-65 and analysed in the Laboratory. As the ponds were not receiving sufficient sewage for the

overflow, reduction in organic load could not be calculated. Data collected so far shows that there is 70 per cent reduction in bacterial load. It is expected that there will be further reduction in the bacterial load as soon as there is a regular overflow. Amongst algae, *Euglena* spp and *Micractinium radiatum* are the predominant forms found in both the ponds. Amongst the zoo-plankton, *Rotifers* were found to be present in appreciable numbers. Mosquito-breeding was quite heavy, due to stagnation of sewage in the ponds. Arrangements have now been completed for the daily supply of sewage to the pond.

87. Oxidation pond at Kanpur

(PROJECT NO. 15.6)

A pilot oxidation pond has been constructed at Kanpur with the funds made available by the Kanpur Municipal Corporation. The plant will be commissioned soon.

88. Oxidation pond for tertiary treatment of sewage at Delhi

(PROJECT NO. 15.7)

It was planned to start the oxidation pond at Okhala, but it was not possible to get the land and necessary facilities.

89. Removal of hydrogen sulphide from sludge gas by scrubbing at Colaba sewage treatment plant

Most of the sewage treatment plants in Bombay are located near the sea andthe incoming sewers carry with them a lot of infiltered sea water which gives rise to hydrogen sulphide in the gas generated in the sludge digesters. As hydrogen sulphide is highly obnoxious and corrosive, the sludge gas obtained at these plants is required to be wasted by burning. Thus, in the sewage treatment plants of this city, more than 0.2 million cu. ft. of gas is being wasted every day. It was observed that the hydrogen sulphide can be removed to a very large extent by washing it with water or with treatment plant final effluent. Further removal can be obtained by passing it over alkaline filings or iron oxide. The pilot plant scale studies are still in progress.

90. Effluent farm irrigation

(RPOJECT NO. 16.1)

Work will be started after the field laboratory at Bhandewadi is completely established.

91. Comparative study of the sensitivity and accuracy for estimation of manganese in air and biological fluids

As a prelude to the undertaking of long term projects reported here under, it became necessary to select the appropriate method for the estimation of manganese in air and biological fluids from amongst the numerous methods commonly recommended in literature. Study on the comparative sensitivity and accuracy of the various methods was therefore, undertaken and completed to select a suitable method.

Manganese is a subtle nerve poison, exposure to it during industrial operations causing both chronic and acute poisoning. Since symptoms are deceptive and can not be diagnosed long after poisoning has developed and organic damage is already done, constant vigilance, frequent assessment of exposure, early detection of poisoning and adoption of prophylactic measures is the only safeguard for workers. Cases have come to light even in India where even 6 years work in manganese handling factories has been responsible for 34 per cent cases of poisoning amongst the workers.

92. Environmental exposure to air-borne manganese dust

(PROJECT NO. 18.1)

As mentioned in earlier reports, this project aims at assessing the intensity of exposure of workers to air-borne manganese in a Ferro-Manganese Alloy concern operating near Nagpur. During the period under review, a preliminary survey of the Factory was carried out to study the nature of different jobs in the processing of manganese ore and the number of workers involved in such exposure. Based on this survey, a number of operations and workers whose exposure is considered as being of health significance have been selected for detailed investigation. The following table summarizes the operations and number of workers selected for study.

Operation	Number of workers
Tapping & Plugging	8
Furnace Maintenance	10
Carbin Operation	8
Charging & Feeding	6
Metal Lifting	15
Screening & Cleaning	20
Grinding & Transporting	200

The Factory is routinely visited once and samples in duplicate collected at various stages and points when the operations are being carried out. Samples are transported to the Laboratory and analysed for their manganese content. Eighty six samples from 20 different locations during various operations have so far been collected and analysed. Some of the earlier analysis could not be completed due to non-availability of exhaust fume cub-board. However, samples collected during the latter half of the rainy season and the winter show significant difference, the concentration during latter season exceeding the permissible limit of 5 mg per cubic meter, while it is below this limit during the rainy season. However, much more comprehensive data spread over all the seasons will be necessary to confirm the seasonal or climatic variation influencing the intensity of exposure of the workers.

93. Urinary excretion of manganese as a probable measure of exposure to manganese

(PROJECT NO. 18.2)

The objective of this work undertaken at Headquarters, is to ascertain if there is a relation between the urinary excretion of manganese by the workers and the intensity of their exposure and whether this would serve as an early index to detect specially susceptible workers. Workers engaged on the following jobs have been selected for this study.

1. Raw ore grinding
2. Charging hoppers
3. Furnace maintenance
4. Tapping and plugging
5. Dressing and cleaning
6. Sorting and screening

The earlier part of the year was spent in standardizing the method for determining manganese in the urine, which presented considerable difficulty. Weekly urine samples were collected from the workers involved in these operations. From what little work has been done so far, it would appear that the concentration of manganese in the urine of workers from this Factory is much more than a comparable control group not

exposed to manganese. The data collected so far is, however, too meagre to form any definite conclusion and the project will continue during the ensuing year.

94. Influence of particle size on the pathological effect of manganese

(PROJECT NO. 18.3)

Unlike other toxic metals, manganese has been found to exert two distinct and yet dissimilar effects on the health of those exposed to its action. The first is characterized by its action on the nervous system. The second in contrast manifests itself in what has been termed as "Manganese Pneumonitis", a condition stimulating respiratory disease. This condition is, however, significantly different from the latter and is not amenable to the same treatment. The project aims at ascertaining whether the difference of the size of particles inhaled has any influence on this two distinctive actions.

A particle size and frequency distribution study of the manganese dust inhaled by the workers in a factory has therefore, been taken up at Headquarters with the hope that sufficient data may enable us to determine if this has any relation with the effect. A number of operations have therefore been selected for weekly sampling of the dust inhaled and their total count and frequency size ratio determined by the standard light field technique and the cascade precipitator. For want of availability of all the equipment needed for the project, only 56 samples could be partly analysed during the year under review. The dust count determinations, however, showed that the particle counts averaged between the limits 11 to 202 million particles per cubic foot of air, the latter being far above the permissible limit. The N.C.B. graticule which is needed for the determination of particle size has, however, been received only recently and the ensuing year will be devoted to the determination of both the total count as well as size distribution.

95. Assessment and reductions of thermal stress on industrial workers

(PROJECT NO. 18.4)

Output and efficiency of industrial workers decrease when environmental temperature deviates appreciably from

certain optimum range. Such an exposure to high or low temperatures has also been shown to unfavourably influence accident rates in industries and give rise to certain occupational diseases like heat exhaustion and cramps. One of the important objectives in improvement of industrial productivity is therefore, to ameliorate the heat stress of workers. Studies for determination of thermal stress on the workers have therefore, been in progress in two of the factories near Nagpur.

A preliminary survey of these factories was undertaken at the Headquarters to ascertain in which operations, the exposure of the workers to the heat is of considerable magnitude. It was observed that while generally most workers are exposed to heat, there are certain operations in which the exposure of the workers to the heat is intolerable. Instead of including all the operations for purposes of study, it was therefore, decided to include a few such typical operations for assessment of thermal stress. The operations on which attention is being focussed at present are listed below :

Khandelwal Ferro-Alloy Ltd

Name of operation	Nature of job
Tapping	Arranging pans and molten metal
Transportation of molten metal	Lifting metal by means of an overhead crane
Collection of molten metal in the pans	As above

Kanpur chemical works

Burner-shed

Laboratory

Boiler Shed

Sulphonation plant

The following thermal indices are at present being recorded over week.

1. Dry-bulb temperature,
2. Wet-bulb temperature,

3. Kata thermometer temperature,
4. Globe thermometer temperature,
5. Humidity,
6. Wind direction and velocity.

From the data collected, the mean radiation temperature and the effective temperature are calculated.

It is also proposed to collect physiological evidence of thermal stress on the workers such as effect on pulse rate, blood-pressure and skin temperature. As this study needs active co-operation of the workers. it will be taken up only at a later stage if the necessary co-operation is forthcoming.

The study will have to extend over 2 years to collect representative data.

96. Air pollution survey work at Nagpur

(PROJECT NO. 18.5)

Though this work has been contemplated for some time, the progress of this project has been slow as the equipment needed was not available. The high volume samplers for collection of air-borne dust, though ordered long back from the WHO, were received only recently while the dust fall jars for collection of settled dusts had to be designed and procurred locally. The year under review had to be spent in doing the preliminary work as indicated below :—

(a) *Standardisation of methods for assessment of sulphur dioxide:* One of the air pollutants to be estimated as a part of the survey work is sulphur dioxide. The quantities of the pollutant expected to be present normally in the atmosphere are extremely small. Since most of the methods commonly available for estimation of this gas are not sufficiently sensitive, comparative trials to test the sensitivity of various methods had to be undertaken, and the one found suitable had to be standardized.

(b) *Comparative studies for selection of an indigenously made filter paper for use with the high volume sample:* The high volume samplers received for collection of air-borne dust need a special type of glass fiber filter paper. Since the stock of papers received with the instruments is not enough to last even

for a month's survey work, and importing the paper from abroad for the 5 years work planned, would be both costly and difficult, it was considered necessary to ascertain if one of the various papers readily available in the country could be used for this purpose. Comparative trials with various makes of such papers have therefore been taken on hand for some time to work out the error factor and the conditions involved in their use. Once these have been standardized, it is hoped that such papers can be used for these instruments.

(c) *Studies on the dust-fall jar:* The jars intended for collection of the dust fall have to be kept under open sky. The collection medium for the settled dust is water. Unlike in the temperate countries, due to the higher temperatures in this country, water kept in the jars will completely evaporate in a couple of days which will introduce serious errors in the assessment of dust fall. Trials with various heat insulation media have therefore, been taken in hand to minimise the loss of water by evaporation so that it can serve as an effective collection media.

Various types of covering nets for the jars are also under trial as a protective measure against the interference from bird droppings which may vitiate dust fall measurements.

97. Fabrication of air-monitoring equipment

(PROJECT NO. 18.6)

Gas absorbers, constant concentration gas chambers, rate-controlling devices and portable air sampling kit have so far been designed and fabricated.

Comparative studies to test the efficiency of such devices against similar standard foreign equipment, ordered over two years' ago but only recently delivered were taken in hand. Extensive field studies have been carried out using both types of equipment for assessment of various contaminants such as sulphur dioxide. Results indicate that both are equally efficient in the matter of air sampling. It is thus concluded that the indigenously fabricated equipment though involving only a fraction of the cost of imported ones could be used with confidence in its reliability in place of the latter one. This should prove a factor of considerable importance to laboratories with slendar resources and difficulty in procurring necessary foreign exchange.

RURAL SANITATION

98. 2 ton high rate composting pilot plant at Nagpur

(PROJECT NO. 17.1)

Preliminary investigations as regards the physical and chemical nature of the refuse of Nagpur, have been ascertained. A pilot plant based on Bangkok process has been designed. The mechanical parts of the plant have been fabricated.

99. High rate mechanical composting plant at Poona

(PROJECT NO. 17.2)

Some samples of the town refuse from Poona were collected and analysed. Further work is in progress.

100. Rural latrines

(PROJECT NO. 19.1)

The various designs of latrine pans have been studied by visiting various research institutions in the Country. The merits and demerits of these have been ascertained by laboratory and field studies.

On the basis of the experience thus accumulated, a new design which incorporates all the needed merits has been evolved. Over 600 latrine-pan units have been supplied to civil and Army centres in India. Demonstrations have been arranged for Municipalities, Gram Panchayats and Refugee camps in the country as and when necessary.

A design suitable for school children has been tried and finalised.

101 (a). Toilet unit for school—A toilet unit for the School/institutions/or home has been perfected. One such installation has been put up at Sewagram (Wardha) on research-cum-demonstration basis.

(b) **Helminthic viability**—The field and laboratory experiments on viability of helminthics in night-soil compost have been continued in the year under report.

(c) **Some edible plants**/vegetables when consumed raw are apt to give an infection of Ascariasis or Ankylostomiasis to

man. Experiments have been made with different known and new disinfectants to evaluate comparative merits and finalise an economic and easily available disinfecting agent, for use by the common man. Elemental iodine in very small dosage has been found to fit in appropriately.

102. Percolation studies for polluted ground water

(PROJECT NO. 19.2)

The oxidation pond may pollute the ground water both chemically and bacteriologically. Hence the necessity arises to find out the extent of pollution by the ponds. Experimental work on this aspect is started recently.

103. Pollution of water by effluent of septic tanks in Jaipur

(PROJECT NO. 19.3)

(a) Chief Engineer (Public Health) Rajasthan Govt. wanted the Institute to study the effect of septic tank effluents on the underground water strata particularly from bores. It is proposed to deal with the problem as follows :—

Two types of septic tanks, *viz:* (i) Boulder type; and (ii) empty--type are in use in the unsewered areas of Jaipur. Drilling of holes will bemade at some definite points in different directions starting from the experimental soak pits. In order to find out whether or not the sewage is passing through the earth strata, a new soak pit and an old one which is in use for the last 10-20 years will be selected. Samples from different depths from each hole will be tested chemically and bacteriologically. Nature of the strata will also be found at several places by these means. New soak pits will be allowed to start functioning and allowed to get saturated with sewage for a period of 20 to 30 days at the end of which soil samples will be collected from the holes and tested. Effluent samples if available in the holes due to seepage will also be collected and tested. In this connection, the Mechanical Division of the Public Health Engineering Department, has been approached for drilling the holes. Further studies will be started as soon as the bores are drilled by them.

(b) *Contamination of vegetables grown in sewage farms:* In Jaipur, the major source of supply of vegetable has been

found to be from the sewage farms. There are two sewage farms in the surrounding area, of Jaipur city where raw sewage is directly used on the land by broad irrigation. On enquiry from the farmers, it was learnt that they were restricted from cultivating the vegetables like Tomoto, but as there is no strict check by the Municipal authorities, the farmers are cultivating underground tubers, green vegetables, cauliflower, cabbage, coriander and beetroot on these farms. Danger of pollution of these vegetables by intestinal pathogens being great, attempts were made for isolating these organisms. Though they could not be isolated, it has been observed that the coliforms and enterococci load on green vegetables was found to be high. One hundred gm of coriandar was found to contain 50 and 100 coliform bacteria. The enterococcal load was also high. Efforts are being made to isolate intestinal pathogens like *Entamoeba histolytica*

104. Cow-dung gas plant

(PROJECT NO. 19.4)

1. Two gas plants were put in collaboration with the beneficiaries in rural and semi-urban areas. The beneficiary contributed the major share for the construction.

2. Advice was rendered to six parties for the construction and design of gas plant suitable in specific conditions.

3. The 1963 CPHERI design of gas plant was modified to suit a rural family of six members. This was based on actual calculation of dietary routine pattern in rural areas.

4. Four representatives of Gram Panchayat and local bodies, etc., were trained in design and construction of CPHERI design of gas plants.

5. Laboratory investigations were carried out on the following aspects :

i) Digestive capacity of the digester was specified.

ii) Optimum design and dimensions for an economic dome has been arrived at.

iii) Studies in correlation between scum-formation and the concentration of effluent have been completed.

6. Series of lectures for common people on the topic were arranged.

TECHNICAL AND EXTENSION SERVICE

Pilot plants were set-up as detailed below :

(i) At Bhandewadi, the existing oxidation ponds were improved and completed. The salient points are as follows :

There are three ponds and each is of the size of 200' x 200'. The sewage is conveyed by a 21" dia. hume pipe to the inlet chamber that is fitted with a wooden baffle. Suitable bell-mouth is provided at the delivery end that lets the sewage at the centre of the pond. Inter-connection wall of the ponds is of brick masonry with weep holes. Inspection chamber is provided for each pond. Outlet chamber is provided at the end of the third pond. Flow is regulated at the inlet end by gate valve, and 'V' notches are fitted at the inlet and outlet chambers for measuring the flow.

(ii) A water treatment pilot plant for the study of virus removal at different stages of water purification was designed for EVRL at Poona. The pilot plant consists of a flash mixer, a clari-floculator, a rapid sand filter, and a clear water tank. The plant was designed for a rate of flow of 100 gal/hour.

(iii) At Bezonbagh in Nagpur, two night-soil digesters of 210 cu ft capacity were constructed and they include all the mechanical and electrical fittings. Each digester is of internal dia. of 6' and 10'-6" height. In addition, two drying beds have been designed and they are to be constructed by the side of the digesters.

(iv) In the Institute campus, a meteorological station been set up. The construction of the same was done departmentally.

(v) Compost plant at the Headquarters designed by this Institute to suit the local conditions is being installed.

(vi) Imhoff tank as per project No. 11.1 was designed and is being installed.

INSTRUMENTATION SERVICE

The Division is looking after the installation, servicng and repairs of various electronic and electrical instruments in the Institute. Some work on the design of various gadgets for the use in the research work at the Institute is also being done.

The work done under the various heads is as follows :

(a) **Mercury thermoregulator** — Mercury thermoregulator has been designed and fabricated. Mercury rise in a capillary tube makes contact with a platinum wire and actuates the relay to make or break the circuit. It has been tried out for temperatures between 25°C and 100°C and works with an accuracy of ± 0.5°C. The design is being further improved for greater accuracy.

(b) **Mono-tube electronic relay control** — Amplifier Unit consisting of a single electronic tube for relay control has been designed and fabricated. It needs no transformer and can be housed in a small chamber of size 3" x 5" x 3". The primary shorting current is of the order of a few microamperes (approx. A). Further work is in progress.

(c) **Twin-tube electronic relay circuit** Amplifier unit consisting of two electronic tubes for relay control has been designed and fabricated. The primary shorting current is of the order of 25 micro-amperes. The circuit is being improved further to reduce the shorting current and increase relay current.

(d) **Electronic Measurement of BOD** — An electronic circuit has been built up for measurement of minute changes in the column of mercury ina manometric tube of a Barcraft-Warburg refrigerated respirometer. The circuit is under test and has been found to work very satisfactory. A change of 0.01 mm of mercury column gives rise to a change of 6 micro-amperes. Attempts are being made to use a recorder along with the above circuit.

(e) **Spectrophotometry**— One of the members of the staff is fully engaged on work with DU Beckman-Spectrophotometer and Perkin Elmer Model 350 Automatic Recording Spectrophotometer, to carry out routine and research work for the benefit of scientific staff of the Institute.

Nirmali seed, which is supposed to be having a high potential as a coagulant aid, is being studied for its composition. Various organic solvents for it have been tried and are being studied in a Ultraviolet and near Infra-Red regions.

(f) **Polarography and Flame Photometry**— These instruments have been standardised for routine measurements in water and industrial waste samples.

(g) **Electronically Regulated Power Supply**— Electronically regulated power supply has been built up from the available design. It gives an output of 200 volts DC at 150 milliamperes with 5 per cent regulation for 10 per cent fluctuation in main supply. The output impedence is 1 ohm.

(h) **Transistor Current Amplifier** — One long-tailed pair amplifier using germanium transistors has been built up, for amplifying signals from low resistance source. This will be used for amplification of signals in electronic measurement of BOD and signals in the dissolved oxygen meter. The necessary stabilized low voltage power supply has also been designed.

TECHNICAL ASSISTANCE

(a) **Analysis of water samples from outside Jaipur City**— During the year under review 45 samples received from Public Health Engineering Deptt. Govt. of Rajasthan, from different places of Rajasthan State were analysed and necessary guidance given to the State Government for further implementation and necessary treatment.

(b) **Water supply of Jhalarpatan** — The causes of white precipitate in the lake at Jahalarpatan, Jhalawar was investigated. The State Govt. was advised to make necessary treatment of the water. It has been informed by the Chief Engineer, P.H.E.D. (Health), that necessary tenders were called for the erection of a treatment unit on the basis of the recommendations.

(c) **Typhoid Epidemic at Dungarpur**— Typhoid epidemic was reported at Dungarpur Distt., Rajasthan. The authorities suspected that the source of pollution was water supply. An analysis of the samples collected from the source of distribu-

tory system revealed that the water supply was safe from enteric pathogens. The information was communicated to the authorities concerned.

(d) **Demineralisation of water by using solar energy** — The State Public Health Engineering Department of Rajasthan is interested in making use of solar energy for desalinisation of water in the State. The State has comparatively saline water areas. In desalinising ground water, the State Government approached the Institute for advice. A suitable design has been given to the Deptt. for fabrication after consulting the literature. A detailed study will be made in the laboratory after the fabrication of the solar still, by the mechanical engineering section of the Rajasthan Public Health Engineering Department.

(e) A survey on the extent of pollution caused by the effluent of a local factory, **viz.,** National Engg. Industries, which is at present mainly producing Ball Bearings is being carried out at the request of the Executive Engineer Survey & Drainage Jaipur. A technical report has already been sent. Further studies will be taken on hand. Samples of water from the dug wells will also be collected from the surrounding area of the Factory for analysis. Duration of study of this project is Approx. 1 year.

(f) **Analysis**—

(i) One hundred water samples and 2 industrial waste samples received from different Government and local bodies were analysed during the year by Delhi Zonal Centre.

(ii) A total number of 55 water samples and 7 industrial wastes were analysed by Ahmedabad Field Centre during the year under review.

(iii) Water samples sent by Integrated Milk Project, M/s Indian Detonators Limited, and R.R.L. of Hyderabad and Nizam Sugar Factory, Bodhan were analysed by Hyderabad Zonal Centre.

(iv) A prolonged survey for the assessment of filaria infection was carried out for Nagpur city. A survey of the quality of water in Bareilly city with special reference to their iron and manganese content was carried out and a detailed report was submitted to the concerned authorities.

SCRUTINY AND DESIGN

(a) During 1964-65, the design of oxidation pond for the treatment of domestic wastes was made as per CPHERI design criteria at four places, namely—

(i) The I.I.T. at Kanpur	(355' x 180')
(ii) Raghuji Nagar Colony of Vidarbha Housing Board at Nagpur	(230' x 110')
(iii) Air Field Colony at Hindor	(260' x 130')
(iv) The Regional Research Laboratory at Jorhat	(150' x 75')

The depth inlet and outlet arrangements of the ponds were as per the typical design evolved at CPHERI. The pond of the Vidarbha Housing Board has started functioning and is working well.

(b) The problem of the water supply and sewage disposal scheme at Sewagram was referred to this Institute. Based on the information and data collected by our survey, the plant was designed and it included —

i. Improvements to the existing well from which the water is proposed to be pumped for domestic consumption by the village.

ii. A pump house with 2 pumps.

iii. An overhead storage tank of 10,000 gal. capacity

iv. Chlorinator

v. Distribution mains

vi. 10 public hydrants

vii. Soakage pit with standpost

In addition to this, a separate estimate has been made for providing CPHERI design latrines for 70 per cent of the present village houses. A sanitary block for the village school

has also been constructed with the use of latrine pans and other accessories made in the Institute sanitary workshop.

(c) For Sudarshan Chemical Industries at Poona, a settling tank with a sludge drying bed was designed for the preliminary treatment of the factory effluent before letting it into the public sewer.

(d) For the tannery waste treatment, at Kanpur, the functional design of settling tank of both continuous type and fill-and-draw type has been prepared based on different rates of waste flow at the factory and on the detention time of settling tank investigated by Kanpur Field Centre. These designs are for the use of the tanneries for reduction of pollution.

(e) A screen chamber and pump house for Regional Research Laboratory at Jorhat has been designed for pumping sewage to their oxidation pond.

(f) Based on critical examination, a detailed report including the design of an oxidation pond for the treatment of sewage of the A.P. Special Armed Police Colony, Kakinada was submitted to the State authorities.

(g) At the request of the State Animal Husbandry Deptt., Andhra Pradesh, detailed investigations were carried out on the nature of available sources of water in connection with 0.1 mgd water treatment plant at Kesarapalli for the proposed Bacon Factory. A complete scheme for the water supply of the factory and their waste disposal problem has been drafted and submitted.

(h) Detailed investigation of Tirupati water supply schemes were carried out and a report was submitted to State authorities of Andhra Pradesh.

(i) Detailed investigations have been carried out regarding the development of resources of water supply to CLRI, Madras and a report was submitted.

(j) Suitable design for an additional unit of 70,000 gpd water treatment plant for RRL, Hyderabad was finalised.

(k) Assistance is being given in Vijayawada for the design of water and sewage treatment plants.

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EXTENSION WORK

I. (i) Extension work to the tanneries at Kanpur regarding primary treatment of effluent and sludge disposal —

The tanneries in Kanpur have been installing fill-and-draw tanks in their factory premises to settle their wastes before discharging their effluent into the sewers. The Kanpur Field Centre is helping them in proper installation and operation of the treatment units including proper type of sludge drying devices.

(ii) Participation in the programme of treatment and disposal of sugar and distillery waste at Golagokarnath —

As per the arrangement between the Director of the CPHERI and Indian Council of Medical Research, the Kanpur Field Centre is taking an active part in the supervision of the starting and operation of the full scale sugar waste treatment plant and the pilot plant for treatment of distillery waste at the factory premises of M/s Hindustan Sugar Mills, Golagokarnath. On the basis of the results obtained last year on sugar waste treatment plant, certain modifications were suggested which were completed this year, and the results obtained show that the plant is running very satisfactorily. The pilot plant for treatment of distillery waste by anaerobic digestion followed by activated sludge process has been commissioned some time ago and waste load is being gradually raised to attain an equilibrium condition after which, data will be collected.

(iii) Industrial hygiene projects executed as part of service to industry.

(a) Investigation of the environmental conditions at Kanpur Chemicals, Kanhan (Nagpur).

The Dy. Director of Public Health, Maharashtra requested the Institute to help him in ascertaining the justification or otherwise of the complaint received by the Brooke Bond Workers' Union. The Brooke Bond Factory and the Kanpur Chemicals are two of the factories located adjacent to each other at Kanhan near Nagpur and it was the contention of the workers

of the former factory that the smoke and the poisonous acidic fumes evolved during the various manufacturing operations in the latter factory were carried over to the premises of the former factory, thus causing both a nuisance and also exerting a long range adverse effect on health.

Environmental assessment work was therefore undertaken in the Kanpur Chemicals for a period of about 3 months. Bi-weekly experiments for the detection and determination of the acidic vapours were carried out during the various operations and at periodic intervals throughout the working shift in the factory. Experimental work showed that, amongst the various noxious vapours evolved, the only air contaminant of sufficient significance for health was sulphur dioxide, the second in importance being the fumes of oxides of nitrogen. During the three-month period of investigation, the highest concentration to which these fumes accummulated in the air was of the order of 3 ppm. It was, however, noticed that throughout the period of investigation wind direction was from the Brooke Bond Factory to the Chemical Factory and not the reverse. It was, therefore, felt that there was not much possibility of the workers of the former Factory being exposed to the toxic action of the fumes. However, the concentration of the fumes in the working environment within the Factory itself, was far above the safe concentration, it was felt that the workers of latter Factory needed protection. Various suggestions were therefore made to effect the reduction of fumes within the Factory environment. It is understood that these recommendations have since then been implemented by the Factory management, and the situation in consequence improved.

(b) Occupational health problem at the Sirsilk Mills, Kagaznagar

This problem was referred to the Institute by the Chief Inspector of Factories, Andhra Pradesh. It concerned serious complaints of adverse effects on health due to exposure to toxic fumes of acetic acid evolved during the various operations connected with the manufacture of acetate rayon silk. Both the environmental survey carried out for about a month, as well as a study of the health records of the workers planned in collaboration with the Medical Officer-in-Charge of the Employees State Insurance Corporation Hospital at the Factory, showed

that the complaint was justified since the former showed that the concentration of acid fumes in different sections of the Factory ranges from 50-200 ppm far above the safe concentration, while the latter showed that the incidence of respiratory diseases amongst the workers of this particular Factory was much higher in contrast to others. A report was therefore submitted to the State Government, recommending various changes and improvements in the ventilation system to be effected by the Factory management. Another survey, recently undertaken showed that as a result of the changes suggested, the concentrations of the toxic fumes in most of the sections are now reduced to less than 10 ppm which is the internationally accepted safe level and thus the working environment rendered completely safe.

(c) Hyderabad chemicals and fertilizers

This was yet another problem referred to the Institute for its opinion by the Andhra Pradesh Factory Inspectorate. The said Factory is engaged in the manufacture of superphosphate fertilizers from phosphatic ores. The raw materials contain fluorides which are toxic leading to an occupational disease called fluorosis. Also conversion of fertilizer by treatment with sulphuric acid led to evolution of fluoride compound in gaseous state. The terms of reference were whether these contaminants, escaped in sufficient amounts as to constitute a hazard to the Factory workers and also if there is a long-term danger to the surrounding areas due to the escape and settling of the environmental fluoride.

An exhaustive industrial hygiene survey was, therefore, undertaken to assess the environmental concentrations of these contaminants, the residual gases let out from the chimney being also included for analysis. It was found that the process of elimination and recovery of fluoride adopted by the factory was fully effective, and, as a result, the environmental air was completely free from toxic material. The concentrations of sulphur dioxide fumes were also found to be generally less than 10 ppm.

It was therefore concluded that no danger to health either of the factory workers or the surrounding residential areas noted be apprehended and a report was accordingly sent to the State Government concerned.

TECHNICAL ENQUIRIES

S.N.	Name of the party	Nature of assistance rendered.
1.	M/s. Valji Ladha Ginning & Pressing Factory, Bombay	Gobar Gas Plant
2.	M/s. Shah Narotamadas Harijivandas Co., Bulsar	Gobar Gas Plant
3.	M/s. Escorts Ltd., New Delhi	Prevention of Oil Dermatitis.
4.	Executive Engineer, Public Health Works Dn., Surat	Improvements to Navsari Drainage Scheme
5.	Indian Inst. of Technology, Madras	Standards for Sewage Effluent for Watering of Play grounds—Data regarding.
6.	Hyderabad Chemicals & Fertilizers Ltd., Hyderabad (AP)	Disposal of Factory Wastes at Maula Ali– Investigation Report
7.	Superintending Engineer, Public Health Engg. Deptt. PHE Circle, Guntur	Tirumalai Water Supply Scheme Corrective Treatment for the Water Supply Sources alongwith Drawing of Treatment Plant.
8.	Chief Engineer, L.S.G.-E.D., Lucknow U.P.	Algae Control in Ganga Water at Varanasi.
9.	Chief Engineer, Delhi Municipal Corporation, Delhi	Algae Problem at Wazirabad Reservoir.
10.	Chief Medical Officer, S.E.Rly. Calcutta	Wheelbarrows for Night-soil.

11.	Director of Municipal Administration, A.P. Hyderabad	-do-
12.	Notified Area Committee Rajpura township, Punjab	-do-
13.	Cantonment Board, Meerut	-do-
14.	O.S.D. Rehabilitation	-do-
15.	Indian Inst. of Technology, Kanpur	Oxidation Ponds for Sewage Disposal.
16.	Dy. Director, P.H. Services, Nagpur (Brooke Bond Factory)	Air Pollution—Smoke Nuisance.
17.	Sir Wanless Hospital, Miraj	Gas Plant for Septic Tank
18.	Regional Engg. College, Srinagar	Fire demand and fire reserve in water supply under Indian conditions
19.	Chief Engineer, P.H.E Rajasthan, Jaipur	Investigation report—Jhalarapatan Water Works trouble due to white suspension in the lake and in the filtered water
20.	N.R.D.C., New Delhi	Hot Dip Aluminising of Ferrous Metals
21.	N.R.D.C., Ranchi	Pattern of treatment to water potable wheelbarrow scheme
22.	Western Rly., Bombay	Wheelbarrow Scheme
23.	Gram Sevak Training Centre, Buldana	-do-
24.	Municipal Council, Rajnandgaon	-do-

25.	Medical Officer, Health Nainital and A.P. Special Armed Police, Kakinada	Oxidation Pond for Sewage Treatment Inspection Report
26.	Chief Engineer, L.S.G. E.D., Lucknow	Preliminary observations on Agra Water Works
27.	Superintending Engineer, Municipal Corporation	Suspected sewage pollution in Yamuna River at Agra
27.	Defence Institute of Physiology & Allied Sciences, Madras	Technical note on remote controlled automatic gas analysers
28.	Commander Works Engineer (Pashan) Poona	Sewage treatment and disposal from four township sites
29.	Shriram Sahakari Sakhar Karkhana, Ltd. Phaltan	Problems of environmental sanitation in Ramnagar, Phaltan
30.	Central Rly., Bhusawal	Water Borne Sewage System Oxidation Ponds
31.	Municipal Board, Ghaziabad	Wheelbarrow scheme, Specifications and drawings
32.	Municipal Board, Badaun	-do-
33.	Satara City Borough Municipality	Specifications & Drawings of Wheelbarrows
34.	Municipal Committee, Karanja	-do-
35.	Anjar Borough Municipality, Anjar	-do-
36.	Manmad Municipality Manmad	-do-
37.	Shirpur-Warvade Municipality, Dhulia	-do-
38	Sarpanch, Gram Panchayat Sevagram	Toilet unit at Sewagram estimates, technical note and drawings

39	Alibag Municipality, Colaba	Specifications & Drawings of CPHERI Wheelbarrows for Night-soil
40.	Nagubandi Lachaiah Rice & Oil Mills, Dornakal, A.P.	Public Health significance of odours arising during the parboiling of paddy
41.	Controller of Stores, Northern Rly, New Delhi	Specifications, Drawings etc. of Night-soil Wheelbarrows
42.	B.D.O., Chandur Bazar	-do-
43.	Municipal Committee, Jakhal Hissar	-do-
44.	O.S.D. (Rehabilitation) Chanda	-do-
45.	Junnar Municipality, Junnar, Poona	-do-
46.	Borough Municipality Amalner	-do-
47.	Anand Municipality, Anand (GS)	-do-
48.	Town Municipality, Sailu Parbhani	-do-
49.	Mahabaleswar Municipality, Mahabaleswar	-do-
50.	City Municipality, Distt. Bhir	-do-
51.	Sidhpur District Municipality, Sidhpur	-do-
52.	M/s Tata Ebasco, Consulting Engg. Services, Bombay	Design of Septic Tanks
53.	Central Railway, Bombay	Bhusawal Water-borne Sewage System (Design of Oxidation Pond)

TRAINING FACILITIES

Month	S.No.	Subject of Training	Name(s) of Trainee(s)
April, 1964	1.	Training in Technology in Rural Sanitation	Shri R. K. Akotkar, Sarvodaya Centre, Karajgaon
June, 1964	2.	Installation of Cow-Dung Gas Plant	B.O.D., Panchayat Samiti, Ramtek
	3.	Assessment of Chlorine Demand for Drinking Water	Asstt. Engineer, Forest Deptt., Chanda
July, 1964	4.	Chemical Methods of Sanitary Engineering Analysis with Special Reference of Industrial Wastes	Sarvashri Rath and Rout Orient Paper Mills Ltd., Orissa
Aug., 1964	5.	Isolation and Identification of Vibrio Cholera from Clinical Specimens	Public Health Laboratory (M.S.) Nagpur
	6.	Water & Sewage Analysis	I.B.M., Nagpur
Sept., 1964	7.	Effect of Temperature and Incubation Period on BOD	A.K. Seth, Roorkee University
	8.	Chemical Analysis of Water D.D.T. Factory Wastes	Kumari Chandra Kanta Sharma, Delhi University
	9.	Analysis of Water and Sewage Samples	Two Chemists from P.H. Deptt. Rajasthan

Other Training Programmes

In addition, the following courses were conducted at this Division for amelioration of rural sanitation practices including design and construction of rural sanitation wares.

Construction of CPHERI Latrine-Pan Units	... 13
-do- Gas Plants	... 8
Laboratory Practice in Helminthic Surveys	... 2
-do- for Public Health Chemistry	... 2
Mosquito Survey, Morphology Vector Studies	... 10

Refresher Course on Water and Sewage

A Refresher Course for in-service Engineers was held during September 7-26, 1964. Eight persons from various State P.W.D's, M.E.S. and Public Sector Undertaking attended the course. The Senior Staff Members of the Institute and senior persons engaged in teaching and/or research in Public Health Engineering delivered lectures.

Research for Doctoral Degrees

Four scientists are currently conducting research at this Institute for their Ph.D. Degree in Sanitary Zoology and Bacteriology.

The Institute as a Centre for Advanced Study

The Universities of Roorkee and Baroda have recognised this Institute as a Centre for Research leading to M.Sc and Ph.D., Degrees of these Universities.

SYMPOSIA & SEMINARS

The Institute conducted three symposia during the last week of October 1964 at Nagpur. The co-operating agencies for organising these symposia were the local branch of the Institution of Engineers (India), the Public Health Engineering Division of the Institution of Engineers (India) and the Research and Development Establishment (Engineers), Ministry of Defence.

SYMPOSIA

"Evaluation of Rural Latrine Design," (Oct. 28th '64)

Shri R. S. Mehta, Director of the Institute gave an Introductory Speech, stressing the importance of this problem and requested Prof. N. R. Malkani to preside over the Symposium and conduct the proceedings. Shri J. M. Dave, of CPHERI, acted as the Convener. About 150 delegates attended this Symposium.

Seventeen Papers were submitted for discussion. However, these Papers were not formally presented by the authors. Instead, a Panel of Experts who have been very active in this particular field took active part and pointed out the merits and demerits of the existing designs of rural latrines with particular reference to (i) Seat, (ii) Pit, and (iii) Super-structure. Afterwards this problem was thrown open for discussion.

"Problems in Water Treatment (Oct. 29th & 30th '64)"

Shri R. S. Mehta, Director of the Institute, after his Introductory Speech requested Air Vice-Marshal O. P. Mehra, Maintenance Command of I.A.F., to inaugurate the Symposium. Air Vice-Marshal O. P. Mehra delivered an informative and inspiring inaugural address, urging the delegates, numbering more than 160, to shoulder the responsibilities of tackling this very important problem and to contribute their share for the improvement of the Health of the Nation.

In all, 33 papers were presented by the authors and discussed during four sessions—Shri A. K. Roy, Chief Engineer, L.S.G.E.D., Uttar Pradesh, Prof. M. V. Bopardikar, CPHERI, Shri A. P. Mehta, Chief Engineer (Public Health) Gujarat, Shri Balkrisna Naique, Chief Engineer (Public Health), Goa; and Prof S. J. Arceivala of V.J.T.I., Bombay, acted as Chairman for these sessions.

The Proceedings of this Symposium have been published.

"Water Supply and Waste Disposal at High Altitudes" (Oct. 31st, 1964)

This was a special Symposium arranged to discuss this vital problem, which is being faced by our Army Engineers

because of the deployment of a large number of defence personnel at high altitudes, in view of the border situation.

Maj. Gen. Harkirat Singh, Engineer-in-Chief, inaugurated the Symposium after Shri R S. Mehta's introduction. Brig. N. B. Grant presided over the proceedings. About 100 delegates took active part in this symposium.

Seven papers were presented and discussed during the proceedings. Delegates took keen interest in the proceedings and contributed to a lively discussion. Brig. N. B. Grant after his brilliant sum-up of the proceedings urged all the Public Health Engineers to devote utmost thought to this new problem and help the army to solve the same. The proceeding of this Sympoium have been published.

SEMINARS

Holding of seminars continues to be a regular feature wherein scientists of this Institute as well as outsiders exchange their views on their specific field. The list of topics of the seminars along with the speakers has been given in Appendix V.

Publications : The quarterly scientific journal: "Environmental Health" (Formerly CPHERI Bulletin) is being taken out in time. The journal is in good demand from the respective interested quarters from within and abroad.

Library : Library caters primarily to the needs of the staff engaged in the research work. However, consulting facilities are being given to individuals of the various universities and research institutes. Plan for the construction of a separate building is ready.

APPENDIX I

(A) Members of the Executive Council

(1964-65)

Chairman

DR. C.G. PANDIT,
Emeritus Scientists,
New Delhi-11

Members

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

2. SHRI BALWANT SINGH,
Chief Engineer (Water),
Water Supply and Sewage Disposal Undertaking,
Delhi Municipal Corporation,
Delhi

3. DR. S.L. KALRA,
Head of the Department of Microbiology,
All-India Institute of Medical Sciences,
Ansari Nagar,
New Delhi-15

4. SHRI K.N. BHARGAVA,
Chief Engineer (Health),
Government of Rajasthan,
Jaipur

5. SHRI M. MOHIUDDIN,
Chief Chemist,
Orient Paper Mills Ltd.,
P.O. Brajraj Nagar,
Dist. Sambalpur, (Orissa)

6. SHRI S. RAJGOPALAN,
Representative of the Ministry of Health,
Government of India,
New Delhi

7. SHRI P.C. BOSE.
Executive Director & Chief Engineer,
Development Department,
Calcutta Metropolitan Planning Organisation,
1-Garstin Place,
Calcutta-6

Ex-Officio Members

8. DIRECTOR-GENERAL,
Scientific & Industrial Research,
New Delhi

9. FINANCIAL ADVISER TO C.S.I.R.,
New Delhi

10. DIRECTOR,
Central Public Health Engineer
Research Institute,
Nagpur

11. PROF. M.V. BOPARDIKAR.
Scientist,
CPHERI, Nagpur
(Ex-Officio Secretary)

(B) Members of the Scientific Sub-Committee

1. DR. B.V. BHOOTA, **Chairman**
2. DR. S.L. KALRA
3. SHRI M. MOHIUDDIN
4. SHRI S. RAJAGOPALAN
5. SHRI R.S. MEHTA,
Director, CPHERI, Nagpur

(C) Members of the Building & Finance Sub-Committee

1. SHRI R.S. MEHTA, **Chairman**
2. SHRI BALWANT SINGH
3. SHRI K.N. BHARGAVA
4. SECRETARY, C.S.I.R.
5. FINANCIAL ADVISER, C.S.I.R.
6. ARCHITECT, C.S.I.R.

APPENDIX II

MEMBERSHIP OF OUTSIDE COMITTEES

I. SHRI R.S. MEHTA, **Director**

I.S.I. Committee/Sub-Committee/Panel

1.	Sluice Valve Sub-Committee	BDC 3.5 (Convener)
2.	Water Supply & Sanitation Sectional Committee	BDC 24
3.	Fluid Flow Measurements in Closed Conduits S.C.	BDC 17:3
4.	Sanitary Appliance & Water Fittings Sectional Committee	BDC 3:4 (Chairman)
5.	Water Meter Sub-Committee	BDC 3:4
6.	Building Materials & Components Sampling Sub-Committee	BDC 31
7.	Polythene Tube Sub-Committee	BDC 3:8
8.	Public Health Engineering Plants & Equipment Sectional Committee	BDC 40

Other Organisations

1. Scientific & Technical Committee, International Water Supply Association, London
2. Public Health Engineering Group, Institution of Engineers (India)
3. Board of Studies, Baroda University
4. Technological Institute Committee, Nagpur University
5. Sanitary Collection & Disposal of Night-soil, Ministry of Health (Model Design for Suitable Receptacles. Hand-carts and other Mechanical Devices for Sanitary Collection and Disposal of night-soil)

6. Advisory Committee and Expert Group, Env. Hygiene & Sanitation Expert Group of I.C.M.R.

7. Committee to Solve Problems of Pollution of Water in river Jamuna and Scarcity of Drinking Water Supply in Delhi, Ministry of Health

8. Expert Advisory Panel on Environmental Health, W.H.O.

9. Water Pollution Control Board of Gujrat State

10. Planning Committee to draw-out a Five-Year Plan for the Development of the City of Nagpur--Nagpur Corporation

11. Water Pollution Control Board of Uttar Pradesh

12. Regional Committee for Investigation of the Problem of Pollution of Rivers and Streams by Industrial Effluents and Trade Wastes--Irrigation & Power Department, Government of Maharashtra

II. PROFESSOR M.V. BOPARDIKAR, **Scientist**

I.S.I. Committee/Sub-Committee/Panel

1.	Industrial Wastes Sub-Committee	CDC 26:1
2.	Water Sectional Committee	CDC 26
3.	Drainage Sub-Committee	BDC 24:2
4.	Sanitary Appliance & Water Fittings Sectional Committee (Alternate Member)	BDC 3
5	Public Health Engineering Plants & Equipment Sectional Committee (Alternate Member)	BDC 40

Other Organisations

1. Expert Advisory Panel on Environmental Sanitation, WHO (1959-1969)

2. Sub-Committee—Development of Meat Technology Scientific Advisory Panel, Ministry of Food & Agriculture

3. Environmental Hygiene & Sanitation Advisory Committee of I.C.M.R.

4. International Water Supply Association, London (Alternate Member)

III. SHRI J. M. DAVE, **Scientist**

I.S.I. Committee/Sub-Committee/Panel

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

Other Organisations

1. Problems of Sanitary & Water Supply Arrangements at High Altitudes and Low Temperature Regions (Ministry of Defence)

2. Advisory Body for the Gobar Gas Scheme—Khadi & Village Industries Commission

3. Committee for Post-Graduate Studies in Public Health Engineering of Nagpur University

4. Sub-Committee of Institution of Engineers (Nagpur Centre) on "Panchdhara Sarowar Scheme" for the augmentation of water supply to the city of Nagpur

5. Examinations Committee—Institution of Engineers (India)

IV. DR. G. J. MOHANRAO, **Scientist**

I.S.I. Committee/Sub-Committee/Panel

1	Panel for Chemical and Allied Industry Wastes	CDC 26:1:6
2.	Industrial Wastes Sub-Committee	CDC 26:1

Other Organisations

1. Committee for Post-Graduate Studies in Public Health Engineering of Nagpur University

V. DR. N.U. RAO, **Scientist**

I.S.I. Committee/Sub-Committee/Panel

1.	Panel for Microbiological Methods of Water Analysis	CDC 26:P2
2.	Disinfectants Sub-Committee	CDC 23:1
3.	Panel for River Water & Waste Water	CDC 26:1:11

VI. DR. S.V. GANAPATI, **Scientist**

I.S.I. Committee/Sub-Committee/Panel

1.	Panel for River Water & Trade Effluents	CDC 26:P4

Other Organisations

1. Water Pollution Control Board, Health & Industries Department, Gujerat State (Alternate Member)

VII. SHRI R.N. CHAKRABARTY, **Scientist**

I.S.I. Committee/Sub-Committee/Panel

1.	Panel for River Water & Trade Effluents	CDC 26:P4
2.	Tanning Industry Wastes Panel	CDC 26:1:4

Other Organisations

1. Water Pollution Control Board of Uttar Pradesh (Alternate Member)

VIII. SHRI J.S. JAIN, **Scientist**

I.S.I. Committee/Sub-Committee/Panel

1.	Fluid Flow Measurements in Closed Conduits Sub-Committee (Alternate Member)	BDC 17:3
2.	Dilution Methods Sub-Committee	BDC 17:7

IX. SHRI S. RAJAGOPALAN, **Scientist**

I.S.I. Committee/Sub-Committee/Panel

1.	Paper & Allied Industrial Wastes	CDC 26:1:3

X. SHRI K.P. KRISHNAMOORTHY, **Scientist**

I.S.I. Committee/Sub-Committee/Panel

1.	Panel for Microbiological Methods of Water Analysis (Alternate Member)	CDC 26:P2

XI. DR. G.K. SETH, **Scientist**

Other Organisations

1. Scientific Advisory Board of the State Medical Research Council of Andhra Pradesh
2. Committee to work out scheme for the industrial effluent disposal of the Synthetic Drugs Project, Hyderabad

APPENDIX III

DEPUTATIONS, HONOURS & AWARDS

SHRI R.S. MEHTA, Director, attended on invitation from the International Water Supply Association, London, the Sixth International Water Supply Congress at Stockholm, during June 15th-19th, 1964. He delivered a lecture by special invitation on "Problems of Water Supply in Developing Countries," at the Congress.

SHRI R.S. MEHTA, who is a Member of the Permanent Steering Committee of the International Conference on Water Pollution Research, attended the 2nd International Conference on : "Water Pollution Research." held at Tokyo, during August 24th-28th, 1964 and presided over one Session on "Fresh Water Pollution."

SHRI R.S. MEHTA, attended the Environmental Health Committee Meeting of WHO at Geneva, in August, 1964.

SHRI R.S. MEHTA has been elected as Vice-President of the Third International Water Pollution Conference, to be held in Munich, in 1966.

PROF. M.V. BOPARDIKAR, Scientist, visited U.S.A., U.K., Netherland, France, West Germany, Czechoslovakia and U.S.R.R. on an assignment under WHO Project No. 210-India to study "Graduate Teaching Methods and Organization of Public Health Engineering" in these countries between September 24th, 1963 to March 15th, 1964.

PROF. M.V. BOPARDIKAR was invited by Director-General of WHO to be a Member of the Expert Panel of WHO for a second term from 1964 to 1969 having finished his first term from 1959 to 1964. He was also invited to prepare a working paper on Environmental Sanitation "Waste Water Disposal and Drainage" for WHO Expert Committee on Health and Sanitary Aspects of Metropolitan Planning at Geneva.

DR. G.J. MOHANRAO, Scientist, attended the Second International Conference on : "Water Pollution Research," at Tokyo, during August 24th-28th, 1964, and presented a Paper therein.

DR. G.J. MOHANRAO went on deputation as Visiting Scientist to Scripps Institution of Oceanography at La Jolla, California, during September 1st-30th, 1964.

DR. C.A. SASTRY, Scientist, has been awarded German Academic Exchange Fellowship for Post-Doctoral Training and Research at Technische Hochschule Stuttgart, West Germany, for a period of 16 months from January 1, 1964.

SHRI H.N. SHRIVASTAVA, Scientific Assistant, was invited to present a Paper on: "Significance of Oligochaetas in the Biological Evaluation of Water Quality" to be read before the

7. GEORGE, M.G. & KAUSHIK, N.K.: Infestation of Surface Water Supplies by Nematodes, VI(4), 229-33 (1964).

8. HAMMAM, S. & SASTRY, C.A.: Design of Egg-Shaped Digesters VII(1), 54-76 (1965).

9. HUSSAINY, S.U.: Limnological Studies of the Departmental Pond at Annamalainagar VII(1), 24-31 (1965).

10. JAYANGOUDAR, I. & GANAPATI, S.V.: Algal Control in Raw Water Storage Reservoirs, VI(2), 166-75 (1964).

11. KANGA, A.R. & BODHMAGE, M.D.: Smokeless Chullahs, VI(3), 201-208 (1964).

12. KAUSHIK, N.K. & BEWTRA, J.K.: Incidence of Coliforms and Enterococci in Natural Waters, VII(1), 32-38 (1965).

13. KAUSHIK, N.K. & PRASAD, D.: Seasonal Variation in Coliform and Enterococcus Organisms in Well Waters, VI(4), 251-64 (1964).

14. KAUSHIK, N.K. & PRASAD, D.: Coliform Productivity in Water of River Jamuna at Wazirabad, Delhi, VI(2), 118-24 (1964).

15. KHAN, K.R.: Potentialities of Algae in the Bioassay of Micro-Chemical Pollutants in Water Systems, VI(4), 274-77 (1964).

16. KOSHY, T. & GANAPATI, S.V.: A Rapid Method for Enumeration of E. Coli Type I in Sewage and Sewage Polluted Waters, VI(3), 225-28 (1964).

17. MURTHY, Y.S., SETH, G.K. & SREENIVASAN, T.K.: Studies on the Waste Disposal Problem of Andhra Paper Mills, Rajahmundry, VII(1), 17-23 (1965).

18. PANDIT, R.K.: Starch as a Coagulant Aid in Water Treatment, VII(1), 39-43 (1965).

19. PANICKER, P.V.R.C., WAGLE, P.M. & RAO, N.U.: Removal of Entamoeba histolytica Cysts from Water, VI(3), 176-80 (1964).

20. PATIL, M.D. & RAO, N.U.: A Cheap Method for Continuous Disinfection of Well Waters, VI(3), 193-200 (1964).

21. RAWAL, B.D. & GODBOLE, S.H.: A Simple Tissue Culture Method for Detection of Viruses in Drinking Water-Sample Incorporation Method, VI(4), 234-36 (1964).

22. SABNIS, C.V., YENNAWAR, P.K. & DESHMUKH, S.B.: An Environmental Hazard Study in Rayon Manufacturing Concern, VI(2), 125-38 (1964).

23. SASTRY, C.A. & MOHANRAO, G.J.: Activated Sludge Progress and its Modification, VI(2), 139-60 (1964).

24. SASTRY, C.A., MOHANRAO, G.J. & MEHTA, R.S.: Reclamation of Sewage Effluents, VI(2), 75-95 (1964).

25. SETH, G.K.: Application of Activated Carbon in Water Treatment Process, VII(1), 44-48 (1965).

26. SREENIVASAN, M.V.: Experimental Studies on the Biological Treatment of Phenol, VII(1), 49-53 (1965).

27. SRIVASTAVA, S.K. & BEWTRA, J.K.: Self-Purification in the Effluent Channel at Okhala Sewage Works, VI(4), 278-84 (1965).

(B) Other Publications

1. BEWTRA, J.K. & NICHOLAS, W.R.: Oxygenation from Diffused Air in Aeration Tanks, JWPCF, 36(10), 1195-1224 (1964).

2. BULUSU, K.R.: Problems Associated with the Disposal of Certain Industrial Wastes, **Indian Industries**, 6(3 & 4), 45-47 (1964).

3. DESHPANDE, A.W.: Design Aspects of Oxidation Ponds. Paper presented for discussion and talks at the 18th Annual General meeting of the Institution of Engineers (India) 1965.

4. JAIN, J.S.: Evaporation Control Studies in India. 18th Annual Report of the Institution of Engineers (Nagpur Centre).

5. JAYANGOUNDAR, I.: A Bio-ecological Study of Nuggikari Lake in Dharwar, Mysore State, South India, **Hydrobiologia**, XXIII, 515-532 (1964).

6. KRISHNAMOORTHY, K.P. : Survival of a Daphnid Moina dubia Gurney and Richards in different Oxygen Content levels, **Proc. Indian Acd. Sci., B. Services,** LXI, 90 (1965).

7. KRISHNAMOORTHY, K.P. : Hydrobiological Studies in Gandhi Bagh—Diurnal Variations in Plankton, **Hydrobiologia,** XXV, 99-119 (1965).

8. KSHIRSAGAR, S.R. : Effect of Temperature on Sewage Treatment, J. Instn. Engrs., (India), XLIV, 10(PH3) 64-77 (1964).

9. KSHIRSAGAR, S.R. : Reuse of Sewage after Tertiary Treatment, **Instn. Engrs.,** XLV, 2(PII), 1-12 (1964).

10. MEHTA, R.S., MOHANRAO, G.J. & LAKSHMINARAYANA, J.S.S. : Use of Chlorine in Sanitary Engineering Practice, **Ind. J. Engrs.,** 4, 13, (1964).

11. MEHTA, R.S. & JAIN, J.S. : Water Conservation by Retarding Evaporation, **J. Instn. Engrs. (India),** XLV, 10(PH3), 78-88 (1964).

12. MOHANRAO, G.J. & MEKINCY, R.E. : Activated Sludge, **JWPCF,** 26, 303 (1964).

13. MOHANRAO, G.J. & SASTRY, C.A. : Effluents from Chemical Pharmaceutical Industries, **Ind. Industries,** 8, 32-38 (1964).

14. MOHANRAO, G.J. & SASTRY, C.A. : Treatment and Disposal of Certain Effluents from the Coal Carbonisation Industry, **Indian Chem. Manufacturer J.,** 2, 23-29 (1964).

15. MURTHY, Y.S., SETH, G.K. & SHANTIKUMAR, L. : Inventory of Urban Water Supply in Andhra Pradesh, **J. Instn. Engrs.,** XLV, 2(PH1), 13-19 (1964).

16. RAMPRASAD, J.N.C. : Regeneration of Operculum in Potomides Cingulatus, (Gmelin) Gastropoda Prosobranchia, **Curr. Sci.,** 33, 10, 310 (1964).

17. RAWAL, B.D. & GODBOLE, S.H. : Epidemiology of Water-borne Infectious Hepatitis in a Locality in Poona, **Ind. J. Med. Sci.,** 439-44 (1964).

18. SETH, G.K. & MURTHY, Y.S.: Treatment and Recovery of By-products from Pickling Liquor Wastes, **Proc. Symp. on Metallurgical Wastes,** NML, Jamshedpur (1964).

19. SETH, G.K. & MURTHY, Y.S.: Status of Industrial Wastes Treatment and Disposal in Andhra Pradesh, **Chem. Ind. News,** (Calcutta), IX, 9 (1965).

APPENDIX V

SEMINARS AND SYMPOSIA

S.No.	Date	Subject/Topic	Speaker
1.	4 April '64	Use of Chlorine in Sanitary Engineering Practice	DR. J.S.S. LAKSHMINARAYANA, Scientist, CPHERI
2.	18 April '64	Emotional Health	DR. A.K. ANWIKAR. Scientist, CPHERI
3.	25 April '64	Waste Water Disposal	PROF. M.V. BOPARDIKAR, Scientist, CPHERI
4.	15 May '64	Water Supply and Sewage Disposal in Australia	C.D. PARKER, WHO Expert
5.	22 May '64	Sewage Treatment in Melbourne (a) Sewage Farming (b) Lagoons	-do-
6.	6 June '64	The Status of Sewage Treatment in Ponds	-do-
7.	17 June '64	The Mechanics of Anaerobic Lagoons and their General Design Aspects	-do-

8.	20 June '64	The Application of Lagoons to Industrial Waste Treatment	-do-
9.	24 June '64	Corrosion of Concrete Sewers by H_2S	-do-
10.	27 June '64	6th International Water Supply Congress in Stockholm	SHRI R.S. MEHTA, Director, CPHERI
11.	29 June '64	Standards of Acceptance of Industrial Waste	C.D. PARKER, WHO Expert
12.	4 July '64	Water Reclamation and Reuse in USA and Israel	-do-
13.	18 July '64	Diatomite Filters and their Economics	PROF. M.V. BOPARDIKAR, Scientist, CPHERI
14.	14 July '64	Poliomyelitis in India	DR. JHALA, Director Haffkine Inst., Bombay
15.	25 July '64	Health Statistics	MR. P. SINGHA, WHO Statistician of WHO Project on Vital & Health Statistics
16.	31 July '64	Problems related to Viscose Rayon Industries	DR. G.J. MOHANRAO, Scientist, CPHERI
17.	17 Aug. '64	Koyali Oil Refinery	MR. U.J. BHATT, Chief Engineer, Koyali Oil Refinery (Gujerat)
18.	24 Aug. '64	Occupational Health Activities in India	ARNE BRUSGAERD, WHO Consultant, under Project India-197

19.	5 Sept. '64	Environmental Change and Resulting Impacts of Health	SHRI R.S. MEHTA, Director, CPHERI
20.	14 Sept. '64	Problems at Delhi Zonal Centre	DR. J.K. BEWTRA, Scientist, Delhi Zonal Centre, CPHERI
21.	17 Oct. '64	Tokyo Conference	DR. G.J. MOHANRAO, Scientist, CPHERI
22.	23 Oct. '64	Tokyo Conference	-do-
23.	21 Nov. '64	Bacterial Reduction at Different Stages in Water Treatment	SHRI N.M. PARHAD, Scientist, CPHERI
24.	27 Nov. '64	New Light Effect	DR. S.S. JOSHI
25.	3 Dec. '64	Training of Public Health Engineers in U.S.A.	MR. WILLIAM WILSON, Asstt. Chief of Training, International Health
26.	19 Dec. '64	Impression of Russian Education System	SHRI K.A. VENKATACHALAM, Asstt. Prof. LIT, Nagpur
27.	2 Jan. '65	Man, Microbes & Evolution—A Common Platform of Health Engineers & Micro-bio-Engineers	PROF. M.V. BOPARDIKAR, Scientist, CPHERI
28.	19 Jan. '65	Role of CPHERI in the Welfare of Nation	DR. K.L. RAO, Minister for Irrigation & Power, Govt. of India
29.	23 Jan. '65	Treatment of Nightsoil in Japan	DR. G.J. MOHANRAO, Scientist, CPHERI
30.	27 Jan. '65	Certain Aspects of Chemical Engineering	DR. M.N. RAO, Prof. & Head of the Dept. of Chem. Engg., Kharagpur

31.	6 Feb. '65	Water Engineering in Ancient India	MR. A.W. DESHPANDE, CPHERI
32.	10 Feb. '65	Design Criteria Development for Bogota, Columbia, S. America	ERNEST LEFFEL, Consulting Engr., Boston, U.S.A.
33.	11 Feb. '65	Role of WHO in the Control of Environmental Pollution	DR. PAVANELLO, Head of the Environmental Pollution, WHO
34.	12 Feb. '65	Ground Water Development Course	PROF. R.D. SINGER, Univ. of Minnesota, U.S.A.
35.	20 Feb. '65	Reaction in Chlorination	PROF. J.C. MORRIS, WHO Expert
36.	6 Mar. '65	Reclamation of Effluents	DR. G.J. MOHANRAO, Scientist, CPHERI
37.	9 Mar. '65	Digital Computers—Application in Engg. Analysis	PROF. ROBERT E. ARCHER, IIT, Kanpur
38.	19 Mar. '65	Disinfection	PROF. J.C. MORRIS, WHO Expert
39.	20 Mar. '65	Opportunities in Chemical Engineering	PROF. DRYDEM, Visiting Prof. in Chem. Engg. from Ohio, USA at IIT, Kanpur
40.	25 Mar. '65	Life at Harvard	PROF. J.C. MORRIS, WHO Expert
41.	27 Mar. '65	Conference of Directors of CSIR National Laboratories	SHRI R.S. MEHTA, Director, CPHERI

APPENDIX VI

LIBRARY

		Total Nos.
1.	Books & Bound Volumes	5,703
2.	Journals Subscribed for Headquarters	165
3.	Journals Subscribed for Field Laboratories (11 Nos.)	12 each
4.	Journal Received on Exchange Basis	22
5.	No. of Photostat Copies and Reprints	774
6.	No. of Pamphlets	460

APPENDIX VII

STAFF POSITION

DIRECTOR

Shri R.S. Mehta

SCIENTISTS

1. Prof. M.V. Bopardikar
2. Shri J.M. Dave
3. Dr. G.J. Mohanrao
4. Dr. N.U. Rao
5. Dr. G.K. Seth
6. Dr. S.V. Ganapati (Resigned w.e.f. 12-3-65)
7. Dr. A.K. Anwikar
8. Shri C.V. Sabnis
9. Dr. C.A. Sastry
10. Shri R.N. Chakrabarty
11. Dr. B.D. Rawal (Resigned w.e.f. 8-1-65)
12. Shri S.R. Kshirsagar
13. Shri J.S. Jain
14. Dr. J.K. Bewtra
15. Dr. J.S.S. Lakshminarayana
16. Dr. P.V.R. Subrahmanyam
17. Shri K.R. Bulusu
18. Shri Y.S. Murthy
19. Shri S. Rajagopalan
20. Shri J.M. Tuli

21. Shri M.V. Srinivasan
22. Shri D. Raguraman
23. Shri N. Dutta
24. Shri K.P. Krishnamoorthy
25. Shri R.P. Mishra
26. Shri S.H. Godbole
27. Shri S.B. Dabadghao
28. Dr. M.G. George
29. Dr. K.L. Saxena
30. Dr. W.M. Deshpande
31. Shri R. Paramsivam
32. Shri J.S. Gadgil
33. Shri H.C. Arora
34. Shri M. Parabrahmam
35. Shri N.M. Parhad
36. Shri V. Chalapatirao
37. Shri R.K. Saraf
38. Shri A.K. Seth
39. Shri A.K. Basu
40. Shri D. Seethapathirao
41. Shri T.G. Padmanabhan
42. Shri I.P. Bahri
43. Shri R.S. Dhaneshwar
44. Prof. M.A. Moghe

(Retired Scientists)

SENIOR SCIENTIFIC/TECHNICAL ASSISTANTS

1. Shri T.K. Srinivasan
2. Shri B.N. Pathak
3. Shri T.S. Bhakuni
4. Shri S.K. Titus
5. Shri M.D. Patil
6. Shri P.K. Yennawar
7. Shri K.R. Khan
8. Shri A.Q. Khan
9. Shri S.S. Mudri
10. Dr. S.K. Meghal
    (Resigned w.e.f. 31-8-64)
11. Shri C.S.G. Rao
12. Shri R.K. Pandit
13. Shri N.S. Phadke
14. Shri N.K. Kaushik
15. Shri S.K. Shrivastava
16. Shri V.P. Thergaonkar
17. Smt. L.S. Jayangoudar
18. Shri L.N. Sharma
19. Shri I.P.S. Prasada Rao
20. Shri A.W. Deshpande
21. Shri P.V.R.C. Panicker
22. Shri S.N. Dabadghaonkar
23. Shri M.V. Badwe
24. Shri V.R. Apte
25. Shri V.R. Bhave
26. Shri Thomas Koshy
27. Shri H.J. Patil
28. Shri Y.N. Murty
29. Shri S.G. Bhat

JUNIOR SCIENTIFIC/TECHNICAL ASSISTANTS

1. Shri M.R. Bodhmage
2. Shri V. Kothandaraman
3. Miss Rekha Mitra
4. Shri P. Kumaran
5. Shri Mohinder Singh
   (Resigned w.e.f. 6-7-64)

6. Shri S.B. Deshmukh
7. Kumari R. Nagalakshmi
8. Shri V.L. Pampattiwar
9. Shri G.K. Kale
10. Shri M.N. Shrivastava
11. Shri G.Rajagopal
12. Shri K. Srinivasan
13. Shri S.G. Shaikh
14. Shri Ahmed Khan
15. Shri K.M. Aboo
16. Shri R.S. Varde
17. Shri S. Hussainy
18. Kumari S.J. Illavia
19. Shri T.K. Reddy
20. Shri S.S. Murthy
21. Shri L. Shantikumar
22. Shri K.N. Radhakrishnan (Resigned w.e.f. 1-12-64)
23. Kumari J.M. Deshpande
24. Kumari S.W. Shende
25. Kumari K.W. Choudhary
26. Shri B.K. Lonsane
27. Shri B. Sivasubramaniyam
28. Shri S.C. Shrivastava (Resigned w.e.f. 31-10-64)
29. Shri S.P. Gupta
30. Shri A.K. Dey
31. Shri R. Nagabhushan
32. Shri R.S. Somyajulu
33. Shri Harish Chandra
34. Shri S.K. Jalhona
35. Shri T.N.C. Ramaprasad
36. Shri T. Venkateswarulu
37. Kumari D. Shah
38. Shri Thomas Joseph
39. Shri S.K. Kesarwani
40. Shri E.P.I. Sundersingh

AUXILIARY TECHNICAL

41. Shri N.M. Narsimhan
42. Shri P.Y. Khanapurkar
43. Shri N. Narayana
44. Shri G.T. Kale
45. Shri S.S. Sethuraman
46. Shri G.L. Banerjee
47. Shri H.V. Garde
48. Shri S.K. Sharma

ADMINISTRATIVE AND HOUSE KEEPING

1. Shri M.G. Thakar (Relieved on transfer (w.e.f. 24-10-64)
2. Shri Naseeruddin Ahmad
3. Shri A. Venkatraman
4. Shri N.S. Anand
5. Shri Mangal Prasad
6. Shri S.N. Nayar
7. Shri R.N. Sharma
8. Shri T. Rajagopalan
9. Shri H. Prasad
10. Shri V. Desikachari
11. Shri M.A. Baig
12. Smt. I. D'Souza
13. Shri J.H. Govind

APPENDIX VIII

BUDGET

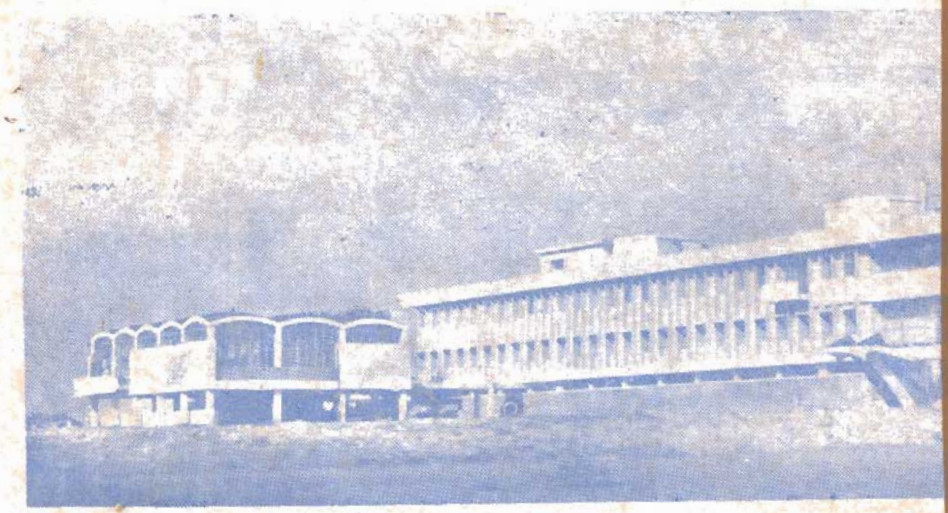
1964-1965

Nature of grant	Sanctioned Amount (Rupees in Lakhs)	Revised Estimate	Actual Expenditure (Rupees in Lakhs)
Recurring grant	18.700	21.879	19.736
Capital grant	5.910	9.650	5.414
Pilot-Plant grant	0.500	1.230	0.464

APPENDIX IX

DISTINGUISHED VISITORS

S.No.	Name	Address	Date
1.	C.D. Parker	Member, Water Science Institute, Australia	3-7-1964
2.	Shri D.M. Knex	6, Farizabad Road, Lucknow (U.P.)	28-10-1964
3.	Edurin V. Abbots	Friends Rural Centre, Rasulia, Hoshangabad, (M.P.)	-do-
4.	David B. Willets	WHO Resident Engineer, 1, Garstin Pl. Calcutta-1	-do-
5.	Rexford D. Singer	School of Public Health, University of Minnesota	12-2-1965
6.	Robert R. Harris	U.S. Embassy, AID/H, Pandara Flats, New Delhi	12-2-1965
7.	Renato Pavranello	WHO, Geneva, Switzerland	12-2-1965
8.	Shri K.L. Rao	Union Minister of Irrigation & Power, New Delhi	19-1-1965
9.	Shri M.R. Chopra	Chairman, Central Water & Power Commission	19-1-1965
10.	Shri N.G.K. Murti	C.E. Maharashtra	19-1-1965



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