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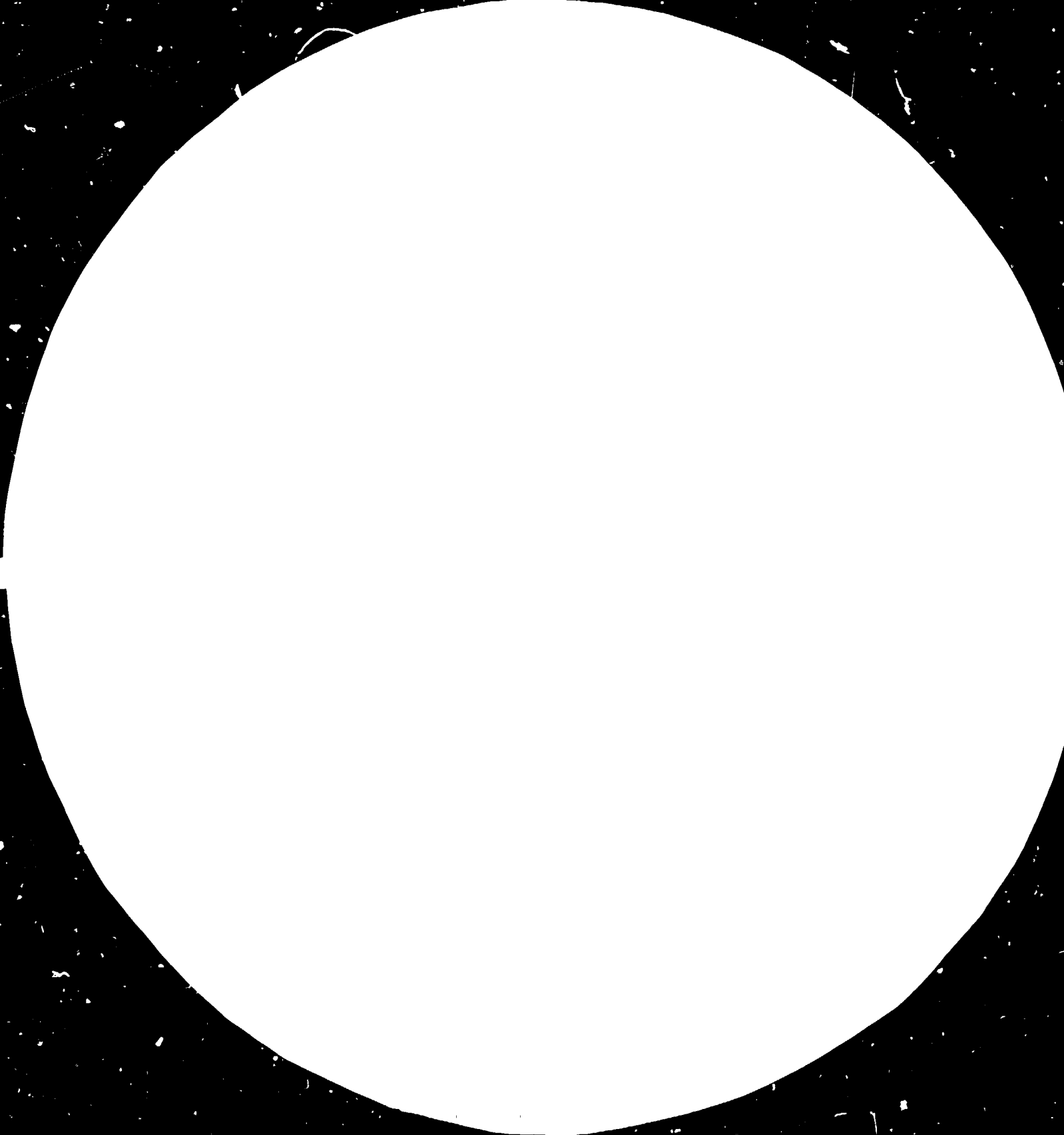

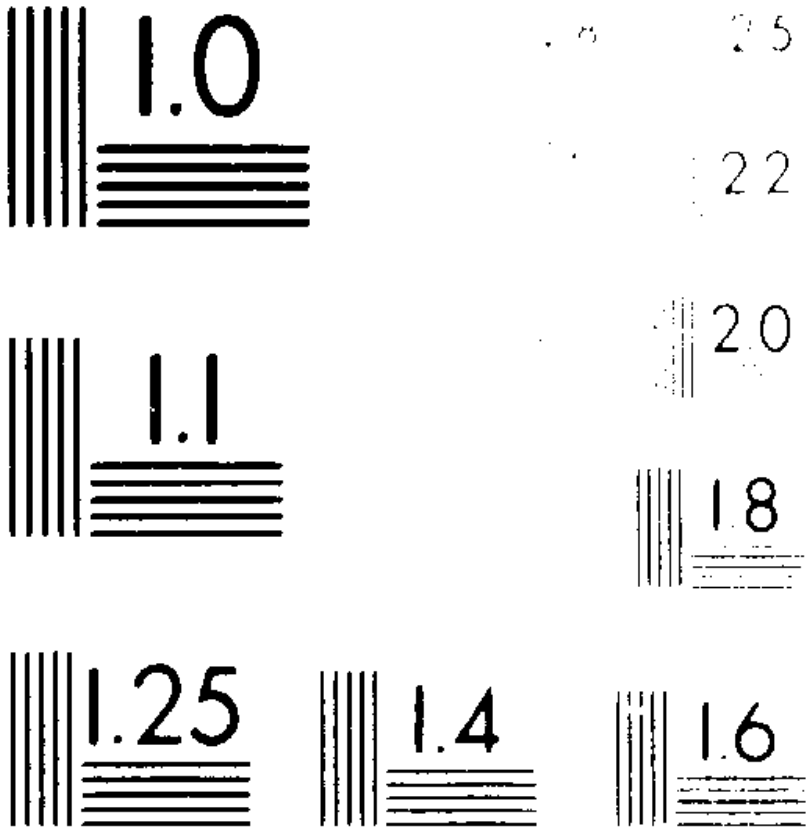
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PESTICIDES DEVELOPMENT PROGRAMME IN INDIA

DP/IND/80/037

INDIA

Terminal report*

Prepared for the Government of India
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of A.H. Manchanda,
Expert in Pesticide Analysis

United Nations Industrial Development Organization
Vienna

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My grateful thanks to members of HIL for their help and assistance during my period of stay in India. In particular I should like to thank Mr.A. R. Panicker, Dr.Pillai and Dr.Sengupta who gave freely of their time and assisted me in better understanding of the pesticide industry in India. To Mr.Satpal and Mr.Makaan of UNDP who were very helpful on the administration aspects of the assignment.

Introduction

The Indian Government Project, Pesticide Development Programme India (PDPI), is being established with UNDP assistance and Hindustan Insecticides Limited, a Govt. of India Enterprise, as the executing agency in India. The aims of PDPI are to assist and strengthen the pesticide industry with special emphasis on aiding the independent small-scale formulator. This is to be achieved by establishing Research & Development (R and D) facilities related to pesticide manufacture, quality control, marketing and pre-requisite requirements for registration of new products.

HIL is setting up a Central R&D centre to serve the needs of its company and PDPI is to form a part of this complex. The buildings have been completed and are located in Dundehera, 25 km. outside Delhi in the State of Haryana.

UNDP, the funding agency, is assisting the PDPI programme through its sister organisation UNIDO, who is providing the technical guidance. The programme is spread over a five year period, July, 1981 to June, 1986 and during this period a number of consultants are to visit India to provide technical assistance. One such area selected is pesticide analysis and the author visited India for a period of six months, September, 1983 to March, 1984 with the following terms of reference :

1. Identify the needs of the project in terms of qualified manpower, equipment and other facilities in order to enable the centre to develop expertise and train people in pesticide analysis;
2. Identify the gaps in the facilities for quality control and pesticide/raw material analysis and suggest ways of improving the same;

3. Formulate a short-term training programme in pesticide analysis and quality control for the trainees and actively participate in carrying out the above training programme by way of lectures, demonstration and conducting practical classes.

4. Train the national counterpart in the operation of analytical equipment, interpretation of data and general maintenance, etc.

The report is based on observation during study tours and discussions with those most concerned with pesticide analysis in India.

Recommendations

As one of the aims of PDPI project is to develop facilities for the analysis of raw materials, inter-mediates and finished products related to pesticide industry, also to provide pesticide residue data for registration purposes and act as a training centre. It is recommended that :

a) Urgent consideration be given to making the R&D centre in Dundehera functional by:
   i) ensuring a reliable and continuous electricity supply. A standy generator should be available.
   ii) the equipment supplied under the PDPI project is installed by qualified engineers from the manufacturers and an adequate supply of spare parts purchased.
   iii) staff be selected, with sufficient experience in, handling the equipment, interpreting results and with basic knowledge and skills in analysis of pesticides.
   iv) a suitably qualified and trained person in the field of electronics be made available for maintenance and minor repairs of the instruments.

b) Library facilities be improved by purchase of books and periodicals relating to pesticide analysis.

c) The analysis of pesticide residues and formulation be separated which will need additional equipment.

d) Identify the programme of work and plan the training both in terms of frequency and nature.

e) Consideration be given to utilising the provision in the project document for a further six months services of a consultant in pesticide analysis, the further visit should take place when the equipment has been installed and tested. Also reliable supply of electricity is available.

Background

The history of pesticide usage and industry in India can be traced back to 1947-48 when imported formulations of DDT and BHC were introduced for agricultural use. Subsequently, the imported technical materials were formulated in the country and this followed by manufacture and formulation of the technical pesticides. Thus in 1954 India produced 432 tonnes of technical material which increased in 1983 to 110,000 tonnes. The amount produced and that imported during the three years 1980-1982 is given in the table below, which clearly indicates that India has a well-established pesticide industry relying to a lesser extent on importation.

	1980		1981		1982	
	Imported	Locally produced	Imported	Locally produced	Imported	Locally produced
	Tonnes		Tonnes		Tonnes	
Insecticides	9121	39186	5849	41459	6144	53893
Herbicides	695	440	926	645	1419	577
Fumigants	-	617	-	993	-	927
Fungicide	5166	2771	5503	2416	5834	2937
Total	14982	43014	12279	45513	13397	58334

It can be seen that India has a well-established pesticide industry relying less and less on importation.

At present 50 technical grade pesticides are being manufactured by 32 industrial organisations which are either multi-nationals, private sector or Govt. owned. There are some 400 formulators marketing the pesticides as dusts or emulsion concentrates. Wettable powders of DDT and BHC are also formulated for use in the malaria eradication programme. Technology for the other types of formulations does not exist in India but it is foreseen that this will be developed in the coming years.

Formulating of the pesticides is carried out either by the manufacturers of the technical material or by independent units. The latter range in size from fairly large organisations to small-scale producers. The multi-nationals and the larger companies have well-established facilities for testing and quality control which is often not the case with smaller units. This can lead to the marketing of inferior material.

The Govt. of India is encouraging small-scale industry in the country and one area selected is small-scale formulators. [illegible] facilities exist for R&D at the national level for pesticide formulation, the Pesticides Development Programme India is establishing such a laboratory and one of its aims will be to provide technical know-how and training for the staff of smaller formulating companies. The PDPI programme is to be organised in India through Hindustan Insecticides Limited.

HIL is a Government of India Undertaking which comes under the Ministry of Chemicals & Fertilizers. It is the largest Indian company producing mainly the pesticides DDT, BHC, Endosulfan and Malathion which it also formulates. The company has three units located in Delhi, Udyogamandal in Kerala and Rasayani in Maharashtra. The units have R&D facilities with emphasis mainly in solving plant operation problems and process improvements. In order to extend the Research and Development facilities, HIL decided to establish a Central Research and Development complex in Dundehera, which would look at all aspects of pesticide formulation technology. PDPI is to form part of this R&D complex and the objectives identified for this programme are:

1. Pesticide demand survey and future planning.
2. Product and raw material identification.
3. Formulation development and raw material identification.
4. Process development of pesticide formulation and generation of data on toxicity, pollution and other allied matters.
5. Training courses for pesticide industry personnel on management, quality control, etc.
6. Consultancy services and industry sponsored R&D capabilities.
7. Offer quality control service to various industries.
8. Documentation service including dissemination of technical information and distribution of abstracts to concerned organisations.
9. Publishing technical bulletin.

The above objectives will fulfil to a large extent the needs of the pesticide industry in India. The existing facilities for pesticide analysis on a national level are very limited in the country. The Central Insecticides Board laboratory in Faridabad is developing facilities for analysis of samples sent to it under the Insecticides Act, which can be the insecticide itself or materials for residues. Its main purpose being laboratory investigation for registration of insecticides. The Central Plant Protection Training Institute, Hyderabad, offers training and undertakes analysis of formulations and residue. The Central Food Technology Research Institute in Mysore is doing work on residue analysis as is also the case with some University Departments. Shri Ram Test Centre in Delhi will undertake pesticides analysis on a fee paying basis.

Discussion

General

The construction of the Central R&D Centre in Dundehera is now completed and ready for occupation. The equipment purchased has been delivered and checked ready for installation. However, the electricity supply, though connected, is made available for limited periods and mainly during the night. To ensure a regular and reliable supply of power a generator is being purchased. When installed, it should be possible to commission the equipment. As the electricity will continue to be erratic, it is advisable to instal a cut-out switch so that subsequent to a power failure the instruments will remain turned off. This will avoid any damage to the instruments when power is restored and there is an upsurge.

Equipment

The equipment purchased under the PDPI programme comprises:

1. Infra red spectrophotometer.
2. Ultraviolet spectrophotometer.
3. Gas liquid chromatograph
4. High pressure liquid chromatograph
5. Polarograph (2 units)
6. Automatic titrator(2 units).
7. Sedimentation balance (2 units)
8. Moisture meter
9. Viscometer.
10. Dissolved oxygen meter.
11. Mainpan balances (2 units)
12. Particulate analyser.
13. Gas analyser.
14. Autofraction collector.

15. Atomic abroption spectrophotometer.
16. Buchi thin film evaporator.
17. Micro doser for TLC (3 units)
18. Refractrometer.
19. Deep freeze
20. Corrosion testing cabinet.
21. Freeze dryer.
22. Spectronic 20
23. Electrophoresis
24. Refrigerated centrifuge.
25. Air Borne-micro organism dust sampler.

The equipment purchased under the PDPI project should be installed as a matter of urgency as the storage in excessive heat and dusty atmosphere will have a deleterious effect. It is important that the laboratory housing the instrument is air-conditioned, which will also reduce the dust. Each equipment should be fitted with a voltage stabiliser capable of coping with the voltage fluctuations in the area.

Instruments such as gas liquid chromatograph and atomic absorption need specialist gases some of which are highly inflammable. From safety point of view, it would be useful to build a shed outside the laboratory to house the gas cylinders and pipe the gases in. An adequate supply of gases should be stored to ensure continuity of work and avoid damage to the instrument, as delays can occur when ordering replacement gas cylinders. A store should be constructed for storage of gas cylinders and should be in the vicinity of the laboratory.

The work envisaged for the pesticide analysis section is to cover (a) analysis of raw, intermediate and final products, (b) collection of residue data for registration, (c) analysis of samples from field trials, and (d) residue analysis from environmental samples. The gas chronatogramme purchased for

the project is fitted with a nitrogen phosphorus detector and heated wire detector. They are of limited value for the work to be undertaken. Additional detectors should be obtained such as a flame ionisation detector for formulation analysis of active ingredient and samples originating from synthesis of new products. An electron capture detector for the analysis of the chlorinated hydrocarbons. Since the work area cover both residue analysis, formulation analysis and sample resulting from development work, it is necessary to have more than one gas liquid chromatogramme. Also the instrument used for residue analysis should preferably be housed separately from the others to avoid contamination.

When a complete programme of work has been planned for the R&D centre decision can then be taken on the number of glcs and types of detectors that will be required.

The high pressure liquid chromatograph will need solvents of high ~~xxxxxx~~ purity and re-distillation is not sufficient, thus a unit such as millipore should be purchased.

The equipment in terms of instrumentation is adequate for a pesticide analysis laboratory. However, an adequate supply of essential spare parts for the instruments should be kept, as the agents in India do not carry any spare parts. The manufacturers on request will recommend the most useful spares needed. A person should be appointed with a background in electronics who will be able to service the instruments and carry out basic repairs. While such a person is being trained it would be worth considering a service agreement with instrument suppliers.

Staff

The Central R&D centre is being manned by existing staff of HIL, who are being transferred from the three factories. Although well-qualified, they lack experience in the use of modern sophisticated instruments. The terms of reference for the authors assignment included training of such staff, but since the equipment was not installed and the staff not identified, this aspect could not be dealt with. It would, therefore, be ful for a consultant to visit India for a further period.

Experiences both in instrumentation and chemical manipulation are essential and this could be achieved by training of staff abroad and in India.

With the diverse range of equipment purchased it would be best to appoint a staff member who will have responsibility for a group of similar instruments e.g. Infra red, ultraviolet and Atomic abrorption could be operated by one person while gas liquid chromatograph and High pressure liquid chromatograph by a second operator. This system would encourage the operators to develop expertise for the instruments by their charge which in turn will enable the R&D centre to innovate new methods of analysis using the particular instruments. The instruments purchased are sophisticated and their use only for routine analysis would not justify the expense.

Training

As mentioned earlier in the report, the Govt. policy is to encourage the small scale sector in the country and PDPI will play an important role as far as pesticide formulators are concerned. Most of the larger companies and multi-nationals have the capability for quality control for the manufacture of their products. However, the small-scale producer lacks this facility and needs assistance. The sophisticated instruments are beyond the scope of the small operator both in terms of cost and availability of trained staff. A way of overcoming this difficulty is to develop methodology such as thin layer chromatography and colorimitry which are not costly and require minimum training. The R&D centre should initiate a research programme in order to develop such methods which can then be passed on to the small-scale producer.

A separate training section should be established in the R&D complex whose staff would be responsible for organising training courses by drawing on the expertise within the centre and from outside. The administrative aspects

such as scrutinising the training requirements within the country, selection of suitable candidates etc, would be the responsibility of this section and leave the scientific staff to utilise their time more profitably in the laboratories.

Subject headings given below for training programme in pesticide analysis are based on materials at present being manufactured in India and with small scale formulators in mind. This can be addedto when other pesticides are introduced in the country or new formulation made.

These subjects should be taught by lectures on the principles involved and practicals.

1. Physical properties
   a) Determination of particle size.
   b) Acidity and alxalinity determination.
   c) Suspensibility.
   d) Wetability.
   e) Emulsion stability.
   f) Flash point.
   g) Cold test and heat stability of emulsifiable concentrates.
   h) Accelerated storage.
2. Chemical tests
   a) Estimation of BHC and DDT by hydrolysable chlorine.
   b) Determination of Y-BHC in technical and formulated material by chromatography.
   c) Detection of adulteration in technical and formulated materials by TLC.
   d) Estimation of endosulfan by alkalins hydrolyses.
   e) Malathion estimation by the iodometric method.

The use of the more sophisticated instruments such as HPLC, Glc, spectroscopy could also be taught as familiarisation to these techniques.

Pesticides analysis for legal requirements in registration of a new product.

In India, the Insecticides Act was enacted in 1968 and its purpose was to regulate the import, manufacture and use of insecticides in India, with a view to prevent risk to humans and animals. The responsibility for enforcement of the Act lies with both the Central and States Govts. All technical matters till the granting of compulsory registration is the responsibility of the Central Govt. which are dealt with through the statutorily constituted bodies like the Central Insecticides Board and theRegistration Committee while Central Insecticides Laboratory in Faridabad verifies the claims made by manufacturers and formulators at the time of registration. After registration the major responsibility moves to the State Govt. to ensure that the manufacturers and formulators are complying with the legal requirements.

One of the requirements for registration of a new product is the residue levels remaining on crops from its use under Indian conditions. Hence an important aspect of the R&D centre would be to generate such data both for HIL products and as a service to others in Govt. sector through the PDPI programme.

Pesticide residue analysis is a specialist field requiring a different approach to formulation analysis. In residue analysis the quantity of pesticides to be determined is very low and requires the use of highly sensitive equipment. GLC is a useful instrument for such determination. Laboratory for carrying out such analysis should be separated from formulation work to avoid contamination.

The steps involved in any residue analysis are

a) Sampling,
b) Extraction of the material with a suitable solvent.
c) Clean-up of the extract i.e. removal of extraneous material.
d) Determination of the residue - which could be the parent compound or a metabolic.
e) Confirmation of the pesticide.

The staff at HIL need to develop expertise in the above methodologies so that they can organise training courses in these. There are other Govt. laboratories in India undertaking pesticide residue analysis. One such laboratory visited by the author was the Central Food Technology Research Institute, Mysore. It would be useful for HIL to have an interaction with this laboratory which will be of mutual advantage.

Library facilities

For an R&D Centre to function effectively library facilities should be adequate, providing books, periodicals, reprints on varied subjects such as Chemistry, Agriculture, Pharmacy, instrumentation, etc. Indexing of relevant papers published in journals should also be maintained. The R&D Centre owing to its location, needs to develop a good library and for this purpose back issues of journals and periodicals will also need to be stocked and should go back for 10 years.

Visits in India

Indian Agricultural Research Institute, Delhi
HIL factory, Delhi.
Sri Ram Test House, Delhi.
Central Plant Protection Training Centre, Hyderabad.
Regional Research Laboratory, Hyderabad.
Central Food Technological Research Institute, Mysore.
National Chemical Laboratory, Pune.
HICO Products, Bombay.
HIL Factory, Rasayani, Maharashtra.
HIL factory, Udyogamandal, Kerala.