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ESTABLISHMENT OF A PILOT PLANT FOR PESTICIDE FORMULATION

DP/BUR/80/011

BURMA

Technical report: Arrangement of the Laboratory*

Prepared for the Government of the Socialist Republic of the Union of Burma
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of I. Gardi,
consultant in pesticide analysis and instrumentation

Backstopping officer: E. Sugavanam, Chemical Industries Branch

3a/1

United Nations Industrial Development Organization
Vienna

* This document has not been edited.

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I. Findings and Recommendations:

Findings:

1. The building of the laboratory is ready, the water and electrical connections of the laboratory have been done.
2. The laboratory glassware and most of the basic instruments have arrived.
3. The installation of the instruments and equipment /excluding the gas chromatograph and Karl-Fischer instrument which has broken parts / have been done by the Consultant, they are in good working condition.
4. The laboratory has a very few chemicals, until their arrival no practical analytical work can be started.
5. Although the laboratory personnel is very enthusiastic and they have the main analytical methods in written form, they have no practical experience in handling instruments and in analytical practice.
6. The instruments available now can fulfill all the analytical work only in the case, when they can work continuously. In the case of any fault there is no chance to use an alternative method.
7. There are bad service conditions for instruments and the servicing is rather time consuming and expensive.
8. The quality of the locally available carrier gas /nitrogen/ for gas chromatograph is very poor and its use is dangerous to the instrument and columns even by using gas filters.
9. There is no inflammable gas source for the flash point apparatuses in the laboratory.
10. The fuses of some electrical connections have been underestimated, there are not safety breakers installed for electrical connections, the laboratories have not been supplied with main circuit breakers.

11. The electrical instruments and devices have not been supplied by plugs of Burmese standard.
12. There is water supply only in the general chemical laboratory and in the washing-up room. The size of water sinks is underestimated, the quantity and type of water taps are insufficient.
13. The temperature and pressure of water will be insufficient to assure proper vacuum by using water jet pumps.
14. The laboratory personnel has no sufficient knowledge on assembling the proper electrical connection of the motors of the exhausting system for fume cupboards.
15. There have not been planned proper positioning of the fume cupboard exhausting system and piping in the laboratory.
16. The surface of the laboratory tables is chemically not resistant.
17. There are no basic tools for the minimum maintenance and minor repairing works.
18. The water content of the local solvents / e. g. superior kerosene/ is changing from time to time and it can effect the quality and stability of the formulated pesticides to be produced.
19. Consultation has been organized between the directors and leading experts of the Pilot Plant for Pesticide Formulation and the Agricultural Corporation Plant Protection Organization on the possible cooperation activity.

Recommendations:

1. Each electrical wall connections should be supplied by safety breakers of proper capacity.
2. The capacity of the fuses should be checked and the underestimated ones should be changed to those of proper value.
3. Main electrical circuit breakers should be installed outside each laboratories for case of emergency.
4. The electrical wall connections should be dismantled in the store room.

5. Each electrical equipment and instrument should be supplied by earthed plugs of Burmese standard /approx. 50 pieces/.
6. A well trained electrical expert should be asked to install the motors of the exhaustors of the fume cupboards.
7. The local civil engineers should be asked to construct proper steel wall holders and holes for installing the exhausting system of the fume cupboards.
8. The physical and big instrumental laboratories should be equipped by water supply together with proper sinks and water taps.
9. The general chemical laboratory and the washing-up room should be supplied by sinks and water-taps of proper size and quantity based on the instructions given to the laboratory personnel.
10. The laboratory tables should be covered by chemically resistant epoxy resin sheets or glass covers.
11. Each laboratories and the store room should be supplied by air-conditioners.
12. A nitrogen/air generator /NITROX/ should be ordered immediately and the installation of the gas chromatograph should be postponed until its arrival.
13. An inflammable gas cylinder equipped by needle-valve /propane/butane/ should be purchased locally to supply the flash point apparatuses by gas source.
14. The instruction manual and detailed list of parts should be asked for the Karl-Fischer titrator in order that the broken parts could be ordered and substituted.
15. In order to assure the continuous quality control activity /in case if gas chromatograph gets wrong/ it is advisable to order the essential parts of a thin layer chromatography kit and a routine UV/VIS spectrophotometer.
16. The maintenance workshop should be supplied by basic tools.

17. Because of the poor service capabilities it is advisable to send an electrical engineer to train him in servicing first of all the Perkin Elmer type gas chromatographs /not necessarily covered by this project/ as there are more instruments of this type in the country.
18. It is advisable to ask for the service manual, construction plan and detailed list of parts of the main instruments in order to help the minor repairs and quick order of the fault parts.
19. It seems to be necessary to order technology for drying the local solvents to be used for producing formulated pesticides from the factory supplying the formulation technology and equipments.
20. It is highly advisable to assure a real practical training in handling instruments and in practical work in the field of analysis of pesticides at least for the head of the laboratory.
It is also advisable to emphasize the need of practical training instead organizing study tours in the future.
21. As the relationship between the Agricultural Corporation Plant Protection Organization and the Project for Pilot Plant for Pesticide Formulation has been very good, it is advisable to continue a more close cooperation for organizing biological trials of experimental formulations, to initiate interlaboratory trials to produce equal or similar pesticide analytical methods, to collect chemical and biological informations of the formulations to be manufactured locally, in the editing proper labels of containers and to establish the responsibility of the Pilot Plant.
22. To follow the Good Laboratory Practice the detailed written informations of the documentations and literature given to the laboratory personnel by the Consultant should be followed.
23. It is advisable for the Agricultural Government to join to the KENPAP Countries in order to gain more informations and training facilities in the field of use, production and quality control of pesticides.

II. Arrangement of the Laboratories.

The present duty of the Laboratory Section /Formulation and Quality Control/ can be fulfilled in the laboratories of the ground floor / See Annex 8./.

The main duties of the laboratories and the allotment of the major instruments and equipments are as follows.

1. General chemical laboratory /9.5x4m/

In the laboratory the preparation of experimental formulations, checking the quality of the solvents and surfactants, and the emulsion stability tests can be carried out.

The laboratory shall contain:

- two fume cupboards with exhaustion system
- Ohaus and technical balances
- vacuum pumps / water jets or/and motors /
- water baths, temperature controlled water bath
- heaters
- distillation units
- mixing motors
- Buchi rotavapor
- water still
- two water sinks of minimum dimensions of 250 x 400 x 200 mm, supplied by two times three pieces of water taps of laboratory types at a proper heights in order that a water jet can be installed
- one or two air conditioners

2. Balance room / 3.5 x 3.5 m /

Here the weighing of the samples shall be done.

It shall contain:

- two Sartorius analytical balances
- dehumidifier
- voltage stabilizer / of 1 kW capacity /
- air conditioner

For holding the analytical balances vibration-free tables should be used not in contact with the ordinary table.

3. Washing-up room / 3.5 x 1.5 m /

Here the cleaning and rinsing of glassware can be done.

The glassware of the formulation and the analytical laboratories should be handled, cleaned, rinsed and collected separately.

It shall contain:

- two water sinks / one for cleaning, one for rinsing / of minimum dimensions of 100 x 500 x 300 mm
- wall drying stand / preferably made of wood /
- polyethene container for distilled water for rinsing

4. Gas chromatograph-instrumental laboratory / 3.5 x 3.5 m /

Here the measuring of the active ingredient content of the technical material and the formulation products can be done.

It shall contain:

- Perkin Elmer gas chromatograph
- hydrogen generator
- nitrogen/air generator
- UV/VIS spectrophotometer /if there is at all /
- column holder/store
- gas filter units
- dehumidifier
- air conditioner
- voltage stabilizer / of 3 kW capacity /

5. Instrumental laboratory /6 x 4 m /

Here the minor instrumental analytical processes /sieving, pH-, flash point-, refractometry-, thin layer chromatography-, microscopy measuring /can be done.

It shall contain:

- pH meter
- flash point apparatuses
- Abbe refractometer
- thin layer chromatography kit / if available /
- two microscopes
- Karl-Fischer titrator
- sieving apparatus
- voltage stabilizer /of 3 kW capacity /

- air conditioner
- water sink of minimum dimensions of 250 x 400 x 200 mm equipped by minimum two water tap of laboratory type

6. Store room / 4 x 3.5 m /

This room is for storing chemicals and the samples of raw material and different batches of formulated products.

It shall contain only shelves, one air conditioner and no electrical wall connections.

7. Physical laboratory / 3.5 x 3.5 m /

Here the general physical processes / drying, emulsion stability tests, some preparative for density measurement, titrating, dilution tests / can be done.

It shall contain:

- two isotemp ovens
- burettes, pipettes
- isotherm water bath / temporarily /
- water sink equipped by minimum two water tap of lab. type
- air conditioner

III. Installation of major and minor equipments.

The instruments and equipments listed in the inventory list have been found, except two automatic transformer of 250 # capacity.

These instruments arrived two or three years ago - except gas chromatograph which arrived this year - and have been stored in a closed store with no air conditioning.

Most of the instruments and equipments had some water condensation outside and inside.

The two dehumidifiers have been taken into two separate rooms continuously working and the more sensitive instruments are now stored in dry place.

The electrical instruments have no plugs of Burmese standard or have not at all.

During testing them the some available plugs of Burmese standard were installed but it is necessary to supply each electrical connections by plugs of local standard.

1. Gas chromatograph.

As the locally available nitrogen gas contains large quantities of impurities which can not be avoided by gas filter units / first of all a large quantity of oxygen /, the use of nitrogen generator is an absolute necessity.

The installation should be postponed until the nitrogen/air generator arrives.

2. Sartorius analytical balances, two pieces.

The balances have been assembled and checked. The measuring and taring sites work normally, the calibration should be checked after longer working time.

3. Rotavapor RE-111/A, Buchi.

The rotavapor has been assembled and checked. After some problems because of the condensed water inside now it works properly. Because of the lack of vacuum source it was not possible to check the gas tightness, but the seals seem to be in good condition.

4. pH meter, Corning 140.

Electrically it works well, the lack of distilled water did not allow to prepare buffer solutions and to check the combined glass electrode.

5. Karl-Fischer titrator.

This instrument arrived in rather bad condition and has some broken glass parts.

As there is no instruction manual attached to, a detailed construction plan and a list of parts would be necessary to order and substitute the broken parts. The installation can be done after substituting the broken parts and after arriving the necessary chemicals / Karl-Fischer solution, drying chemical /.

6. Balance, Ohaus model 760.

After assembling and checking it works well.

7. Technical balance.

The balance works well.

8. Abbe refractometer.

The refractometer was checked, works well.

9. Motor/compressor K-213-750.

After repairing it works well. The max. vacuum is only 0.2 bar in closed circuit.

10. Stereo microscope.

After assembling it works well.

11. Olympus microscope.

After assembling it works well.

12. Electrical dehumidifiers, two pieces.

These work now continuously and well.

13. Sieve shaker.

This works well, but can be used only for dry sieving.

14. Flash point apparatus, Abel PEH 670 M.
After assembling this seems to be good.
 15. Flash point apparatus, ASTM D 93-IP 34.
After assembling this seems to be good.
For using the flash point apparatuses an inflammable gas cylinder equipped by a needle, as gas source / propane or butane / is to be purchased.
 16. Heating mantles, three pieces.
After some repairing these work well.
 17. Magnetic stirrer and hot plate.
This works well.
 18. Hot plates, two or three pieces.
These work well.
 19. Refrigerator.
This work well.
 20. Fume cupboards and fans, two pieces.
These are under installation.
These need some civil engineering work to prepare holes to the piping out system and steel holders to hold the fans on the wall in proper position. The details of planning have been discussed with the maintenance engineer.
The electrical connection of the three phase motors of fans should be made by a well trained electrician.
- Because of the unfavourite circumstances it was no time to check some equipments. These are:
21. Sterilizer, double walled.
This seems to be in good condition.
 22. Water still.
This has been assembled, but not checked. Most probably will work properly.

23. Water bath, Grant SE 15.

This has been assembled well, not checked.

24. Water baths, three pieces.

These seem to be in good condition, not checked.

25. Environmental chambers, two pieces.

These seem to be in good condition, not checked.

26. Isotemp lab. ovens, two pieces.

These seem to be in good condition, not checked.

27. Electric bunsen lamps, two pieces.

Not checked.

IV. Provisions of voltage stabilizers and emergency power requirements.

The main Project plans to install an own transformer station what means that the tension of the electrical supply of the plant will be more or less stable. In this case voltage stabilizers are necessary only for the more sensitive electrical and electronic instruments.

Referring to the Section II. / Arrangement of the laboratories / it seems to be necessary to install three pieces of voltage stabilizers, which should be of electro-mechanical types.

These can be STAVCL Automatic Voltage Regulators.

SVC 1000 N	1 kVA capacity	1 piece
SVC 3000 N	3 kVA capacity	2 pieces
input voltage: 160-240 V		
output voltage: 220 V \pm 3 %		

In the present state the approximate electrical power requirement of the laboratory is 70 kW.

The proposed capacity of the emergency generator is 50 kW.

In order to assure safe working conditions it is advisable to purchase two pieces of emergency generators of the same capacity, one of which would be a spare one.

The emergency generator of the capacity mentioned above can be used only for the laboratory building. In case of the need of similar facility for the Pilot Plant too, the capacity requirement should be reestimated.

The general specification of the emergency generator:

Working environment:

temperature: 0 - 60°C

humidity: max. 98 % relative / at 50°C /

dust content of the environment: high

Nominal capacity:	50 kW / 63 kVA /
Type of current:	three phase, alternative current
Nominal voltage:	400/230 V
Deviation of voltage:	\pm 3 %
Nominal frequency:	50 Hz
Deviation of frequency:	\pm 2.5 %

Asymmetric loadability: approx. 25 %
Working time without fuel refilling: min. 4 hrs
Continuous working time: approx. 100 hrs

Equipped by built-in voltage stabilizer.

The generator should be equipped by 3 separate magnetic switches to avoid overloading.

The connection of the three phases to the main lines should be symmetrical.

It should be mentioned that the generator/s/ shall be installed so far from the laboratory building / approx. 15 m distance / that the vibration and noise will not disturb the instruments.

V. Training needs of personnel.

During the installation of equipments the maintenance of those has been explained to the head of laboratory.

- The instruments having electronic parts should be kept in dry rooms until and during full run of laboratory work. For this reason at least two rooms need continuous air-dehumidifying besides air conditioning, by using the two dehumifiers. Until normal laboratory work and installation of the gas chromatograph all of these instruments should be kept in these two rooms, avoiding the water condensation inside the instruments.

These instruments are:

- gas chromatograph
- Sartorius analytical balances
- Buchi rotavapor
- pH meter
- Abbe refractometer
- microscopes
- flash point apparatuses

General laboratory maintenance.

- All the chemicals should be kept in well closed, properly labeled, chemically inert container / e.g. glass bottle /.
- The glasswares to be used in analytical laboratory should be cleaned and stored separately from those of used in the formulation laboratory.
- Each different types of glasswares should be kept in their own store which are labeled.
- Each volumetric flasks and pipettes to be used for weighing and diluting samples should be calibrated by distilled water of the same temperature by using analytical balances.
- Each electrical instrument which is out of order for longer time should be switched on every week for one or two hours running in order to avoid the development of rust.
- The more sensitive instruments / gas chromatograph, analytical balance, refractometer, pH meter / should be checked and calibrated regularly.

- The laboratories should be protected against dust and rodents /by using rodent baits in each laboratory, more particularly in the instrumental laboratories / and the instruments should be covered by their plastic covers while not in use.
- While weighing by analytical balance nor the plate of the balance and the glassware to be weighed be touched by naked fingers in order to avoid grease deposition on those. Use thin cotton gloves !
- In order to avoid the contamination of the chemicals used in the laboratory, clean spatulas and pipettes should always be used and after use the container of the chemical should be closed tightly and taken back to its place.
- In order to avoid cross contamination of the solutions to be measured formulated pesticides or raw materials should never be brought into or kept in the instrumental laboratory.
- After a cut down in electricity each electrical instrument having been in work should be checked and reswitched. The inspection of the refrigerator is essential even at night and weekend.
- The contaminated solvents and sample solutions should never be discarded to the sink, these chemicals should be collected in a separate, labeled container for incinerating safely.
- Each analytical standard and standard solution should be stored in refrigerator.
The shelf life of the analytical standards and solutions of those should be checked regularly.
- All the safety precautions should be strictly kept in the laboratory.

VI. Acknowledgement

I would like to express my warm thanks to UNDP deputy Resident Representative, Mr. Bjorn T. Carlsson, Project Director U Win Kyi, Laboratory lead U Saw Mooler, who assisted me to succeed the mission in Burma, and Mr. Sugavanam of UNIDO, Vienna for his kind help and cooperation.



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

JOB DESCRIPTION

DF/BUR/SG/O11/11-54

Post title	Instrumentation Consultant
Duration	1.0 y/m
Date required	1988
Duty station	Rangoon with travel to Hmawbi
Purpose of project	To provide facilities for the formulation of liquid pesticides using locally available solvents as far as possible.
Duties	<p>The consultant in association with the project authorities will assist and advise on:</p> <ul style="list-style-type: none">- the arrangement of the laboratory- allotment of equipment at appropriate places in the laboratory- installation of major and minor equipment- provision of voltage stabilizer and emergency power requirements- training needs of personnel in day-to-day running and maintenance of the laboratory- follow FAO specifications and CIFAC methodologies in analysis of pesticide formulations- follow good laboratory practice (g.l.p) protocol and- proper documentation and interpretation of analytical results- library facilities need to run the laboratory and the plant.

Applications and communications regarding this Job Description should be sent to:

Chief Personnel Recruitment Section, Industrial Operations Division

Qualifications: Chemist with long-standing experience in setting up of analytical laboratories and analysis of pesticides according to International Standards. Experience in industries and/or Government laboratories essential.

Language English

Background information The backbone of Burma's economy is agriculture and the staple crops are rice, cotton and sugar cane. At one time Burma was a major exporter of rice but now, due to lack of fertilizers and pesticides, the productivity in agriculture has declined considerably. The country has to import all its pesticide requirements as finished products. Due to shortage of foreign exchange, supply of pesticides has been erratic and always below the requirements. Having realized the importance of proper supply of pesticides, the Government of Burma approached UNDP/UNIDO for technical assistance in the establishment of a pesticide formulation plant.

Based on various studies conducted by UNDP and UNIDO, it has been decided to set up a liquid formulation plant (E.C) making use of the locally available solvents as much as possible in combination with standard solvents such as xylene.

The project will be executed by UNIDO with the Pharmaceutical Industries Corporation (PIC) as the National Counterpart Agency. The plant will be established at 50 km north of Rangoon, and a site is being made ready for the plant. The basic infrastructure is being created by providing all utility services, analytical laboratory, a small pilot plant, trained staff and the necessary safety precautions.

INSTITUTIONS AND PERSONS CONTACTED

UNITED NATIONS ORGANISATIONS

Mr. B. Carlsson	RR. a. i., UNDP
U Tin Aung Cho	Programme Officer, UNDP
Dr. A. Ambrus	Expert on Pesticide Analysis, FAO

PHARMACEUTICAL INDUSTRIES CORPORATION

U Ba Myunt	Managing Director
U Ban Yi	Planning Director
U Win Kyi	Project Director
U Myint Swe	Project Manager
U Saw Mooler	Laboratory Head
U Mon Tin Win	Quality Control Chemist
U Saw Win	Production Manager
U Nyo Lay	Maintenance Engineer

AGRICULTURE CORPORATION

U Maung Maung Tin	General Manager, Plant Protection Organisation
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List of the chemicals to be ordered

No.	Name	Quantity
1.	Acetone, spectro grade	20 litre
2.	Methyl-isobutyl-ketone, spectro grade	10 litre
3.	Ethyl alcohol, anhydrous,	10 litre
4.	Ethyl alcohol, spectro grade	10 litre
5.	Methyl alcohol, spectro grade	15 litre
6.	Ethyl acetate, spectro grade	10 litre
7.	Toluene, spectro grade	5 litre
8.	Toluene, reagent grade	10 litre
9.	Benzene, spectro grade	5 litre
10.	Xylene, reagent grade	15 litre
11.	Chloroform, spectro grade	5 litre
12.	n-Hexane, spectro grade	15 litre
13.	Cyclohexane, spectro grade	5 litre
14.	Diethyl ether, anhydrous	10 litre
15.	Dimethyl formamide, reagent grade	10 litre
16.	Di-n-butyl phtalate, 99%+	200 grams
17.	Di-/?-ethylhexyl/-phtalate, 98%	200 grams
18.	Bromine	500 grams
19.	Iodine	200 grams
20.	Fluorescein	100 grams
21.	Silver nitrate, 99%+	25 grams
22.	2-phenoxy ethanol	1 kg
23.	Diphenyl amine, 99%	1 kg
24.	Sulfosalicylic acid dihydrate, 98%	500 grams
25.	Zinc chloride, 98%+	1 kg
26.	Palladium/II/chloride	5 grams
27.	Sodium hydroxide, pellets 97%+	5 kg
28.	Potassium hydroxide, pellets	2 kg
29.	Ammonium hydroxide, 28-30%	4 kg
30.	Hydrochloric acid, 35%+, pure	5 litre
31.	Sulfuric acid, 95%+	5 kg
32.	Nitric acid, 70%	3 kg

No.	Name	Quantity
33.	Sulfanilic acid, anhydrous	200 grams
34.	Sodium nitrite	1 kg
35.	Sodium carbonate, granular	3 kg
36.	Sodium sulfide nonahydrate	1 kg
37.	Sodium thiosulfate pentahydrate	1 kg
38.	Sodium sulfate, anhydrous	5 kg
39.	Fluoranthene, 98%	100 grams
40.	Ammonium molybdate, /VI/ tetrahydrate	100 grams
41.	Ammonium nitrate	1 kg
42.	Acetic acid, glacial	2 litre
43.	Magnesium chloride hexahydrate	3 kg
44.	Ethylenedisminetetraacetic acid disodium salt	1 kg
45.	Calcium carbonate	1 kg
46.	Ammonium chloride	1 kg
47.	Methyl Red	50 grams
48.	Eriochrome Black T, indicator grade	200 grams
49.	Palatine Chrome Black 6BN	100 grams
50.	Diethylamine	1 kg
51.	Zinc, dust	1 kg
52.	Starch, soluble	250 grams
53.	Calcium chloride, anhydrous	10 kg
54.	Potassium chromate	1 kg

List of copies of documents given to the laboratory personnel.

- Manual on the development and use of FAO specifications for plant protection products. Rome 1987.
- International Code of Conduct on the Distribution and Use of Pesticides. FAO Rome 1986.
- Guidelines for Quality Control of Pesticides during Formulation and Packing. GIFAP
- Miscellaneous Techniques. CIPAC methods.
- ISO 5725 International Standard - Precision of Test Methods
- ISO 3534 International Standard - Statistics - Vocabulary and Symbols
- Good Laboratory Practice in the Testing of Chemicals. OECD
- EPPO Guidelines on Phytotoxicity Assessment
- An Introduction to Gas Chromatography. Pye Unicam
- An Introduction to High Performance Liquid Chromatography
- Troubleshooting Guide to Gas Chromatography. Supelco
- The Chrompack Guide to Chromatography. 1988
- Informal Consultation on Planning Strategy for the Prevention of Pesticide Poisoning. WHO
- FAO Guidelines for the Packaging and Storage of Pesticides. 1982
- TLC Systems for Identification of Pesticides. EPA
- Pesticide Tank Mix Application. 1982

List of the basic literature required to establish a library.

- Analysis of Technical and Formulated Pesticides. CIPAC Handbook
1., 1a., 1b., 1c.
- Official Methods of Analysis. Association of Official Analytical
Chemists / AOAC /
- EPA Manual of Chemical Methods for Pesticides and Devices
- The Pesticide Manual. British Crop Protection Council
- Whole series of Technical Monographs of GIFAP
- Specifications for Pesticides Used in Public Health. WHO
- CRC Handbook of Chemistry and Physics. Ed.: R. C. Weast
- CRC Handbook of Laboratory Safety. Ed.: N. V. Steere
- CRC Handbook of Chromatography Vol I-II Ed.: G. Zweig
- Microemulsions: Structure and Dynamics Ed.: Friberg /CRC Series/
- Controlled Release Pesticide Formulations Ed.: Cardarelli /CRC Series/
- Emulsions. P. Becher. / Rheinhold Publ. Corp. New York/
- Pesticide Formulations. W. Walkenburgh / Marcel Dekker Inc. New York/
- Pest and Disease Control Handbook. Ed. N. Scopes and M. Leding
British Crop Protection Council.
- Thin Layer Chromatography. Ed. : Stahl. / Springer Verlag /
- Chemical Engineers' handbook. Vol I-II Ed.: J.H.Perry /McGraw-Hill/
- Journal of the Association of the Official Analytical Chemists
- Journal of Agricultural and Food Chemistry
- Journal of Chromatography
- Analytical Chemistry

List of some manufacturers of surfactants.

- Geronazzo Milano

20 021 Ospiate di Bollate - Via Milano, 70 Italy

Tx : 331547

- Hoechst AG Frankfurt

D-6230 Frankfurt am Main 80

W-Germany

- Tenzia, Belgium

Carbochim Sa.

B-4200 Ongree, Rue de Renory 21.

Tx : 41241

- ICI Specialty Chemicals

B-3078 Everslaan 45. Belgium

Tx: 26151

- Kemi AG.

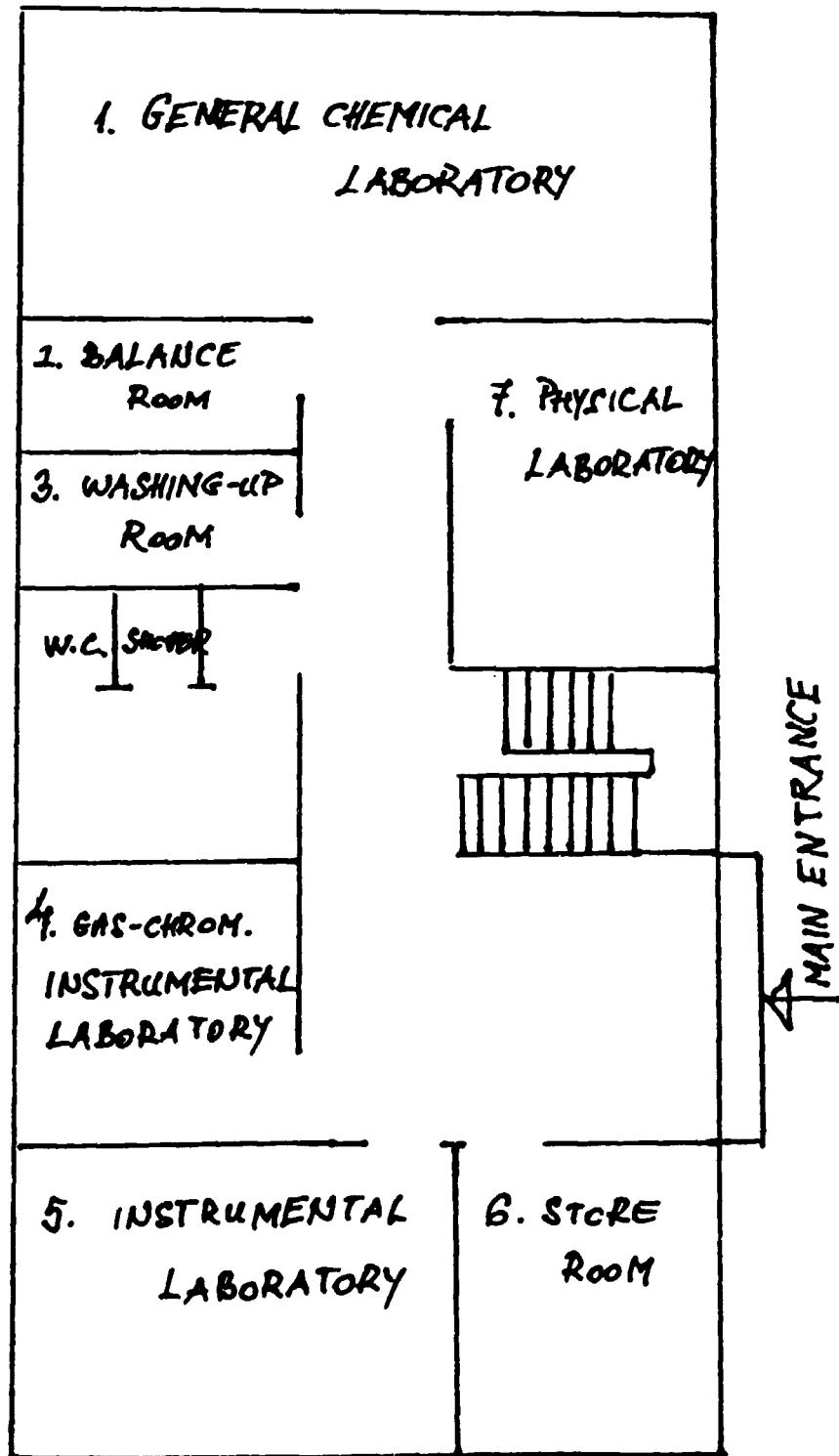
S-44401 Stenungsund, P.O.B. 851 Sweden

Tx : 20997

List of the instruments and equipments to be ordered

1. Nitrogen/air generator / essential /
Type: Nitrox, ANG 750/l
Capacity: 0.75 l/min nitrogen; 1.0 l/min air
Power: 150 W
Model style: A
Dimensions: 350 x 260 x 810 mm
Weight: 23 kg
Address of manufacturer:
Nitrox Ltd.
Cornwallis House
Basildon, Essex, SS 14 3BB
Great Britain
Telex: 995 092 CR SBC G
2. Thin layer chromatography kit / optional /
1 plate leveller
1 spreader
2 racks for plates of 200 x 200 mm
1 spotting template
2 developing tanks
1 spray, complete
60 glass plates 200 x 50 mm
30 glass plates 200 x 100 mm
40 glass plates 200 x 200 mm
1 microsyringe 10 ul
1 microsyringe 250 ul
1 UV lamp of short and long wavelength
3. Routine UV/VIS Spectrophotometer / optional /
Main description: wavelength 180 - 650 /800/ nm
Routine instrument, selection according to the financial possibilities.
4. Laboratory vacuum pump / optional /
E.g. Trivac B type of Leybold Vacuum Products, Inc.

Plan of the Laboratory



GROUND FLOOR

Regional Coordinator of RENPAP

The regional coordinator of the RENPAP Countries / Regional Network for Pesticide Production of Asia and Pacific/ work in India.

His name and address:

Dr. S. P. Dhuq,

Regional Coordinator

RENPAP and

Chairman and Managing Director,

Hindustan Insecticides Ltd.,

Hans Bhavan,

Bahadur Shah, Zafar Marg,

New Delhi,

INDIA

List of the tools required for laboratory maintenance

1. Multimeter for basic measurements
2. Magnifier lens, min. 10x
3. Stainless steel tweezers
4. Dental mirror, plain, with rotating head
5. Screwdriver kit, normal
6. Screwdriver kit, Philips heads
7. Screwdriver kit, hexagonal heads
8. Jeweller's screwdriver kit
9. Assembly plier, 140 mm long, snipe nose
10. Assembly plier, 140 mm long, round nose
11. Assembly plier, 140 mm long, flat nose
12. Drill, manually operated
13. Drill bits from 1.0 mm to 10 mm, increment 0.1 mm
14. Knife system /e.g. X-Acto knife/
15. Sandpaper /sets/
16. Wire bristle brush
17. Small-size end-cutter plier
18. Medium-size end-cutter plier
19. Soldering iron /e.g. Weller TCP-1/
20. Transformer for the abovementioned item
21. Stopwatch
22. Glass tubing cutter with spare cutting wheels
23. Tubing cutter with spare wheels /"Imp" type/
24. Teflon tape with tape dispenser