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ESTABLISHMENT OF A PILOT PLANT FOR PESTICIDE FORMULATION

DP/MYA/80/011

UNION OF MYANMAR

Technical report: Findings and recommendations\*

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

Based on the work of Roger Teuber-Weckersdorf,  
consultant in formulation technology

Backstopping officer: B. Sugavanam,  
Chemical Industries Branch

United Nations Industrial Development Organization  
Vienna

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\* This document has not been edited.

T A B L E O F C O N T E N T S

		<u>Pages</u>
1	Acknowledgements	3
2	Abbreviations and Acronymes used	4
3	Conclusion	5
4	Introduction	6
5	HWABWI Pilot Plant for Pesticide Formulations Findings and Recommendations	8
6	General Safety Requirements	14
7	Quality	15
8	Plant Managing Aspects	16
9	Commercial Aspects	16
10	Outlook on other Formulation Technologies	17
11	Waste Management	18
12	Additional Equipment applied by UNDP, EC Formulation	18
13	Additional Equipment applied by MPI, EC Formulation	19
14	Additional Equipment applied by MPI, Granules	19

ANNEXES:

	<u>Pages</u>
1. Supplier of Active Ingredients	20
2. Literature	23
3. Duties and Responsibilities of Safety Officer	24
4. Outlook on Future Formulation Technologies	25
5. Contacts	26
6. Letter to General Manager of MPI	27
7. Employees' Duty	28
8. UNIDO comments	29

1. ACKNOWLEDGEMENTS

I would like to express my thanks to all the people who helped me to do my job in these 3 weeks. At the very outset I wish to thank U. WIN KYI (Project Director) for his outstanding hospitality and U. MYIN SWE (General Manager) and to the teams of HWAWBI Plant Managers who supported me in a most helpful way.

Also I would like to thank U. BANYI (Planning Director) for his kind hospitality.

I am grateful for the help of U. MTIN AUNG (Programme officer) and all the people from UNDP who guaranteed an optimum work.

2. ABBREVIATIONS AND ACRONYMES USED

AI	Active Ingredients
EC	Emulsifying Concentrates
FAO	Food and Agriculture Organization of the United Nations
G	Granules
GIFAP	Groupement International des Associations Nationales de Fabricants de Produits Agrochimiques
GLC	Gas Liquid Chromatography
PC	Personal Computer
HPLC	High Performance Liquid Chromatography
MAS	Myanmar Agricultural Service
MPI	Myanmar Pharmaceutical Industries
HPPP	HMAWBI Plant Pesticide Production
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
UPS	Uninterrupted Power Supply

### 3. CONCLUSIONS

After spending nearly 3 weeks at the formulation site of HPPP under normal working conditions I can say that the plant is running in an optimum way. Very few additional remarks are mentioned in my report but they all give a more economic and safety way to run the plant.

The most important thing is to get foreign money to buy the necessary AI, Emulsifiers and Solvents to fulfill the demand on Pesticides for that country. All forces of people from MPI and of the plant management must go in that way. From the technical point of view there is nearly everything done which was necessary.

Beside these technical and commercial aspects of the plant there is the one and only big problem: The road to the plant. This could become a reason that one day the plant cannot run as the material cannot be transported on that road.

During my stay the road was cut off for 2 weeks and nobody knew how long this would last. Transport of dangerous goods on that road is impossible.

Another must is a telephone-connection due to an emergency case in the plant. I wrote a letter to the Managing Director of MPI (see Annex 10) regarding these 2 problems.

#### 4. INTRODUCTION

The project is part of the aims of the Government of Myanmar to increase the production of essential crops like cotton, rice, pulses, vegetables and lemons for home consumption and for exports.

The project is intended to supply the needs of the country for liquid insecticide formulations (EC) and to start to develop formulations based on locally available materials like solvents (kerosin) and to identify alternative, cheaper sources of technical active ingredients (AI), see Annex 1.

Another project is to develop the capability of the plant to formulate granules (G), see Chapter 10.

Main products (AI) used in paddy, total demand and actual production:

<u>AI</u>	<u>Total Demand</u>	<u>Actual produced</u>
Feritrotion	200.000 l	100.000 l
	200.000 l	100.000 l
Diazinon	50.000 l	50.000 l

FIGURE I

These quantities must be produced before July. Due to the gap of foreign money only 45 % of the demand could be produced although the formulation capacity is more than 1 million litre.

Main products (AI) in cotton, total demand and actual production:

<u>AI</u>	<u>Total Demand</u>	<u>Actual produced</u>
Endosulfan	200.000 l	100.000 l
Cypermethrin	200.000 l	100.000 l
Fenvalerate	100.000 l	-
Monocrotophos	50.000 l	-

Figure II

The gap between total demand and actual production is 36 %.

Due to the import of active ingredients, the solvent (Xylene) and the emulsifiers the total quantity of formulations at HPPP will be for the season 1991/92, that is from 1.4.1991 till 31.3.1992,

474.000 l

That means only 45 % of the capacity is used at the moment.

## 5. HWABWI Pilot Plant for Pesticide Formulations

### Findings and Recommendations:

#### 1. General Plant-Maintenance:

- a) Findings: The Plant is in a very proper maintenance, carefully gardened, the buildings are in a good condition and it seems that the people working there take care of their plant.
- b) Recommendation: To run such a modern plant it is impossible to have a road like the one at the moment. The consultant had to walk nearly for 2 miles because it was impassable for 2 weeks. There was no possibility to bring goods from or to the plant.

Another absolute necessary installation is a telephone or an Emergency-Call from the plant to an emergency installation. Using inflammable liquids and poisonous active ingredients an emergency case can happen and the only way to call for help is running to the next village!

#### 2. Laboratory:

- a) Findings: The laboratory is well designed and obtains all utilities for analytical checks of the formulated products and raw materials. The samples of batches and raw materials will be stored for 3 years.

Formulation development (EC and G) can be easily made by the well trained people.

b) Recommendations: I agree to the technical report of Mr. Crozi : on quality control and to the report of Mr. Srivastava on safety but I think that an exproof electrical system is not necessary. Due to the often happening breakdowns of current the laboratory which is working on GLC and HPLC must have an UPS for at least 10 minutes battery power till the generator can provide electricity again.

The same has to be said for the PC as a damage of the hard disc means a loss on information.

Safety Data Sheets for every formulated product must be provided by the laboratory, formula see Annex 2.

Fire-extinguishers see Annex 4

.3. Library:

a) Findings: The library of HPPP is very poor at the moment.

b) Recommendations: HPPP should be on the list of GIFAP Publications and some other literature, see Annex 3.

4. Maintenance Workshop:

a) Findings: A suitable room which is used as warehouse for diesel and other things at the moment and battery charging station is located here.

- b) Recommendations: For the future there should be an installation for shelves for spare parts and tools. The number of tools is poor at the moment and should be adequately supplied with.

Fire extinguishers must be located in every room next to the door, installed on the wall approx. 1 m from floor with an additionally sign = F (red) on white field with red surrounding located 2,5 or 3 m above the floor, see Annex 4.

#### 5. Warehouses: Empty Bottles and Xylene

- a) Findings: Both warehouses are properly maintained although the storage is not economically arranged.

- b) Recommendations: To handle the empty bottles and xylene drums in an economical way they should be stored on pallets which can be easily transported by trollies to the formulation and filling plant.

I suggest providing a local facility to produce pallets for above mentioned products. This can be done locally and should be provided by MPI.

Additional fire extinguishers have to be installed next to both doors, see Annex 4.

Due to the amount of nearly 200.000 l xylene, the plant management should look for delivery in tank containers than in drums (1000 drums!). Additional storage containers must be provided by MPI, capacity 200.000 l.

UNDP is providing HPPP a drum crusher to bring the crushed drums to a steel melter (see GIFAP Handbook of waste disposal).

6. Power Sub-station:

a) Findings: Proper room with good ventilation but slight disadvantage that the switch pannel for formulation and filling station is inside the Power-Sub-station.

b) Recommendation: Doors must always be closed. Sign of "No Entry" and "High Voltage" has to be placed on the front. Rubber mats and leather gloves must be inside.

A 50 kg powder fire extinguisher must be placed in the room, see Annex 4.

The entrance to the Power-Sub-station must be made as a permanent connection to the main way.

As the switch-pannel is inside the power sub-station a fence with door should be made dividing that room.

7. Generator-room:

- a) Recommendations: Due to frequent breakdowns of power automatic start of the generator is necessary. Only 10 minutes are needed between breakdown and big damage of analytical equipments and PC.

Fire extinguisher, see Annex 4, and maintenance-connections to street are to be made.

8. Formulation and Filling plant:

- a) Findings: This room is well planned with technical combination of formulating and filling. Very modern equipments easy to handle guarantee a sufficient work. The capacity can be increased easily.

The safety precautions are at international standard the exhaustion is working proper so there is only minimum odour in the room mainly due to the hot temperature.

- b) Recommendations: The cartridge filter between blender and storage tank should be two sizes bigger. The existing small one should be done into line Storage Tank - Filling station.

Due to the automatic filling line an additional carton-packing rap is necessary, see Annex 5.

Because of the sudden breakdowns of the filling line a second station, semi-automatic, should be installed, opposite to the now working one. This second filling station can be used additionally if a small quantity

of another product is requested, see Annex 6.  
This filling station should be given by UNDP.

The emergency shower combined with the eye-washer has to be placed immediately in the formulation and filling room. Nobody can survive burning running into the next room.

Additional fire-extinguishers see Annex 4.

9. Warehouse and AI storage room:

a) Findings: Both rooms are in proper condition. Due to the storage arrangement a pallet is easy to handle by trolley or forklift.

b) Recommendations: Due to two way entrance in the warehouse the driftways must be signed.

Additional fire-extinguishers, see Annex 4.

## 6. GENERAL SAFETY REQUIREMENTS

1. The most important requirement is an alarm in emergency case either by telephone or by others
2. A safety officer and his deputy were named during my stay and together with the plant management we worked out his duties. He is responsible for all the positions named in "Site Regulations", see Annex 7
3. "Site Regulations" have to be signed by every employee in 2 copies. One belongs to the employee, the other is added to the employees file at the central administration.
4. Once a year employees handling with pesticides should be instructed by the plant management about danger and precautions.
5. All fire extinguishers must be marked in the site plan and should be checked one a year.
6. Every year a fire drill exercise must be done by everybody
7. Due to the big amount of inflammable liquids a fire engine with a high pressure pump and a storage of at least 10 - 20 l cans of foam should be provided by PDI.

## 7. QUALITY

### 1. Formulated products:

The quality of the formulated products is in conformity with the international standards.

### 2. Labelling:

After a visit at MAS-Warehouse we were informed about an essential requirement on labels: Every product should have a separate colour.

We could have a look at the warehouse and in fact it is nearly impossible to distinguish between the 5 products. Mr. Win Kyi promised me to change that as soon as possible.

### 3. Bottles

Unfortunately the last bulk of bottles, supplied by Ceramic Ind. are of a very bad quality. They did not break at the transport but were leaking on the sides and so there were many complaints. Managing Director Win Kyi told me that the next batch of bottles will be produced with the new, mould, given by UNDP.

### 4. Capsules

Still a possibility for pillferproofing the caps should be checked.

### 5. Overpacking:

If there is an increase on broken bottles one should think of reducing the amount of bottles from 12 to 6 because of the heavy weight. As already mentioned in point 8 an automatic wrapping machine is useful.

6. Storage:

Good-storage on pallets but one should reduce the amount of bottles due to the weight.

8. PLANT MANAGING ASPECTS:

After 3 weeks working together with the management of the plant I can say that it is an optimum team doing their job. General Manager U. WIN KYI knows his work and he is qualified to guide the people. Mr. MYINT SWE is a very good deputy with experience in all fields. The production department in charge of Mr. SAW WIN and the quality control department in charge of Mr. Mooler have perfect training and because of their experiences learnt abroad they easily carry out their job.

The time I spent there nearly 50 persons were running the plant. This is a very economical run under these conditions.

To get the name as the first Myanmarian Formulation Plant I suggest to start a "Corporate Identity" and to try to find a suitable "Logo".

9. COMMERCIAL ASPECTS

Due to the big gap between demand and foreign exchange HPPP should try to find other dealers than the Ministry like private dealers who have foreign money. They could supply AI and Emulsifiers to HPPP and could distribute the formulated products. Within next months Managing Director and General Director will have meetings with private dealers. This is the result of a meeting with the management.

## 10. OUTLOOK TO OTHER FORMULATION TECHNOLOGIES

### 1. Wettable Powders:

The demand for the season 91/92 is about 100.000 kg. Because of the lack of foreign exchange there only will be 27.000 kg imported.

In my opinion there is no need for installing a wettable powder plant because the profitability of a local formulation is with an AI content of 70 % at the average very low due to the high costs of equipment.

### 2. Granules:

The demand for the season 91/92 is about 500.000 kg and about 95 % of that consists of diazinon 10 G. In my opinion this is the right way to continue, although money for only 40 tons diazinon 10 G is available for this season. Due to the local available carrier the demand on foreign exchange will be only needed for the AI.

The plant management and the laboratory are advised to develop a diazinon 10 % granule using local carriers like bentonite, etc. Because of their laboratory equipment and their knowledge they can develop the granules by themselves.

### 3. EC:

Beside the ECs produced at the moment they will go on in developing formulations of xylene and blending it with the local available kerosin. Together with MAS they worked out already a suitable formulation of cypermethrin 10 EC which is non-phytotoxic and shows good stability of AI and good suspension.

### 4. A worldwide general outlook on formulation-technologies is given in a report from Rhone-Poulenc, see Annex 8.

11. WASTE MANAGEMENT

The disposal of solid and liquid waste is nearly in all countries a problem.

Due to the EC-Formulation with only insecticides the liquid waste is minimized because of good management in reusing washing solvents.

Waste, mainly solid containing trenched sawdust and trenched cartons rises up to max. 10 kg a day.

This quantity is for incineration far too less.

In my opinion an oven, constructed locally with a chimney can be used for burning this material.

Liquids coming out of showers, etc. will make a daily quantity of about 50 - 100 l and can easily be handled by SENTINELL EQUIPMENT. Consultant of Sentinell arrives early November there.

12. ADDITIONAL EQUIPMENT APPLIED BY UNDP FOR EC FORMULATION

Drum Crusher	already advised
HPLC	" " + professional instructor
Wrapping Equipment	
Semi automatic filling line	
PC for laboratory	
UPS Battery for GLC and HPLC + PC used at a break-down of electricity	
Pillferproof -equipment	
Cartridge between formulation and storage tank	
3 mobile eyewashing-stations	

13. ADDITIONAL EQUIPMENT SUPPLIED BY MPI FOR EC FORMULATION

Fire engine

Oven for burning waste

Equipment for making pallets

1 truck for transport of AI and solvents from the port to the plant (Safety Reason)

Foam extinguisher

High pressure pump

Turning lathe

14. EQUIPMENT FOR GRANULE FORMULATION PLANT APPLIED BY MPI  
with assistance of UNDP

1 Ribbon blender: Capacity 1000 kg of formulated material

1 Spraying equipment for AI spraying into blender

1 Semi automatic filling line for 5 kg packages consisting of PE bag and carton, although a handfilling line for 200 x 5 kg bags per day is suitable too.

1 Exhaustion Unit

1 Scale (range 1-20 kg)

1 Scale (range till 1000 kg)

1 Trolly

ANNEX 1

SUPPLIER OF ACTIVE INGREDIENTS

=====

Active Ingredient	Supplier
Diazinon	All India Medical Corp. Corbelt Chemicals Co. Drexel Chemicals Co. Makhteshim-Agan PT Petroside Gresik
Fenitrothion	All India Medical Corp. Cheminova, Denmark Diachem, Italy Jin Hung Fine Chemicals Co Ltd Rallis India Ltd.
Endosulfan	Bharat Pulverising Mills Ltd Diachem Excel Industries Hindustan Insecticides Korea Explosives Co. Makhteshim-Agan
Cypermethrin	Yai Yeh Pesticide Plants Co. Taiwan Cequisa, Spain Gilmore Inc. ICI Agricultural Products ICI Agrochemicals Jewnin Joffe Industry Ltd. Krishi Rasayan Mitchell Cotts Chemical Ltd. Rallis India Ltd. Sanachem Shell International Chemical Co Ltd.

ANNEX 1

<u>Active Ingredient</u>	<u>Supplier</u>
Cypermethrin	United Phosphorus Ltd. Wellcome Foundation Ltd. All India Medical Corp. Atabay Agrochemicals & Veterinary Products Bharat Pulverising Mills Ltd. Diachem Gharda Chemicals Ltd.
Fenvalerate	All India Medical Corp. Bharat Pulverising Mills Ltd. Krishi Rasayan Rallis India Ltd. United Phosphorus Ltd. Yai Sen Pesticide Plants Co., Taiwan
Dimethoate	Cheminova, Denmark All India Medical Corp.
Monocrotophos	Bharat Pulverising Mills Ltd. Cia-Shen Co., Ltd. Ciba-Geigy Ltd. Comlets Chemical Industrial Col, Ltd. Crystal Chemical Inter-America Gilmore Inc. Hindustan Insecticides Ltd. Jin Hung Fine Chemical Co., Ltd. KenoGard AB Makhteshim Agan National Organic Chemical Industries Ltd.

ANNEX 1

<u>Active Ingredient</u>	<u>Supplier</u>
Monocrotophos	Pillar International Co Quimiea Estrella Shell International Chemical Co., Ltd. Shinung Corp. Sundat (S) Pte. Ltd. Taiwan Tainan Giant Industrial Co., Ltd.

## Literature

**AGRICULTURAL CHEMICAL BOOK SERIES** by *W.T. Thomson*

The four books in this series describe each major category of pesticide in detail. Trade names, chemical structure, chemical formula, toxicity, formulations available, usage, application directions, pests controlled, precautions and other relevant information are given for each chemical.

- Book I — Insecticides, acaricides & ovicides (1989 revision)
- Book II — Herbicides (1989-90 revision)
- Book III — Fumigants, Growth Regulators, Repellents, Rodenticides (1988 revision)
- Book IV — Fungicides (1988 revision)

**NEW**

**Recreation Resource Management**  
by *Dr E.O. Gangstad*

**The Safe and Effective Use of Pesticides**

**NEWLY REVISED**

**Tree, Turf and Ornamental Pesticide Guide**  
by *W.T. Thomson*

**The Pesticide Book, 3rd Edition**  
by *George W. Ware*

**The 1990 Newly Revised Insecticide, Herbicide, Fungicide Quick Guide**  
by *B.G. Page and W.T. Thomson*

**The 1990 Pesticide Directory: A Guide to Producers and Products, Regulators, Researchers and Associations in the United States**  
by *Lori Thomson Harvey and W.T. Thomson*

**Growers Weed Management Guide**  
by *Harold M. Kempen*

**OTHER BOOKS**

**Complete Guide to Pest Control — with and without chemicals**  
by *George W. Ware*

**Freshwater Vegetation Management**  
by *Edward O. Gangstad*

**Fundamentals of Pesticides — A Self Instruction Guide**  
by *George W. Ware*

**Lawns: Basic Factors, Construction and Maintenance of Fine Turf Areas**  
by *Dr Jonas Vengris and Dr William A. Torello*

**Health Hazards from Pigeons, Starlings and English Sparrows**  
by *Walter Weber*

**Fleas, Ticks and Cockroaches — Disease Transmitters**  
by *Walter Weber*

DUTIES AND RESPONSIBILITIES OF SAFETY OFFICERI. PLANT SAFETY

1. TO OBSERVE THE FIRE EXTINGUISHERS ARE PLACED AT THE DESIGNATED PLACES AND THEY ARE EASILY ACCESSABLE.
2. TO CHECK THE EXTINGUISHERS PERIODICALLY WHETHER THEY ARE WORKING WELL.
3. TO ORGANISE NECESSARY DEMONSTRATIONS IN COOPERATION WITH FIRE BRIGADE EVERY ONE OR TWO YEARS.
4. TO CONDUCT FIRE DRILLS PERIODICALLY.
5. TO CHECK THE EMERGENCY EXISTS AND WORKING AREAS ARE NOT BLOCKED.
6. TO CHECK THE ELECTRICAL CONTROL ROOM WHETHER
  - (1) THE MAIN DOOR BE KEPT CLOSED.
  - (2) NECESSARY PROTECTION EQUIPMENT, SUCH AS HIGH VOLTAGE GLOVE, MAT ARE IN PLACE.
  - (3) A DRY TYPE FIRE EXTINGUISHER IS IN PLACE.
7. TO CHECK THE FUME EXTRACTION SYSTEM DAILY ON WORKING DAYS.

II. PERSONEL SAFETY

1. TO CHECK THE WORKERS WEARING NECESSARY SAFETY WEARS.
  - (1) MIXING:- BOOTS, APRON, GLOVES, MASK, GOGGLES.
  - (2) FILLING:- BOOTS, APRON, GLOVES, GOGGLES.
  - (3) PACKAGING:- BOOTS, APRON, GLOVES.
  - (4) LABORATORY:- GOGGLES, GLOVES  
(ONLY WHEN HANDLING PESTICIDES AND XYLENE)
2. TO CHECK NECESSARY WASTE HANDLING MATERIALS (TOXIC WASTE BIN WITH LID, BROOM, SHOVEL, SAWDUST) ARE IN DESIGNATED PLACES.
3. WORKERS TO CHANGE INTO WORKING CLOTH AND BOOTS BEFORE ENTERING WORK PLACE.
4. LABORATORY CHEMISTS ARE TO PUT ON OVER COAT AND BOOT.
5. NO SMOKING, NO DRINKING, NO EATING IN RESTRICTED AREAS (PRODUCTION, WEAR HOUSES, LABORATORY)

**PESTICIDE FORMULATION TRENDS IN USA**

FORMULATION TYPE		% MARKET SHARE (DOLLARS)		SUITABILITY FOR 'WSP'
		1989	1995	
1.	Wettable Powders, Soluble Powders	40	< 35	High - 'WSP'
2.	Emulsifiable Concentrate, Organic Solutions, Solventless Emulsions, Micro-Emulsions Non-Aqueous Suspension Concentrate	> 25	20	Moderate - Gels in 'WSP'
3.	Aqueous Suspension Concentrates & Solutions	20	15	Need Technological Breakthrough
4.	Water Dispersible Granules and Dry Flowables	< 5	20	High - 'WSP'
5.	Granulars	10	10	Unsuitable (?)

'WSP' = Water Soluble Packaging

ANNEX 5

CONTACTS

=====

MYANMA PHARMACEUTICAL INDUSTRIES

U. SAW MYINT	Managing Director
U. BAN YI	Planning Director
U. THAN TIN	Deputy Planing Director

PESTICIDE FORMULATION PLANT

U. WIN KYI	Project Director, General Manager
U. MYINT SWE	Deputy Manager
U. SAW WIN	Production Dept. Manager
U. SAW MOOLER	Quality Control Dept. Manager
U. NYO LAY	Maintenance Engineer
U. MON TIN WIN	Quality Control Dept. Manager
U. AUNG MIN	Planning Department
U. WIN NAING	Administration Department

PLANT PROTECTION (MAS) - STORE

U. MYA THOUNG	Manager
U. THA NO	Assistant Manager
U. THAN TUN	Assistant Manager

PLANT PROTECTION (MAS) - Extension

U. MAUNG MAUNG TIN	Deputy General Manager
Mr. Dr. G. Pierrard	FAO

UNDP

Ms. MONINA S. MAGALLANES	Assistant Resident Representative/Debriefing
U. HTIN AUUG	Programme Officer/Briefing-Debriefing

Dated. 7 October 1991.

To the attention of U Saw Myint, Managing Director of Myanma Pharmaceutical Industries (MPI),

Dear Sir,

At the end of my staying in your beautiful country, I would like to express my thanks to you and your wonderful people, mainly Project Director Win Kyi and his staff who gave me a real home-atmosphere while staying with them at the site in Hmawbi.

I have to congratulate you and your people to the outstanding work done there. International quality with best GFP (Good Formulation Practice) give optimum products to help your farmers to increase their yields. Unfortunately there are two very severe points I want to point out:

The first point is the road from junction Tatkyigon to the site. This very important road must be made by asphalt. Since two weeks no cars or trucks can pass the road and block up everything. To reach the plant we had to use a cart, tractor or go by foot. The transport of dangerous goods is impossible.

The second point is the absolute necessity to have a telephone. For a plant with thousands of litres of inflammable and hazardous goods has to have the possibility to call for help in case of emergency. No where in the world you would find the situation like here.

I am sure you will try your best to overcome these two remaining matters so there will be no problem left to go into a prospering future for your plant and the staff.

With Best Regards,



(Roger Teuber-Weckersdorf)

UNIDO Consultant.

EMPLOYEES' DUTY

1. DON'T SMOKE, DRINK OR EAT IN RESTRICTED AREAS.
2. CHANGE YOUR CLOTHES BEFORE STARTING AND ENDING THE WORK.
3. WEAR SAFETY GOGGLES, APRONS, GLOVES, MASKS AND BOOTS  
WHERE REQUIRED.
4. KEEP YOUR WORKING PLACE CLEAN.
5. NEVER FORGET YOU ARE HANDLING HAZARDOUS GOODS.

PLANT MANAGEMENT.

-----  
SIGN.

**UNIDO'S SUBSTANTIVE COMMENTS ON THE REPORT OF****MR. ROGER TEUBER-WECKERSDORF****DP/MYA/80/011**

The report gives a detailed account of the operational aspects of the formulation plant. Being a return mission, the author was able to compare the present situation with the situation that existed during his previous mission. While the expert found the plant in good working order with the project counterparts taking good care of the operation of the plant, he also pointed out the problem of the road leading to the plant being in bad shape posing safety risk for transport of goods to and from the plant.

The expert's recommendation to purchase some books and additional minor equipment will be taken up by UNIDO. He has given in detail the duties of the safety officer and his responsibilities. We suggest appointing a principal safety officer for the plant with a safety committee looking into the regular and preventive maintenance of the plant.

The report also gives the basic requirements for granular formulation to be set up as a follow-up of the liquid formulation plant.