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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 Keith S. Johnson,
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Vienna

* This document has not been edited.

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Explanatory Notes on Abbreviations Used:-

UNDP	:	United Nations Development Programme.
UNIDO	:	United Nations Industrial Development Organisation.
MAS	:	Myanmar Agricultural Services Ltd.
MPI	:	Myanmar Pharmaceutical Industries Ltd.
GLC	:	Gas Liquid Chromatograph.
EC	:	Electron Capture Detector.
FID	:	Flame Ionization Detector.
HPLC	:	High Pressure Liquid Chromatography.
SHE	:	Safety, Health and Environment.

1. SUMMARY

There has been a very positive and pro-active response to the identified improvements for Environmental, Health and Safety controls arising from the last audit conducted in November 1991 (Ref. 1).

Of some 35 actions recommended, 29 of these (85%) have been actioned or are in the process of completion.

Essential items of capital equipment and plant have been provided by UNIDO and are either installed or in the process of installation.

The Management and Staff at the Hmawbi Pesticide Pilot Plant are also commended for their efforts and commitment to the implementation, so far as possible, of recommended actions and also seeking initiatives for further improvements.

Effluent treatment facilities are now installed and operating, producing high quality final effluents.

Analytical facilities and methodology now exist for regular quality control on all effluent discharges from site. The completion of a dedicated area to house both effluent treatment and waste disposal equipment (drum crusher) is awaited and should be progressed without delay.

Waste handling and disposal facilities on-site have been up-graded and include systems of waste collection, storage, labelling and recording.

The delivery and installation of a high temperature incinerator to the site in June 1993 will provide virtual self-sufficiency for the disposal of toxic and combustible waste types.

The continued need for point source minimisation of both effluent and solid waste arisings is strongly emphasised for reasons of reduced treatment and disposal costs and benefits of recovered materials for re-use.

Some progress in fire fighting resources has been achieved with the construction of a fire-water storage vessel. Items of additional safety measures including safety guard rails and lifebelts, along with the need to inhibit algae growth and associated problems of pipe and pump blockage, have been identified with recommendations for control.

Additional pumping equipment and possibly a fire tender to complete a site fire fighting facility are recommended with specific examples for urgent consideration.

The need for containment of contaminated run-off waters from fire-fighting activities to prevent contamination of local water courses is addressed with a recommendation for urgent implementation.

A site Environmental, Hygiene and Safety Officer has been appointed. The role has been delegated, on a part time basis, to the Assistant Laboratory Manager.

It is essential that this Officer receives specialist training in order to carry out the job. Training options are given with opportunities for outside assistance.

Little progress has been made in the area of Occupational Hygiene Monitoring, largely due to the absence of training staff and provision of specialist equipment including vapour monitoring instruments.

Progress on the implementation of on-site blood cholinesterase monitoring on a regular basis is slow and disappointing. Test methodology provided has not been adopted. The most recent proposal, to adopt the assay procedures used by the local Department of Health has merit in providing the availability locally of both training and guidance along with supplies of test reagents. This arrangement should be initiated without delay and a programme of regular on-site cholinesterase activity monitoring initiated as soon as possible.

A review of workplace operation activities confirmed that earlier problems of spillage and leakage in plant filling lines has been resolved with modification and servicing of equipment.

While the plant was not operational at the time of the visit, the full range of protective clothing provided to operators was displayed with the assurance that it was fully used, under the supervision of the Production Management.

Plant housekeeping was much improved with all unnecessary stocks, packages and equipment removed and stored outside of the workplace.

Extensive new developments are in progress with the construction of a new Xylene store, dining area and kitchen, ablutions block and changing rooms, and provisions for a new incinerator and waste store.

With due regard to the effects of on-site construction work, genuine attempts are being made to up-grade site appearance with landscaping and cutting-back of weed growth. Progress has been limited, affected largely by the hot season, but further progress will be made during the on-set of the monsoon rains.

Local Community Relations appear good with no further complaints relating to site activities having been received.

No further progress has occurred with local representations to the Government Authority to upgrade the public service road to the Hmawbi Site. Meanwhile, the potential risk of pesticide spillage and loss from vehicles, particularly during the wet season, remains a hazard to the environment external to the site.

Finally, short training courses were given to Site Management and Supervisors on effluent treatment, waste minimisation, handling and disposal, along with the interpretation and implementation of the UNIDO (Brussels) International Safety Guidelines. These will continue to be used as a basis of information and guidance for future environmental, health and safety improvements.

2. RECOMMENDATIONS AND ACTIONS (1993)

General Note

A Progress Against Actions Summary for the Recommendations Listed in the original visit Report DP/ID/SER.A/1554, 6 February 1992, is given in Appendix I.

A revised list of outstanding actions along with new recommendations are given below for consideration and implementation as appropriate by UNIDO and Myanmar Agricultural Services (MAS).

2.1 Effluent Treatment and Disposal

ACTIONS FOR UNIDO:-

2.1.1 Effluent Plant Operating Maintenance (4.9.1)

Spare parts and chemical supplies: - consider the purchase of package to cover a 3-year period of maintenance.

ACTIONS FOR MAS:-

2.1.2 Effluent Collection (4.2)

i. Construct an additional dividing wall within the existing 20 cubic metre collection vessel to provide a smaller (3 cubic metre) but deeper compartment for the pumped transfer of effluent to the treatment plant.

ii. Provide galvanised iron sheet covers over effluent collection vessel to keep out rainwater.

2.1.3 Effluent Treatment Plant (4.3)

i. Erect a roof cover over plant as a protection against extremes of wet weather and direct sunlight.

2.1.4 Effluent Minimisation (4.7)

i. Initiate point source studies to minimise the production of aqueous effluents.

ii. Ensure full advantage is taken of solar evaporation effects to reduce ultimate volumes of effluent for treatment.

2.1.5 Effluent Treatment Chemicals (4.8)

i. Investigate local sources of supply for ferrous sulphate and calcium hydroxide (hydrated lime). Check quality and suitability as substitute to proprietary flocculants supplied in unit packs.

2.1.6 Effluent Plant and Waste Treatment Compound (4.10)

i. Clear debris and rubbish from site area.

ii. Lay bunded hard-standing to accommodate drum crusher.

iii. Erect security fence and double gates.

iv. Provide access roadways.

2.2 Waste Disposal

ACTIONS FOR UNIDO:-

2.2.1 Specimen Toxic Waste Labels (5.2.2)

Provide examples ex UK agrochemical industry. K S Johnson via UNIDO Vienna.

ACTIONS FOR MAS:-

2.2.2 Drum Crusher (5.1.1)

i. Complete installation of drum crusher in new effluent/waste handling compound.

2.2.3 Incinerator and Waste Store (5.1.2 and 5.2.3)

i. Complete construction of incinerator site incorporating a new waste store.

2.2.4 Waste Collection Receptacles (5.2.1)

i. Change colour of non-toxic waste containers from pink to green.

2.2.5 Drum Disposal (5.2.6.1)

Comments concerning the disposal of non toxic drums for secondary outside use must be observed.

2.2.6 Waste Compost Trials (5.3)

Analytical data on pesticide residues when completed should be forwarded to UNIDO Vienna.

2.3 Industrial Hygiene and Safety

ACTIONS FOR UNIDO:-

2.3.1 Safety Supervisor Training Programme (6.2.2)

Liaise with MAS for possible assistance and support in providing specialist training.

2.3.2 Atmospheric Monitoring Vapour Detection (6.3.1)

Consider the acquisition of a vapour monitor to check

workplace and laboratory atmospheres (Ref. 4).

ACTIONS FOR MAS:-

2.3.3 Protective Clothing - Rubber Gloves (6.4.1)

Consider, in cases of regular container handling, the use of:-

i. Heavy duty neo-prene gloves.

ii. The use of a protective leather glove worn over a rubber glove.

2.3.4 Blood Cholinesterase Activity Monitoring (6.6)

i. The Nachmansohn and Wilson method for cholinesterase activity should be adopted.

ii. The Environmental Safety Officer should liaise with the local Department of Health for assistance in method use, acquisition of necessary equipment and laboratory reagents.

iii. Blood cholinesterase monitoring should be introduced on a regular (weekly) basis for all plant operators likely to be working with OP Compounds and others exhibiting cholinesterase inhibiting properties.

iv. Full baseline and test data for blood cholinesterase activity should be recorded and retained with each operator's medical records. These should be periodically reviewed by a qualified physician.

2.3.5 Xylene - Palletted Drum Storage (6.7)

The use of wooden pallets for stacking and storage of drums of xylene should replace, as soon as possible, the current unsafe system of pyramid stacking and manhandling of drums onto forklifts.

2.3.6 Drum Handling Equipment - Forklift Drum Clamp Equipment (6.7.1)

Liaise with UNIDO on the possible acquisition of a clamp for safe handling of 200 litre drums of xylene and other products (Ref. 5).

2.4 Fire-Fighting Prevention and Control

ACTIONS FOR UNIDO:-

2.4.1 Site Fire Tender (7.2.2)

Consider the purchase of a site fire tender to respond to emergency fire incidents on site (Ref. 6).

ACTIONS FOR MAS:-

2.4.2 Fire Water Storage Reservoir (7.1.2 and 7.1.3)

i. Erect safety guardrails around storage tanks.

ii. Provide emergency lifebelts (rings) to be placed on guardrails.

iii. Algae growth inhibition:- provide tanks with covers to restrict sunlight or consider the use of algicides.

2.4.3 Fire Fighting Appliances - High Pressure Auxiliary Pump (7.2.1)

i. As a matter of urgency, a high pressure water pump should be acquired to provide the site with a basic fire-fighting facility.

2.4.4 Contaminated Fire Water Storage (7.3)

i. Provide and fit a lock-off valve into the main surface-water drain outfall pipe to contain fire run-off water.

ii. Erect a dry-bunded lagoon area in the south west corner of the site to store contaminated fire water.

2.4.5 Grass and Weed Growth Control (7.4)

i. Continue routine cutting and removal of grass and weed growth both within and around the perimeter of the site to prevent fire risk.

2.5 Site Appearance (9.1)

i. Continue programme of site landscaping, grass and tree planting to coincide with the on-set of the monsoon season.

ii. Consider the acquisition of a mechanical grass cutter for use with site landscaping programme.

2.6 Road Access (9.3)

Maintain pressure on Government Authorities to improve the surface of the public access road to the site.

3. INTRODUCTION

3.1 Visit Objectives

The Consultant, in collaboration with the project counterparts (Myanmar Agricultural Services) will assist in the proper management of the Pesticide Formulation Plant, assess the extent of the progress against actions taken, based on his previous report (Ref 1) and also assist in the implementation of the Brussels Guidelines on Safety in Pesticide Formulation Plants developed by UNIDO.

Specialised assistance will be given in the commissioning and start-up of the newly installed site effluent treatment plant.

3.2 Background

The initial visit by the Consultant to the Hmawbi Pesticide Formulation Plant was made 14 - 27 November 1991 (Ref. 1).

Some 35 recommendations were identified to implement and upgrade safety, health and environmental standards at the site.

3.2.1 Since the visit in 1991, the overall management and control of the Hmawbi Plant has been transferred from the Myanmar Pharmaceuticals Industry (MPI) to the Myanmar Agricultural Services (MAS) Department of the Local Government.

3.3 Current Position at Hmawbi (April 1993)

The Project Director, U Win Kyi, retired during April 1993 and has been succeeded by U Myint Swe the former Project Manager.

The manufacturing programme continues on the basis of single product-type emulsion concentrate (EC) production.

Ongoing expansion and improvements to the site continue with the notable inclusion of:-

i. New Xylene store.

ii. New High Temperature Incinerator and Waste Store (June 1993).

iii. New Effluent Treatment Plant and Storage Vessels.

iv. Fire-water Storage Vessels.

v. New Kitchen and Dining Area.

vi. New Ablutions Block and Changing Rooms.

Site staff manning levels - management, operational and casual workers remain virtually unchanged amounting to some 50 people working on a single day-shift basis.

3.4 Scope of the Report

This Report reviews progress against actions identified during the previous visit (Ref. 1). These are fully summarised in Appendix I.

Other areas specifically covered include:-

i. Effluent Treatment and Disposal.

ii. Waste Management and Disposal.

iii. Industrial Hygiene and Safety.

iv. Fire-Fighting Measures and Controls.

Other site-related technical issues, where appropriate, are noted with comments and recommendations.

A separate summary of outstanding actions and recommendations is also presented to assist with the progression and implementations of specific items identified.

4. EFFLUENT TREATMENT

4.1 Provisions for the collection, treatment and disposal of detoxified final effluent are virtually complete and operational.

4.2 Effluent Collection

Modifications to the existing collection system have, for the most part, been actioned with some items awaiting completion.

4.2.1 The main effluent collection vessel for the reception of mixed untreated effluents has been re-piped.

This vessel, of some 20 cubic metres capacity, requires a further dividing wall to contain incoming effluents in a smaller but relatively deep compartment to hold sufficient effluent for pumped transfer to the effluent treatment unit. The volume of this compartment should be approximately 3 cubic metres capacity with an overflow weir into the larger area of the reception vessel. The larger surface area in this compartment will allow more efficient solar evaporation and minimise the overall volume of effluent requiring treatment.

The provision of sliding covers to keep out rain water is still awaited. It is proposed to construct these from corrugated galvanised steel sheets.

4.2.2 An additional concrete vessel, capacity 5 cubic metres, has been constructed for the storage of final treated effluents to await analysis and final disposal approval.

4.2.3 Laboratory effluents are collected separately in the existing vessel adjacent to the building.

Losses in volume due to evaporation minimise the need for regular treatment. When necessary, excess effluent is drummed-off and transferred to the main treatment plant collection vessel for subsequent treatment.

4.3 Effluent Treatment Plant

Delivery has been taken of an Allman/Sentinel Package Effluent Treatment Plant. This is s batch treatment process with one cubic metre of effluent treatment capacity.

The plant has been erected on bunded hard-standing adjacent to the effluent reception vessels situated in the south west corner of the site (see Appendix II).

Full mains electrical power is connected. Mains water supply awaits the extension of a pipe to the plant area.

A roofed area to offer protection against extremes of wet weather and prolonged exposure to direct sunlight is recommended.

The provision of a permanent roadway and fencing to form a security compound around the treatment plant area still awaits completion (see also section 4.10, Effluent and Waste Treatment Area).

4.3.1 Treatment Plant Commissioning

The treatment plant was fully assembled and hydraulically tested with mains water.

The unit has suffered slight damage in transit resulting in a plastic elbow-connector to the carbon column being broken off. Also it was reported that the operating instructions were not supplied.

In response to a fax message to Allmans Ltd, UK, - both of these replacement items were dispatched airmail and received just prior to the departure of the author (see also Section 4.9, Spare Parts - Future Supplies).

As an interim measure operating instructions were written to enable treatment instruction and trials to continue without delay.

Two batches of effluent taken from the more concentrated liquors in the laboratory collection tank were treated.

Good flocculation and settlement of sludge was achieved using the standard chemical treatment packs supplied. High quality colourless effluents were produced following second-stage activated carbon adsorption.

The chemical analysis of the first batch of effluent treated is given in Table 1.

TABLE 1

Effluent Treatment - Removal of Pesticide Residues

COMPOUND	PESTICIDE CONCENTRATION	
	BEFORE TREATMENT PARTS PER BILLION	AFTER TREATMENT PARTS PER BILLION
Endosulfan	3100	ND
Fenitrothion	Absent	Absent
Phenthoate	200	ND
Cypermethrin	600	ND
Diazinon	2800	ND
		ND = none detected

(See also Section 4.5 Chemical Analysis)

The remaining test parameters including chemical oxygen demand still await completion, but from the appearance and

partial analysis of the initial treated sample, it is likely that final effluents will have little difficulty in compliance with the provisional effluent standard established during the last site visit and reproduced in Table 2.

TABLE 2

TEST PARAMETER	TENTATIVE LIMITS - MAXIMUM ALLOWABLE CONCENTRATION mg/L (Note II)
Appearance	Colourless - odourless
pH	6 to 9
Chemical Oxygen Demand (COD)	< 50
Individual Pesticides	< 0.1
Total Pesticides	< 0.5
BOD	see Note I
Note I Biological Oxygen Demand (BOD) is sometimes stipulated by controlling authorities as a mandatory requirement for treated effluent and must, in such instances, be included in the test schedule. It should be noted, however, that BOD is not a reliable quality parameter for pesticide effluents, as some of the components are not readily biodegradable.	
Note II In the event of legal standards for effluent discharge quality being imposed by a controlling authority, the most stringent standard shall apply.	

4.4 Sludge Treatment

Sludges produced by the 'Sentinel' process consist essentially of slurries of ferric hydroxide plus entrained pesticide residues.

The sludges produced during commissioning trials were de-watered via the in-line basket filter and subsequently air dried on a sand drying bed.

Dried sludges were weighed and equated to approximately 3 kg of dried solids per cubic metre of effluent treated.

The sludges were overpacked in a polythene bag and stored in a sealed open-topped clamp-lid steel drum, appropriately labelled and stored to await disposal in the new site incinerator (June 1993).

4.5 Effluent Analysis and Quality Control

Analytical equipment at the site has been upgraded by UNIDO with the acquisition of :-

1. High Pressure Liquid Chromatograph - Shimadzu CR4 AX Chromatopack.

2. UV/Visible Spectrophotometer - Shimadzu 160A.

These newly-acquired instruments complement the existing analytical equipment - Gas Liquid Chromatograph Perkin Elmer 500 fitted with ECD, FID and NPD detectors.

This total range of equipment is now adequate for the general run of environmental and occupational hygiene monitoring and control analysis.

4.6 Effluent Disposal

Final treated effluents, subject to quality checks and compliance with provisional effluent control standard (Table 2) will be irrigated onto waste land on-site. A small irrigation sprinkler has been acquired for this purpose.

4.7 Effluent Minimisation

Effluent treatment is expensive and currently fully dependent on the use of imported treatment chemicals.

Advantage should be taken wherever possible of solar evaporation to reduce the volume and corresponding frequency of effluent treatment. Organic components and suspended solids concentrated in effluents by solar effects will respond equally well to chemical flocculation and subsequent activated carbon adsorption.

4.8 Effluent Treatment Chemicals - Alternative Local Supplies

The prescribed effluent treatment process, for the most part, uses a mixture of inorganic flocculants such as iron sulphate and hydrated lime (calcium hydroxide) plus a clay adsorbent containing a marker dye, along with a long chain polyacrylamide anionic polyelectrolyte coagulant.

Both iron salts and lime are available locally in Myanmar and subject to treatment tests could be substituted into the treatment process.

Polyelectrolytes and adsorbent clay with incorporated marker dye are not available, but could be imported by special arrangement in bulk at much reduced cost.

A summary of the effluent treatment process giving guideline treatment dosage rates is listed in Appendix III.

A small quantity of solid polyelectrolyte sufficient in aqueous dilution to treat some 50 batches of agrochemical effluent has been sent by the author to the Hmawbi Formulation Plant as an interim measure.

4.9 Effluent Plant Operating Maintenance

4.9.1 Attempts to repair minor damage, inflicted during transit, to the Sentinel treatment plant highlighted the extreme difficulty in Myanmar in obtaining locally even the most simple components such as plastic elbows, connectors, correct size polythene tubing, and replacement items to pumps and switch gear.

4.9.2 Subsequent discussions with the Sentinel plant manufacturers, Allman Ltd, UK, has confirmed their willingness to assemble a comprehensive spare parts package including essential treatment chemicals (adsorbent clay and dye and polyelectrolyte) suitable to sustain a maintenance period of 3 years at an inclusive price of US $ 3,500 (Ref. 2).

With due regard to the importance of this effluent treatment plant to future site operations and necessary compliance with environmental standards, it is recommended that consideration be given to the acquisition of the effluent plant spare parts and chemicals package described.

4.10 Effluent Plant and Waste Treatment Security Compound

Earlier recommendations (Ref. 1) to enclose the effluent plant and waste treatment equipment, ie drum crusher in a secure fenced area, still await completion.

The designated area in the vicinity of the new effluent plant is till overgrown and littered with debris. This should be cleared without delay, and ground areas concreted and paved to accommodate the drum crusher, provide bunded storage and paved access, all enclosed within a chain-link security fence with double width access gates.

5. WASTE DISPOSAL

Good progress has been made overall to upgrade waste handling procedures and disposal facilities on-site.

5.1 Proprietary Equipment

5.1.1 Drum Crusher

A drum crusher has been purchased and delivered to the site.

The unit awaits installation and will be located in the effluent plant waste handling compound (see 4.10).

5.1.2 High Temperature Incinerator

A package incineration plant has been ordered from SIC-Plant Italy. The unit is currently in transit to Myanmar and delivery is expected during June/July 1993.

Preparations have commenced to locate the incinerator in the north west corner of the site, well away from solvent storage areas and manufacturing plant.

It has been decided to locate the site waste store in close proximity to the incineration unit for ease of operation when carrying out incineration operations on-site (see Appendix II).

5.2 Site Waste Management - Handling and Disposal

5.2.1 Waste Collection - Manufacturing Areas

Colour-coded steel drums - red for toxic waste and pink for non-toxic waste - are now provided in the workplace and laboratory. These are routinely cleared on a daily basis.

It is recommended that a more contrasting colour, for example green, is used to identify the non-toxic waste receptacles.

5.2.2 Segregation of Wastes, Labelling - Hazard Markings

All waste handling operations are now conducted under the direct supervision of the Production Manager.

Supplies of waste and product labels plus a Waste Record Logbook are retained in the office of the Production Manager.

Examples of standard toxic labels used for waste containers elsewhere in the agrochemical industry (UK) will be provided.

5.2.3 Dedicated Waste Storage Area

The completion of the store is still awaited. This will be sited within the secure compound serving also the site incinerator.

5.2.4 Security Fencing

Security fencing is still required to enclose both the effluent plant/waste handling area and the proposed incinerator/waste storage area. The completion of these areas are vital to the site waste management safety and security and must not be delayed further.

5.2.5 Bunded Areas and Roadways - Containment of Spillage

These are due for inclusion in the forthcoming waste storage area construction programme.

Again these important areas of secure containment must be implemented without delay to minimise risk of pollutant run-off into monsoon drains and local external water courses.

5.2.6 Toxic Drum Disposal

All emptied Active Ingredient drums are triple-rinsed with solvent which is recycled into the manufacturing process.

Rinsed drums are currently stored on-site to await the installation of the drum crusher. An accumulation of several hundred 200 litre drums currently await disposal.

The drum disposal process, when operational, will comprise:-

1. Crushing and compaction.

2. Incineration to remove toxic residues.

3. Detoxified metal scrap sent to the local steel smelter.

5.2.6.1 Drums used for non-toxic solvent and surfactant storage are suitable for disposal for secondary industrial use if suitable outlets can be found.

On no account should any drums arising from pesticide formulation activities be used in any activity associated with the food or animal feedstuffs industry.

5.3 Experimental On-site Waste Composting

A trial 'compost' bed comprising soil, organic matter and lightly contaminated pesticide waste residues, ie contaminated sawdust

and adsorbents, has been ongoing for one year.

Core samples will be taken from the bed and analysed for residual pesticides.

Composting and degradation of pesticide waste is of considerable interest to the pesticide industry as a possible additional disposal resource. The MPI analytical data will be of considerable academic interest, although the installation of a high temperature incinerator on-site will at this stage preclude the use of composting for local waste disposal requirements.

6. INDUSTRIAL HYGIENE AND SAFETY

6.1 General Note

During the period of the visit to the pesticide formulation plant 19 - 30 April, production had been suspended awaiting delivery of supplies of raw materials.

It was not possible, therefore, to monitor workplace practices from the aspect of hygiene and safety measures currently implemented. However, considerable time was spent with the Site Management on the review of procedures now in force and the systems and practices introduced since the last hygiene/safety assessment (Ref. 1).

6.2 Safety Supervisor - Training Programme

6.2.1 Safety Supervisor

A part-time Safety/Environmental Supervisor has been appointed. This role has been delegated on a part-time basis to the Deputy Laboratory Manager who is technically qualified and has long working experience in both industry and the medical sector.

6.2.2 Training

To be fully effective in the job it is important that the Safety/Environmental Supervisor receives the training necessary to fulfil the requirements of the job. It was reported at the time that no provisions for training had been made. This position must be resolved as soon as possible and could, in part, be initiated by a visit to a well established pesticide factory (eg ICI Pesticida Indonesia) where high standards of safety, health and environmental (SHE) controls are in place and fully implemented.

It was confirmed during the visit that the management of ICI Pesticida would be pleased to assist with a short SHE training programme extending over 1 - 2 weeks (Ref. 3).

6.3 Industrial Hygiene

6.3.1 Atmospheric Monitoring - Vapour Detection

No further progress has taken place and the provision of atmospheric vapour detection equipment is still awaited (Ref. 4). The importance of having a resource to monitor vapour concentration in the workplace, solvent stores and laboratory, cannot in the interests of health and safety of operators, be over-emphasised.

6.4 Automated Filling Line - Spillage Avoidance

The plant was not operational during the visit of the consultant.

It was confirmed that the automated filling equipment had received a full overhaul with complete replacement of delivery control valves which had virtually eliminated problems of product loss and spillage witnessed during the previous visit (Ref. 1).

6.5 Protective Clothing

It was reported that all operators involved in process manufacturing operations and product filling duties were equipped with and were required to wear full protective clothing and eye protection.

Examples of the protective safety clothing provided were displayed and included overalls, boots, eye shields, rubber gloves and hard helmets.

6.5.1 Quality of Rubber Gloves

It was reported that rubber gloves worn by operators with responsibilities for checking and tightening plastic caps on filled containers, quickly became worn and developed leaks.

Two solutions were offered to resolve this problem.

i. Use a heavy-duty neo-prene glove more suitable to the task.

ii. Wear a leather glove over the top of the rubber glove, which in an undamaged state, would offer full protection to the operator from contact exposure risk.

6.6 Plant Housekeeping

Acknowledging that the production unit was not operational at the time of the visit, a full inspection of the workplace and storage areas showed them to be clean and tidy. There was no evidence of accumulated packages, drums and waste materials observed during the previous visit and the obvious improvements must be commended.

6.7 Blood Cholinesterase Activity Tests

6.7.1 Progress on this matter is slow and disappointing.

Full details of the Michelle Method for blood cholinesterase activity assay were provided during February 1992. Baseline test data on new operators has still to be adopted. Meanwhile, operators working in contact with organo-phosphates and other cholinesterase inhibitors remain at risk from exposure to these compounds, the effects of which need to be monitored at an early stage.

It is emphasised that six-monthly blood cholinesterase activity tests on specific operators is of questionable

benefit.

Activity levels of both plasma and erythrocytes can depress and restore within short periods of hours or days. There is a risk therefore of OP contact exposure occurring undetected under the present six-monthly test regime conducted by the local health authority laboratory.

6.7.2 Alternative Methods for Blood Cholinesterase Activity

An alternative method by Nachmansohn and Wilson, currently used by the Local Government Health Laboratory, Yangon, has been identified as a preferred method.

The method is similar to the Michelle Test in approach but has the advantages of:-

i. Being fully established and available for the purposes of training and assistance to the staff of MAS Hmawbi Site.

ii. Equipment and essential reagents are readily available.

iii. Blood cholinesterase data obtained to date on MAS personnel will remain valid for purposes of baseline reference on all future blood samples tested.

With this alternative analytical procedure identified and the availability of training assistance from the local Health Department, full blood cholinesterase activity tests on a weekly basis as recommended following the earlier site visit (Ref. 1) should be implemented without further delay.

6.8 Warehouse - Xylene Storage

A new warehouse is in the process of construction to store all future stocks of Xylene packed in 200 litre drums. The store is designed with much improved open-side ventilation and will be far more suitable for the safe storage of solvents of this type. The existing store currently used for Xylene will be made over for the storage of empty packages.

6.8.1 Palletted Drum Storage

In the interests of safety and more efficient methods of drum handling the current method of pyramid stacking of drummed Xylene and manual removal of these onto forklifts should be abandoned in favour of palletised drum storage as soon as possible.

6.8.2 Drum Handling Equipment - Forklift

Details of forklift drum clamp equipment for the safer movement of filled drums of Xylene have been provided (Ref. 5).

7. FIRE PREVENTION AND CONTROL

7.1 Fire Water Storage Reservoir

7.1.1 A water storage vessel equivalent to some 150 cubic metres capacity has been constructed on the western boundary of the site in close proximity to the tube-well pump house.

The vessel, constructed below ground level in reinforced concrete, consists of 2 x 50 m^3 tanks and 2 x 25 m^3 tanks all interlinked by connecting pipework.

7.1.2 Each tank is fitted with safety rungs for emergency escape or rescue in the event of someone falling into a vessel. Further safety actions are immediately necessary:-

i. A safety rail 1.5 metres high should be erected around the combined storage tank area.

ii. Lifebelts (rings) should also be placed on the rails for use during emergency.

7.1.3 Stored Water Quality

The storage tanks are currently only partly-filled with water. The large surface area of water will encourage algae growth with the attendant problems of potential blockage to pumping equipment and filters arising during an emergency.

Measures must be taken to minimise algae growth by:-

i. Placing covers over the tanks to restrict exposure to sunlight.

ii. Use of algicides to inhibit growth.

NB Copper sulphate (5 ppm cu equivalent) or sodium hypochlorite are both effective inhibitors of algae growth in static water tanks.

7.2 Fire Fighting Appliances

7.2.1 Auxiliary Water Pump

There is an urgent need to obtain a high pressure auxiliary water pump to transfer water from the reservoir to the site of a fire outbreak.

As a guide, the pump should be rated at least 300 gallons per minute (1364 litres) operating against a head of 15 metres.

Sufficient fire hosepipe must be available to convey the water via the pump to the site of the fire.

7.2.1.1 A future objective in the short to medium term should be to construct a water supply pipeline network around the site with strategically placed hydrants and hosepipes.

7.2.2 Site Fire Tender

A site fire tender fully equipped with water pump and foam generator would greatly enhance the site fire fighting capability and in particular the ability to respond and deal quickly with localised outbreaks of fire.

Custom-designed tenders are available and are usually built traditionally on a Landrover vehicle chassis. This offers an effective on/off road capability to permit coverage of a wide range of incidents.

A broad based cost indication for this type of tender vehicle would be of the order of US $ 50,000.

Alternatively, a lower cost option would be to construct a fire tender locally using a vehicle chassis from the local motor industry (ie Japan).

Full details of a range of fire water tenders (UK origin) were provided to both MAS Hmawbi and UNIDO Vienna (Ref. 6).

7.3 Containment and Storage of Contaminated Fire Run-Off Water

7.3.1 The need for the collection and containment of contaminated water in the event of an outbreak of fire must be addressed as a matter of urgency.

Two options recommended during the last visit await action:-

i. Lock-off gate valve into the main surface water outfall pipe is needed to prevent escape into local water courses.

ii. The provision of a dry lagoon area into which contaminated fire water can be pumped and stored to await a disposal solution.

These options were again discussed with Local Management and agreed in principle. It was agreed that the dry lagoon should best be located in the south west corner of the site well away from the location of the tube well but within close proximity to the effluent treatment facility (see Appendix II).

7.4 Grass and Weed Growth Fire Risk

Attempts have been made to keep this potential fire risk under control. Weed growth around the perimeter fence is regularly cut and cleared to prevent spread of fire from an outside source into

the site.

Some weed growth inside of the site in un-used areas requires cutting and removal (see also Section 9.1 Landscaping).

8. SITE AMENITY SERVICES

Two new site amenity improvements are well advanced and are nearing completion.

8.1 New Dining Area and Kitchen

This building is in a well-advanced state of construction. Essentially an open-side building with two levels of pitched roof, it will provide an attractive and much-needed facility to the site.

8.2 Ablutions Block and Changing Rooms

The construction of this building has commenced and will initially serve the workforce employed in close proximity within the EC plant, warehouse and stores.

Besides adequate washing, shower and toilet facilities, provision is also made for clean and contaminated clothes changing areas ensuring that all personnel can wash and change into their own clothes at the end of each shift and prior to departure from the site.

9. SITE APPEARANCE AND PUBLIC RELATIONS

9.1 Site Appearance - Landscaping

The overall appearance of the site is dominated by major construction work and building projects including the Xylene store, dining room and ablutions block.

These activities, along with ground areas utilised for the storage of building materials, has to some extent hampered attempts to extensively landscape large areas of un-used land within the site.

Attempts have been made to develop crab-grass cultivated areas along roadways adjacent to the laboratory, stores and EC plant along with planting of flowers and shrubs.

Considerable time and effort has been given to the landscaping in and around the entrance of the site. A gardener has been employed to cut grass and maintain ornamental beds. The acquisition of a lawnmower has been proposed.

At the time of the visit at the peak of the dry season, all vegetation was showing signs of dehydration.

Further landscaping is proposed following the on-set of the wet season.

9.2 Public Relations - Impact of Site Activities on Local External Environment

Local relationships with the surrounding community remain good.

Communications are maintained via a local liaison committee and site representatives. It was reported that no complaints concerning site activities had been received.

9.3 Road Access

The state of the (public) earth road between Tatkyigon and the factory site remains unchanged and during the wet season is at times impassable.

Token attempts to replace subsidence and damage caused during the wet season with latherite are expedient but of little effect as a more permanent solution to the problem.

The risk of vehicles shedding a load of chemicals en route to or from the factory poses one of the real hazards to the local environment.

Acknowledging the potential size of a project to upgrade the entire road with a permanent hard surface, it would seem unlikely that a satisfactory solution to the problem will be reached in the short term. Pressures on the Government Authorities to carry out improvements should nevertheless continue.

10. TRAINING - ENVIRONMENTAL CONTROLS

Two separate training sessions were given to Site Management and Supervisors covering the following topics:-

10.1 Effluent Treatment

- Minimisation.
- Collection and Storage.
- Chemical Treatment.
- Carbon Adsorption.
- Quality of Final Effluent.
- Disposal Options.

This area of training was particularly important and relevant to the satisfactory maintenance and future operation of the newly-installed effluent collection system and treatment plant.

10.2 Waste Disposal

- Minimisation, Recycling and Re-use.
- Handling and Storage.
- Labelling and Records.
- Review of Overall Disposal Options.

The potential benefits of high temperature incineration and in particular the forthcoming installation of a high temperature incinerator on-site were covered in considerable detail.

10.3 Interpretation of Implementation of the UNIDO (BRUSSELS) Integrated International Safety Guidelines For Pesticide Formulation Plants in Developing Countries

These were reviewed and discussed at some length with the Site Management.

It was agreed that much of the comprehensive programme for safety, health and environmental improvements currently in progress was based upon or within the intended philosophy of the guidelines (Ref. 7).

These would continue to be used as the basis of information and guidance for ongoing and future SHE improvements on-site.

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U Aung Min, Project Manager.
U Saw Win, Production Manager.
U Saw Mooler, Laboratory Manager.
U Nyo Lay, Maintenance Engineer.
Y Mon Tin Win, Deputy Laboratory Manager/ Site Environmental/Safety Officer.

A special note and thanks are extended to Y Wyn Kyi, former Project Director for his support, cooperation and hospitality along with best wishes for a long, active and happy retirement.

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4. Neotronics Ltd (Atmospheric Monitoring Equipment), Parsonage Road, Takeley, Bishop's Stortford, Herts, CM22 6PU, United Kingdom.

5. Powell and Company Ltd, Materials Handling Manufacturers, Bury Port, Dyfed, SA16 0LS, Wales, United Kingdom.

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APPENDIX I

Summary - Progress Against Actions/Recommendations Listed in the Original Visit Report DP/ID/SER.A/1554, February 1992

NB. Actions specified as incomplete or not-actioned have been included in the new list of recommendations listed under Section 2 of this Report (1993).

Current status, April 1993

ACTION NUMBER	TOPIC	ACTION STATUS/ BY WHOM?
2.1	Effluent Treatment and Disposal.	
2.1.1	Provision of Effluent Treatment Plant.	Yes/ UNIDO (Complete)
2.1.2	Advice and Assistance with Analytical Equipment and Methodology.	Yes/ UNIDO (Complete)
2.1.3	Effluent Collection System.	Yes/ MAS (In part only)
2.1.4	Modification of Existing Collection Vessels.	Yes/ MAS (In part only)
2.1.5	Modify Laboratory Collection System.	Yes/ MAS (Complete)
2.1.6	Obtain Sprinkler-Irrigation Equipment.	Yes/ MAS (Complete)
2.1.7	Sludge Disposal.	Yes/ MAS (In part only)
2.2	Waste Disposal	
2.2.1	Drum Crusher.	Yes/ UNIDO (Complete)
2.2.2	High Temperature Incinerator.	Yes/ UNIDO (Complete)
2.2.3	Waste Management Handling and Disposal.	
2.2.3.1	Collection.	Yes/ MAS
2.2.3.2	Segregation of Wastes/ Labelling Hazard Labels.	Yes/ MAS

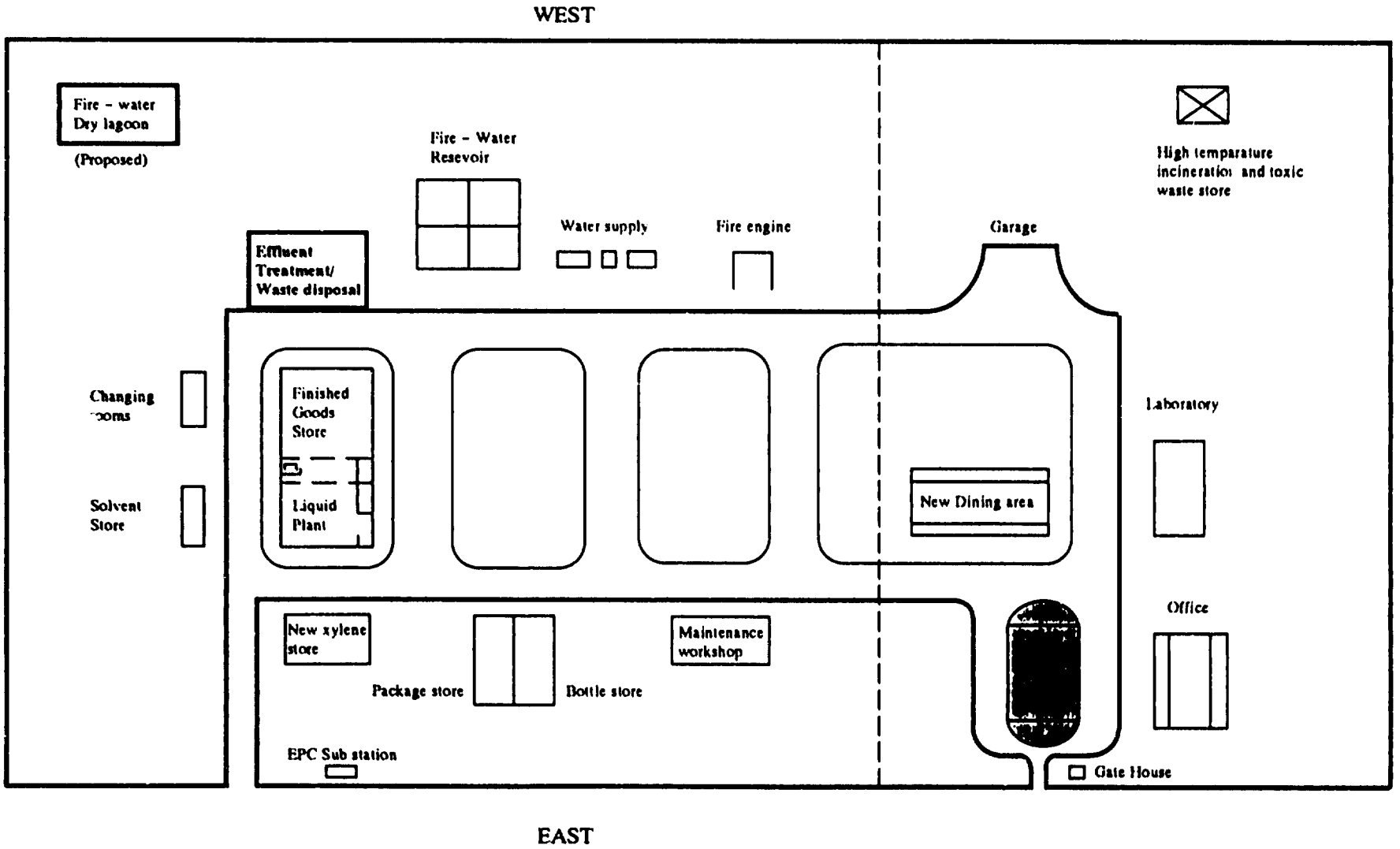
continued/...

ACTION NUMBER	TOPIC	ACTION STATUS/ BY WHOM?
	..continued 2	
2.2.3.3	Secure Packaging and Labelling of Wastes.	Yes/ MAS
2.2.3.4	Dedicated Waste Storage Area.	No/ MAS
2.2.3.5	Security Fence.	No/ MAS
2.2.3.6	Bunded Roadways - Containment of Spillage.	No/ MAS
2.2.3.7	Waste Storage Area.	No/ MAS
2.2.3.8	Preparation and Storage of Records.	Yes/ MAS
2.2.3.9	Records of All Waste Arisings and Disposal.	Yes/ MAS
2.2.3.11	Toxic Drum Disposal.	Yes/ MAS
2.3	Industrial Hygiene and Safety.	
2.3.1	Safety Supervisor - Training Programme.	No/ MAS
2.3.2	Atmospheric Monitoring Equipment.	No/ UNIDO
2.3.3	Appointment of Site Environmental/Safety Supervisor.	Yes/ MAS
2.3.4	Filling Line Adjustment - Spillage Avoidance.	Yes/ MAS
2.3.5	Protective Clothing.	Yes/ MAS
2.3.6	Plant Housekeeping.	Yes/ MAS
2.3.7	Blood Cholinesterase Tests.	No/ MAS
2.3.8	Warehouse Xylene Storage - wooden pallet storage - acquisition of forklift Drum clamp.	 No/ MAS No/ MAS
2.4	Fire Protection and Controls. continued/...	

ACTION NUMBER	TOPIC	ACTION STATUS/ BY WHOM?
	...continued 3	
2.4.1	Water Storage Reservoir.	Yes/ MAS
2.4.2	Containment of Fire Run-Off Water.	No/ MAS
2.4.4	Grass and Weed Cutting.	Yes/ MAS
2.5	Site Appearance.	Yes/ MAS
2.6	Road Access.	No/ MAS

PESTICIDES FORMULATION PLANT (HMAWBI) 1993

APPENDIX III



TREATMENT OF AQUEOUS EFFLUENTS FROM MANUFACTURE OF AGROCHEMICAL PRODUCTS

AUTHOR: K S JOHNSON

1. Introduction

Pesticides in general, have a low solubility in water and are usually manufactured in the form of wettable powders, suspension concentrates or miscible liquids.

The breakdown in stability by chemical treatment of suspensions, emulsion, etc, causes the flocculation and settlement of a high proportion of the pesticide ingredient in the form of a dense sludge. This process offers a convenient method of detoxifying aqueous plant effluents arising from the formulation of pesticides.

2. Treatment Process

It is necessary to collect plant effluents in a common sump. This offers storage capacity, and means of buffering the changes in composition of effluent frequently can occur.

The flocculation process is normally conducted on batch treatment system using a conical-based cylindrical vessel. This allows the settlement of sludge residues in the cone, and a means of decanting the upper supernatent clarified effluent.

Optimum conditions for flocculation/clarification of effluent are pH 10-12. The addition of iron salts and lime (calcium hydroxide) to aqueous pesticide effluent normally induces rapid flocculation of all suspended solids.

The inclusion of a small amount of polyelectrolyte will serve to accellerate the co-agulation of flocs and subsequent settlement.

The addition of an adsorbent clay and possibly powdered activated carbon can be beneficial in the removal of trace residual pesticide if this is deemed to be necessary.

Doseage rates of chemical flocculants need to be established for specific effluents but the following can serve as a starting point:

	mg/litre
Lime pH 11-12	500
Ferric sulphate (40% solution)	200
Polyelectrolyte (anionic type)	5
*Powdered clay	1000
*Activated carbon	500

*Carbon and clay is normally dosed as a secondary stage following initial flocculation and separation/removal of sludge.

Ideally, a vessel 5-10 m^3 capacity with mechanical agitation is suitable for collection and treatment (see Appedix 1).

To maintain a consistent standard of high quality finish effluent, a second stage of activated carbon adsorption should be considered. This should comprise of at least 2 x 1 tonne beds of activated carbon operating in series flow. (Appendix II).

High activated carbon granules (14/44 mesh), surface area >1000m^2/g should be used.

Coal or wood-based carbon granules will give the best adsorption performance. Coconut shell carbons, by virtue of their relatively small pore sizes, are generally insuitable for pesticide effluent treatment.

Flow-rates of clarified sand-filtered effluent should be regulated through the beds to allow a minimum of 1 hour contact residence time.

Final effluents are normally clear, virtually colourless and non-toxic.

Disposal can be directed to a sewer, soakaway or in hot climates possibly an evaporation pond. Direct discharge of effluent to a water course is not recommended.

Sludges from the process can be dried in shallow drying beds and subsequently disposed of to a designated waste disposal site.

The sludges are normally maintained at pH 12-14 during storage to accellerate the degradation of pesticide residues.

KSJ/LCW - 29/9/88

UNIDO COMMENTS

The report gives an excellent survey of integrated safety related activities within the battery limits of the plant. while a major portion (89%) of the earlier recommendations have been met, the report gives a simple check list for various parties to take care of. While the recommendations are being implemented, the management should make sure that they are routinely maintained and carried out with utmost dedication. This is vital for long term success of the plant beyond UNDP/UNIDO assistance.

UNIDO will provide the necessary additional inputs before completion of the project within the limitations of the available budget.

If the the recommendations are fully met, the plant could become a model plant for small-scale operations. UNIDO could then make use of it within the scope of the regional project RENPAP.