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PHILIPPINES

Technical report: Recommendations on industrial hygiene  
aspects of pesticide formulation and wood  
treatment in the Philippines\*

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

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\* This document has not been edited.

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**A. GENERAL RECOMMENDATIONS TO THE FERTILIZER AND PESTICIDE AUTHORITY TO ASSIST THEIR STAFF IN ASSESSING WORKPLACE HAZARDS WHERE PESTICIDES ARE MANUFACTURED, FORMULATED, PACKAGED, OR WHERE WOOD TREATMENT IS BEING CONDUCTED.**

**FORMULATION AND PACKAGING**

- The FPA should accumulate a file of the raw materials used at all formulation sites. This should include inert materials. This may be included in the new inspection form developed by Dr. Maramba.
- These files should contain Material Safety Data Sheet (MSDS) type information with health and safety data.
- To assess potential inhalation risk during liquid formulation, for all organic components, (pesticides, solvents, inerts) find vapor pressure data to calculate degree of potential hazard at saturation. This will give an idea of a worst-case worksite condition and potential inhalation exposure due to vapor exposure. Compare these values with existing workplace standards if available or consult to determine applicable exposure limit. Use formula:

$$\frac{\text{vapor pressure at } 20^{\circ}\text{C}}{760 \text{ (atmospheric pressure)}} \times 10^6 = \text{ppm}$$

This calculation will give a quick, direct value of the maximum amount of vapor possible (saturation) in the work- place air.

For dermal protection, gloves should be required at all formulation sites (liquid or dry) where there is contact with pesticide or contact can be anticipated.

- Require employers to develop selection criteria for gloves. Obtain recommendation from raw material supplier (product stewardship), or other sources. US EPA will issue guideline for choosing hand protection soon. As a basic guideline, employers should choose gloves based on resistance to solvent system.
- For site survey evaluation of workplace engineering controls, obtain smoke ventilation tubes. I will obtain and forward some to FPA. These tubes allow an inexpensive, quick method of checking exhaust ventilation system.
- With the smoke ventilation tubes, check exhaust ventilation systems at formulation sites. All systems should have a capture velocity of at least 100 linear feet per minute (0.5 meter per second). This can be estimated with the tubes.

- For the sole manufacturing plant, after FPA review of all raw materials used and associated hazards, and calculation of hazard potential from vapor at saturation for organics, review reaction products to ensure safety of workers. Consider a model monitoring program with University (Prof. Elma B. Torres). However, the best solution is to upgrade their equipment and adopt a totally closed system.

**WOOD TREATMENT** - Follow up on biological monitoring of workers exposed to arsenicals.

- Require full containment of CCA treatment chemicals.
- Ensure that site operators and employees are aware of chronic health hazards of working with arsenic and creosote.

**Applicable to all Worksites**

- Require that engineering controls be given highest priority at all sites.
- Work toward minimizing use of PPE in light of ambient conditions of high temperature and humidity.

**B. INTRODUCTION**

This Special Service Agreement for duty in the Philippines developed as a result of recommendations made by Dr. Keith Maddy. In two visits he made to the Philippines and work with the Fertilizer and Pesticide Authority (FPA), he observed pesticide formulation and wood treatment plants with varying degrees of control over workplace hazards. He recommended to the FPA and UNIDO that I follow-up on his work and evaluate some of these worksites from an industrial hygiene viewpoint. This evaluation would assist FPA management in the assessment of the working environment where pesticides are produced, formulated, or applied. In addition, this duty was to include review and comment on existing guidelines for evaluating workplaces and other safety and training materials.

This trip was scheduled to coincide with a planned regional workshop on industrial hygiene and occupation health and safety.

Included in this report are some general recommendations to assist the FPA staff in evaluation of these worksites, some observations, impressions and comments, and recommendations specific to each site visited and other comments

on other activities. Please note that the site visits should not be considered comprehensive reviews of all the hazards present. The surveys allowed me to only estimate the degree of workplace control over exposure presently in use in the Philippines. In addition, the site surveys and discussions with FPA staff are the basis for the general recommendations to the FPA staff. These recommendations include some appropriate methods of exposure evaluation that do not rely on monitoring and can be easily adopted as general methods of assessing these workplaces. Used in combination with the inspection checklist, and routine follow-up inspections, the FPA should have adequate tools to assess the degree of hazard control at most worksites.

### C. MAIN ACTIVITIES

The activities for this visit were arranged by Aida Ordas of the FPA. Included were several onsite workplace surveys, review of inspection guidelines and training modules, preparation for and participation as a speaker and resource person for a regional workshop, and review and evaluation of FPA field inspection program.

### SITE VISITS

#### Site Number 1

This plant was visited on Wednesday, April 3, 1991. Also present were Ms. Aida V. Ordas and Ms. Bella Fe D. Carmona. We were taken to facility by the Product Development Manager. At the site, we met the Plant Manager. Following a brief introduction we were taken on a tour of the plant.

This plant manufactures 2,4-D and 2,4-D salts. There are 27 employees involved in production, distributed over three shifts. Capacity is at 200 metric tons per year and the product is used for herbicide control on rice.

The plant manager reviewed chemistry involved in making the product and a flow sheet of the proces and chemicals involved will be sent to FPA for review.

There is a full-time nurse on site, a reported stable workforce, and periodic training of workers. A physician is present twice a week.

Our survey included the raw material storage area, large building containing the reactors, filling area, filtering area and part of the finished product storage area. We also toured the worker washing and changing area.

**Impressions and Comments:**

- Site location is not ideal - close to residences.
- Site security is good - two check points on the way.
- General ventilation in raw material storage is probably adequate. The structure is covered with open sides.
- General ventilation in manufacturing area could be improved - a significant odor said to be due to dichlorophenol the major raw material was very evident.
- Workers provided with PPE, organic vapor removing respirators.
- Adequate facilities for cleaning and changing.
  - Emergency eyewash
  - Local exhaust ventilation
  - not provided at filling stations, filtering stations
  - could be improved throughout
- Other potential hazards
  - electrical - grounding, guard rails, belt guarding
  - noise from granulation equipment (not operating), inadequate lighting.
  - no product being packaged at time of site visit
  - housekeeping, lack of closed systems.

**Recommendations for FPA**

- Obtain MSDS-type information for all raw materials - and products being produced and review hazards for health, fire and products of reaction. I can also review if sent to me after my return to California, also flow sheets of process.
- For organics, determine vapor pressure at 20°C. Perform hazard evaluation calculations to determine possible worst-case scenario for inhalation potential.
- The present occupational health standard for worker exposure to 2,4-D is 10 mg/m<sup>3</sup> which is a considerable amount and probably not being exceed since the 2,4-D is not very volatile. Skin contact should be always avoided. MSDS-type information is needed for all the other reactants. Also there is concern about various reaction products that may form during reaction - see general comments.

- Require local exhaust ventilation for all non-closed system areas, filling station, pressing station - this local exhaust ventilation must provide 100 linear feet/min or 0.5 m/sec.
- FPA should require replacement of old outdated equipment and machinery.
- Observe cleaning procedures - when filtering apparatus is cleaned - are workers protected? Where does filtrate and other waste go?
- Observe operation of granulation equipment when operating. Is dust controlled? Is noise a problem?

## Site Number 2

The formulating plant is located south of Manila near Canlubang. This visit began about 12:00 on April 3, 1991. Aida Ordas, Bella Carmona and I were present. There we met with the Plant Manager. We also met the Quality Control Officer from the headquarters office in Manila.

This plant formulates and packages BUTACHLOR "MACHETE" 2,4-D and ROUNDUP.

Potential workers exposure concerns appeared to have been addressed during construction and the site is equipped with an elaborate local exhaust ventilation system for the granulation operation. However, the equipment was not in operation at the time of this visit.

Half of the building (approximately) is devoted to the granulation process where sand is coated with 2,4-D and BUTACHLOR to make the herbicide MACHETE.

The granulation process employs workers and one supervisor. Local exhaust equipment appeared well designed. However, the large hood-type at the bagging station is probably not adequate. It should be at source of dust - not over the operator's head. However, this equipment was not in operation.

The other half of the main building contained the liquid formulation line. At this area, 1 liter bottles were being filled with Butachlor for the liquid "Machete" product. Machete is classed as a category III pesticide by FPA. This liquid line employs 10 workers and a supervisor. This operation was working at the time of our visit. Filling was accomplished semi-automatically and with local exhaust ventilation. However, the local exhaust appeared to be too far above the line to be very effective. Product was fed to the filling machine through plumbing and there was little odor present - Operation appeared to be controlled and workers protected from excessive inhalation exposure.

The operator of the filling machine was wearing a respirator - but it may not be necessary. None of the workers were wearing gloves. Hand protection should be used for all work stations after the bottles are filled and until capped to avoid dermal contact.

We were shown the personal protective equipment used - the respirators were from Australia. It is unclear if they are tested or approved by any agency. The plant manager thought they were good for three months.



Present plant capacity for liquid product is 7,500 liters per batch and it takes 16 hours to formulate and pack. Plant capacity is 14 metric tons per day for the granular products. The plant is presently working about 5 days per month.

**Impressions and Comments:**

- Modern plant with considerable worker protection designed in.
- Local exhaust ventilation "appeared" adequate - see general recommendations.
- Good location and security, away from residential area.
- Some concern with change and wash rooms - FPA standards.
- Eye wash not operable near granulation area.

**Site Number 3**

This facility is located north of Manila in the town of Norsagaray, in the Bulacan province. This visit took place on the morning of April 4, 1991. Also present were Aida Ordas and Bella Carmona of the FPA.

At the site we were met by the plant manager, and the company nurse. This plant formulates Endosulfan, Chlordane and Malathion. Presently, only a liquid line is in use with products being packaged in 1 Liter bottles. There are 17 workers and four managers and a single work shift.

All workers are given clean work clothes daily. Respirators in use are changed weekly. There were separate washing areas for men and women.

A granulation process that was earlier shut down by the FPA was being readied for start up.

A thorough walk through of the site was conducted. The company nurse explained how all employees are trained in hazards, first aid by the Red Cross, and that the company is a member of the Safety Organization of the Philippines (SOPI).

We observed the bottle filling operation. Local exhaust ventilation was provided to the bottle filling machine. Product was withdrawn from a 55 gallon drum behind the machine. There was a series of threads suspended in the hood apparatus to demonstrate the hood was operating. Production rate at present is 200 cases in an eight hour work period. Each case consists of 12 liter size bottles.

Also present was the company physician. He is on site up to 3 x a week. I was given a copy of their annual medical report with detailed notes of the occupational health care provided.

The manager was anxious for my assessment of the granulation equipment as now modified to comply with FPA rules. The equipment consists of a large cement mixer-type mixer into which sand is added and while tumbling, 2,4-D will be added. After the sand is adequately coated and dried, the mix will be discharged into a size separator and then bagged, weighed and sewn. This operation is in a separate area, next to the liquid line. There is an exhaust ventilation hood built over the mixer assembly and there are plans to further enclose the sides of the mixer and the size separator. The ventilation system for this mixer is also connected to the hood over the liquid line filling machine and two of the formulation mixing/storage tanks. This system was demonstrated for me. It appeared inadequate to control dust from this operation. However, without seeing this in operation, nothing definite can be said. See further comments under recommendations.

The manager asked about information on the chemicals they use. I told him I would send what we have from California.

**Impressions and Comments:**

- This plant has evidently improved a great deal since the visit(s) of Dr. Maddy.
- Their recently finished clinic and full time nurse and close-by physician are all positive signs of their commitment to worker safety.
- The facility itself is old and the ventilation system questionable.
- Ventilation is probably inadequate in the proposed granulation area - both the general and the local exhaust provided.
- The management (nurse and manager) are very safety conscious.

**Recommendation:**

- Provide for greater control of all sources of vapor exposure-use closed system transfer to filling machine or pipe (closed system) into area.
- Examine adequacy of filling machine exhaust ventilation with smoke tubes (see comments).
- Observe and check proposed granulation operation with smoke tubes prior to giving ok to proceed. Use only with 2,4-D?
- Refer to other plants (such as site # 2).
- Do vapor pressure evaluation of organics used - both pesticides and solvents.
- Review with fire marshall adequacy of equipment containing, transferring and moving kerosene and xylene.
- Separate storage of finished product from work areas.

- Oscillating fan positioned above granulation mixer will only probably blow dust around unless a totally closed system is installed.

#### Site Number 4

The site visit to this plant located in Manila took place starting at 1400 on Thursday, April 4, 1991.

With Ms. Aida Ordas and Ms. Bella Carmona, we met with the general manager who is in charge of the site, and the plant operations manager.

After introductions, we toured the plant clinic where we met by the occupational health physician, another part-time physician, and several other medical staff. The plant has a very comprehensive occupational health program. The plant physician is a very knowledgeable in the principles of industrial hygiene.

The plant was formerly used for battery production. Many improvements and additional improvements are planned.

Among products formulated are formetanate and thiodicarb. There are 34 workers involved in the formulating operation. We observed the packaging of the formetanate in 200 gram packages. The wettable powder was packaged by machine into sealed foil packages. Workers placed packages in boxes, sealed and packed cartons. All equipment was enclosed and provided with local exhaust ventilation.

The physician has conducted air sampling for this operation and reported that results were satisfactory.

#### Impressions and Comments:

- Well managed plant.
- Location not the best, but company very aware of being a good neighbor.
- Many ongoing improvements being made to control worker exposure.
- Physician and staff are doing excellent job.

#### Recommendations:

- Continue with ongoing improvements.
- Use plant as resource to assist others.

#### Site Number 5

This site was visited as part of the program of the regional workshop. On Wednesday, April 19, 1991, I went with the group to this plant located south of Manila near Canlubang.

The plant is relatively new and situated away from residences in an industrial zone. The group was given an overview of the operation which was followed by a tour of the facility.

Due to the size of the group, very little direct interaction with management was possible.

The plant was producing a granular formulation and operating three liquid formulation lines.

The management of the plant maintained little control over the group of visitors and they were free to roam almost at will.

The use of respirators appeared to be inconsistent. Some workers were wearing respirators while another worker in the same area did not.

**Impressions and Comments:**

- Good location, plant layout and site security.
- Environmental protection stressed with waste water clean-up system, incinerator, etc.
- Engineering controls probably not adequate or need updating.
- Use of PPE needs attention - worker safety needs higher profile.

**Recommendations:**

- Management should review control measures presently in use with attention to exhaust ventilation equipment in formulation and storage areas.
- FPA's next inspection should consider all organics, hazards associated with each, and use smoke tubes to check for adequate control at liquid filling and granulation lines.
- Gloves should be mandatory for any contact with bottles following filling and until the potential hazard of dermal contact with product is over.

**Site Number 6**

This plant was visited on Monday, April 27, 1991. It is located near Davao, on the island of Mindanao. With Attorney Nicholas Deen of the FPA, we met with Ilominda Salting, Regional Coordinator for FPA, the Vice President the company, several other staff, and two representatives of Mitsubishi Chemicals.

The plant is situated on company property, away from any residence and provided with good security. At the time of this visit, the plant was formulating carbofuran granules to be used for nematocide control in the banana plantation.

Also present was one of the physicians from the company-operated hospital. She explained that cholinesterase tests are conducted every other week and that only one person had shown a depression within the last year. Most of the work involves carbofuran, but they also formulate a granular Mocap.

The formulation is a batch-type operation. For each batch, 100 kg. of technical carbofuran powder is added to 640 kg. of sand. After addition of water and a polyvinyl alcohol binder, the ingredients are mixed in a large mixer. After about 30 minutes, the granular material is moved to the dryer and then bagged. Four batches are produced each 4 hour period. The plant produces 6-7 tons per day. After observation of the operation and visual assessment of the potentially most exposed workers, personal sampling was started on the worker adding the technical carbofuran and the worker operating the bagging machine. These samples were collected for about an hour by drawing breathing zone personal air samples through filter and sorbent collecting media. These samples will be analyzed when I return to California.

In addition to the air sampling, various areas were monitored for noise. The worst included the bagging station (88 dBA), behind the dryer (92 dBA) and at the charging station (93 dBA).

Employees were provided with extensive PPE including hooded coveralls, rubber gloves, bump cap, rubber boots, and respirators.

**Impressions and Comments:**

- Operation looked clean and well organized.
- Good medical support.
- The plans to build a new system to be totally enclosed should allow this work without the full amount of PPE presently required.
- 4-hour workshifts is a good administrative control at present to avoid heat stress.
- Minor problems include- guarding of chain drive (dryer), unstable charging platform without a guard rail, several exposed electrical boxes, guarding of fans, and a kerosene leak in the corner near the dryer.
- Adequate warning signs and employee instructions.
- Operation appears to be controlling exposure.
- Much of present protection is due to use of PPE, good housekeeping, and existing engineering controls.

**Recommendations:**

- Encourage management to go forward with modernization and engineering controls to relieve employees of PPE.

Notes:

Personal samples

Employee: bagging station operator

Start	Rate	Stop	Rate
10:55	1.5Lpm	11:05	1.4Lpm

Employee: charging station operator

Start	Rate	Stop	Rate
10:55	2.0Lpm	11:10	2.0Lpm

Site Number 7

Plastic Bag Plant

This facility was visited after the formulation plant on April 22, 1991. This facility produces chlorpyrifos impregnated polyethylene bags that are used to bag banana bunches and prevent insect damage.

This process uses a Dow product made for making plastic bags which contain 1% chlorpyrifos. We observed the bag extrusion process. The machines are enclosed and provided with exhaust ventilation. The design of these enclosures was based on Dow information. Employees only enter to correct problems and when entering, wear respiratory equipment.

The Dow label for the plastic bags does not provide any information on respiratory or dermal hazards associated with the product.

Pressing Table

Start	Rate
3:50	1.5 Lpm
Stop	Rate
5:25	1.5 Lpm

Counting Table

Start	Rate
3:50	2.0 Lpm
Stop	Rate
5:25	2.6 Lpm

While collecting the above samples, a noise survey was made with the plant engineer. Noise levels approached 95-96 dBA near the twine making machine spinners and 86-87 dBA near the twine extrusion machines, and several other areas. The plant engineer thought he could correct some of the causes of the noise and reduce the levels.

**Impressions and Comments:**

- Calculations done later show that vapor hazard is not a concern, samples should show low levels of chlorpyrifos.
- Workers may not need to wear respirators in room where pressing and folding is done. See above.
- Potential dermal hazard is difficult to assess.
- Noise may be a problem - some workers may work longer than 8 hours.

**Recommendations:**

- Anticipate that results of sampling will confirm an absence of an inhalation hazard to employees counting and punching and pressing.
- Company should request any information from Dow on potential dermal or inhalation hazards.
- If Dow has no information, consider worker exposure study to determine extent of hazard.
- Request a noise dosimeter study to determine daily exposure for workers most exposed to noise.

**Site Number 8**

**Wood Treatment Plant**

This site was visited on Tuesday, April 23, 1991. With Attorney Nicholas Deen and Ilominda Salting of FPA, we met with the plant engineer and plant operations manager.

This plant treats utility poles with creosote and CCA, and cross arms and poles used in banana plantations with CCA.

The CCA process involves pre-drying of poles followed by stacking on small rail cars which are rolled into a large 95,000 liter pressure treating tank. After a vacuum is established, the tank is flooded with a 5% water solution of the CCA chemical. The product used is manufactured by Laporte Industries and contains  $As_2O_5$  (pentavalent arsenic). After 4-6 hours at a pressure of 200 psi, the solution is withdrawn and the wood left in the chamber to drain for 24 hours. After this time period, the wood is withdrawn. The engineer showed me written operating procedures and site plans.

The creosote treating is quite similar. However, the creosote is dissolved

in bunker oil and must be kept warm (140°F) to lessen the viscosity. The solution is 70% creosote (koppers) and 30% oil.

There are 5 employees and the plant operates 6 days per week with each shift 8 hours in length.

The company provides clean work clothing daily and other PPE. Goggles, gloves and respirators are used during mixing and the unloading process of both treatment types.

The plant engineer reported the only major illness or injury was due to wood splinter wounds in the last four years.

The integrity of the pressure treating vessels are reportedly checked once a year by the Department of Labor and Employment (DOLE).

- Company appears to be in control of health and safety hazards, however, they lacked information on chronic health hazards of creosote and arsenic.
- They have plans to concrete the railway leading out from the CCA treating tank.
- The urinary monitoring program for arsenic was not reviewed.

**Recommendations:**

- Review and update urinary monitoring program.
- Require completion of concreting of CCA railway to prevent further ground contamination.
- I will forward information on occupational hazards of arsenic and creosote.
- Have company ask CCA and creosote manufacturer for latest information on health hazards and recommended methods of dealing with environmental contamination (product stewardship).

**Site Number 9**

**Plastic Bag Recycling Plant**

This site was visited on Tuesday, April 23, 1991. This plant recycles the chlorpyrifos-containing bags from the banana plantations and other polyethylene from plastic bag liners of fertilizer bags, etc.

At the time of our visit, only the untreated plastic was being processed. There are three plastic extrusion machines that remelt the plastic into small pellets suitable for recycling by other plastic manufacturers. These machines are supplied with considerable electrical power to heat and melt the plastic. There appeared to be numerous potential electrical hazards due to inadequate



electrical work.

A recovery machine, used to shred and melt the bags into small pieces suitable for feeding into the extrusion machines, appeared to produce considerable dust. This machine was beneath a round exhaust hood but probably too far away to adequately control the dust. Ilominda Salting reported this was more evident when processing pesticide containing bags.

Noise measurements were made to assess the magnitude of noise levels. The measurements ranged to 85 dBA at the hopper of the middle extrusion machine, 86 dBA near the center of the middle extrusion machine, and the highest was 93 dBA measured at the chopper of machine number 3.

**Impressions and Comments:**

- There doesn't appear to be an inhalation hazard from chlorpyrifos in a vapor state, due to vapor pressure calculations.
- There should be better control of dust from the recovery machine and from the extrusion machine. Some smoke and volatized plastic was observed. This is reported to be much worse when the treated plastic is processed.
- Although noisy, most workers would probably not experience levels exceeding 85 dBA as a time-weight average for an 8 hour day (current ACGIH TLV).

**Recommendations:**

- Have management improve exhaust ventilation system for recovery machine.
- Have management control emissions of hot plastic vapor from extrusion machines and survey for electrical hazards.

#### **PARTICIPATION IN REGIONAL WORKSHOP**

A considerable amount of the available time (approximately half) was spent preparing for and participating in the Regional Workshop on Industrial Hygiene and Occupational Health Safety and their Environmental Concerns. This workshop was held during the third week of my visit (week of April 15-20, 1991).

During the week prior to the workshop, I prepared three separate presentations. One presentation was developed to discuss the principles of occupational health and safety adopted in the U.S.A. This presentation was to substitute for the US OSHA person who was unable to attend. Another major presentation was prepared to discuss the principles and guidelines of industrial hygiene in the pesticide industry. In addition, a third shorter presentation was prepared to discuss and demonstrate the basics of air sampling for exposure assessment to airborne hazards.

During the conference, the three presentations were delivered and I was available as a resource person.

#### **D. OTHER ACTIVITIES**

##### **Review of Training Modules for Inspectors and Guidelines for Inspection.**

I met with Dr. Nelia Maramba, Ms. Aida Ordas, and Prof. Elma Torres to discuss these training materials. Some suggestions were made and the guidelines were distributed at the workshop and will be used for worksite evaluation at pesticide sites. These materials should provide FPA and regulatory inspection teams of other countries with a valuable evaluation tool for these worksites.

##### **Review of Training Module for Exterminators**

The training manual devoted to fumigation was reviewed and I attended several hours of instruction being given to certified pesticide applicator students. The book should be updated to delete all the fumigants that are no longer registered in the Philippines, to update exposure limit values for methyl bromide (now 5 ppm), and to delete the use of canister-type air-purifying respirators (SCBA should only be allowed). I agreed to take a copy with me to edit and return.

##### **Review of FPA Program for Worksite Inspection of Pesticide Formulation and Wood Treatment Sites**

There is presently inadequate staffing at the FPA to maintain an adequate level of continuous monitoring at these worksites.

I recommend that the FPA establish a full-time industrial hygienist position and several other staff specialist that would be dedicated to the routine inspection of formulation and wood treatment sites.

I also recommend that regulations be promulgated to institutionalize monitoring programs to assess various workplace hazards (noise, ventilation, safety hazards, respirable dusts, etc.).

I also recommend that FPA explore collaborative activity towards standardizing exposure sampling and analytical methods.

As part of the developing workplace monitoring program of these worksites, I recommend a longitudinal program be started to provide follow up on the health status of the workers in these sites with time.

E.

UNIDO COMMENTS

The report deals with an important issue of occupational and industrial hygiene related to pesticide formulation. In the Philippines mainly pesticide formulation is undertaken except for one or two units which manufacture active ingredients. The report includes study visits to 9 pesticide formulation units and for each visit there is a summary of findings and recommendations. It is interesting that the visits included a small unit at Mindanoba (site No 9) and to a plastic recycling unit (site no 9).

It is very encouraging that all visits were accompanied by one or two senior Government officials clearly indicating the level of interest shown by the Government regarding the safety of workers operating in plants producing hazardous chemicals. The report also deals with Personnel Protective Equipment (PPE) and how to make them comfortable to wear under high temperature/humidity conditions. This is one of the major problems in developing countries where PPE is ignored due to adverse weather conditions.