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**STRENGTHENING OF PESTICIDE DEVELOPMENT CENTRE**

DP/IND/89/128

INDIA

**Technical report: Findings and recommendations\***

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

*Based on the work of A. H. Gregory,  
consultant on pesticide packaging*

Backstopping Officer: B. Sugavanam  
Chemical Industries Branch

United Nations Industrial Development Organization  
Vienna

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\* This document has not been edited.

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**ABSTRACT**

**Project title:** Pesticide Packaging in India - Findings and recommendations DP/IND/89/128/11-66

**Objective:** To give lectures on different aspects of pesticide packaging in one and two day seminar workshops at four locations in India, organised by project authorities; together with lectures given by two other UNIDO consultants on pesticide safety and waste disposal. Advice was given on international guidelines and standards for pesticide packaging and materials. A selected survey was made of materials and packages being used by the pesticide industry in India. Recommendations were made for improvements within reasonable economic limits, without sacrificing safety and transport norms. All of the objectives were achieved within the allocated time.

**Duration of project:** 1.0 man month

**Main conclusions:** The current position regarding pesticide packaging in India is reviewed (section 4.0 of the report). A number of specific observations were made as follows:-

a. There are aspects of tinfoil, aluminium and plastic containers in use in India which do not meet some of the main GIFAP recommended design criteria for one-way solids or liquids pesticide packaging.

b. Urgent improvements need to be made to existing packs to provide increased user safety, reduced incidence of leakage, more effective rinsing and empty pack disposal methods. It is considered these improvements could be achieved in a phased programme over two to three years. The capital cost of improvements could be born by the package suppliers and then amortised in the unit pack costs.

c. The pesticide packaging standards in force in India and the new pack approval system operated by the registration authorities has successfully prevented gross failures occurring over several years. However, the excessive time needed for new pack approvals (up to three and a half years) is now a severe constraint in the adoption of new packaging technologies for pesticides. The existing specification based pack evaluations carried out by the Central Insecticides Laboratory should be replaced by the United Nations (UN) performance tests based on the UN Recommendations for the Transport of Dangerous Goods. The regulatory requirements could then be consistent for both the Indian national and international transport modes, in keeping with other UN signatory countries.

d. Members of the Indian pesticide industry associations who export or plan to export products to other countries need to be reminded of their legal obligations to use appropriate UN certified packages for the movement of goods classified as dangerous.

**Recommendations:** It is recommended that, with UNIDO's agreement, a work programme is drawn up to bring about improvements to pesticide packaging in India within a short time span. The suggested activities, which would require further assistance from a packaging Expert, are:-

a. Obtain more background data on pesticide package usage in India by carrying out a confidential survey among members of the Pesticides Association of India (PAI). This would provide vital details of pack sizes and materials used, quantities purchased per annum, approximate cost, sources of supply, and improvements sought by pesticide manufacturers. A questionnaire has already been used successfully in other countries to gather such information. The results have been invaluable in bringing about improvements and devising industry initiatives for pack collection and disposal.

b. Upgrade tinplate, aluminium and rigid plastic container manufacture in India with the assistance of manufacturers in developed countries who specialise in pesticide packs, have machinery and tooling knowledge and are willing to provide the necessary technology transfer. This would have to be carried out under a technical know-how or licensing agreement.

c. Prepare an easily understood booklet on the current export legislation/regulations affecting the international movement of dangerous chemicals for use by pesticide manufacturers. This would be a condensed version of the UN "Orange Book".

d. Urge the United Nations Food and Agriculture Organisation (UN FAO) Rome to finalise and publish the new draft Guidelines for the Packaging of Pesticides to replace the 1985 version.

e. Produce a Pesticide Packaging Handbook to accompany the new FAO Guidelines. This would describe the latest packaging principles and practice in detail. The basic outline for this Handbook has already been drafted and could be completed within a few weeks, once commissioned.

f. Investigate the progress made by the World Packaging Organisation/UNDP with the three year International Packaging Programme on improvements to packaging in developing countries to see if this would be of help with the proposed pack upgrading programme in India.

g. Devise a three to four week packaging familiarisation programme for senior IPFT and Central Insecticide Laboratories personnel. This should take place in an industrialised country (Europe and/or USA) where current international pesticide packaging designs, materials, filling and handling equipment, laboratory evaluation and registration procedures for packages can be seen. Special emphasis would be given to the growing use of water-soluble materials to reduce the risk of spray operator contact.

h. Form a Packaging Work Group from members of the Pesticide Association of India to consist of 5/6 people qualified in packaging technology, with responsibility for this function.

j. Set up the proposed package laboratory at IPFT for storage testing and train staff to run it.

## 1.0 INTRODUCTION

The main duty station for this project was the Institute of Pesticide Formulation Technology (IPFT) at Gurgaon, Haryana, twenty-two kilometres south of New Delhi. The IPFT is an institution building project developed in 1991 with the assistance of UNDP and UNIDO by the Government of India to promote safe, efficient and economically viable technologies for new generation pesticides. It makes such technologies available for large scale commercial exploitation and caters for the needs of both the Indian pesticide industry and the Asia and Pacific Region.

Packaging of pesticides has featured in a number of training seminars organised by IPFT and its predecessors, the Pesticide Development Centre (established in 1988) and the Pesticide Development Programme India (1981).

### 1.1 Project objectives

The detailed project objectives are described in the Job Description (annex 11.1). The one month duration was divided into one and two day Training-Cum-Meet workshop sessions at Ahmedabad, Bombay (World Trade Centre), Bombay (Hoechst) and Hyderabad, when lectures were given on different aspects of pesticide packaging. Advice was given on international standards and guidelines. A selected survey of materials and packs being used was carried out within the available time constraints in order to give recommendations for improvements. These improvements need to be carried out within economic limits which have still to be defined, without sacrificing safety or transport norms.

### 1.2 Scope of the report

The report reviews in broad summary the current status of packaging in India and specifically focuses on pesticide packaging. The Indian Standards for packaging and testing pesticides are not commented on in detail as no complete copy was available to the author during the project.

## 2.0 TRAINING WORKSHOPS

The first two day session was organised by IPFT in collaboration with the Gujarat Pesticide Formulators Association at Ahmedabad, Gujarat on 21-22 January. The programme covered effluent treatment and disposal, the implementation and monitoring of international safety standards, new filling machinery for powders and granular products. A paper was given by the author on "An International Overview on the Packaging of Pesticide Formulations".

Thirty delegates from Technical Grade manufacturing (TGM) and Pesticide Formulating

industries attended. There was strong interest in water soluble packaging, PET barrier bottles and precision moulded HDPE containers.

The second two day workshop at the World Trade Centre at Bombay (24-25 January) was organised by IPFT in collaboration with the Pesticide Formulators Association of India and eighty-one delegates attended. The programme (annex 11.2) was similar to Ahmedabad. Videos were shown by the author on water soluble packaging and a low cost automatic filling line for 1 litre PET and 5 litre HDPE bottles. Again questions were centred on water soluble packaging, compatibility of formulations with PET and tests for tinplate lacquer systems. In addition, Dr Ponkshe of Bayer India, Thane, gave a paper entitled "An Indian Industry Perspective on the Packaging of Pesticides".

A one day workshop (27 January) followed at Hoechst India Limited, Mullan, Bombay, in collaboration with the Association of Basic Manufacturers of Pesticides (ABMP) Bombay (annex 11.2). The twenty-three delegates were mainly senior, well-qualified people who generated lively discussions. Proposals for a used pack collection and disposal programme were made and information sought on similar programmes in other countries. It was felt that disposal of empty clean containers will not be easily accepted by Indian farmers, many of whom sell empty packs in the local market for secondary use. An education programme and an incentive scheme are needed to rectify this situation.

The final training workshop took place at Hyderabad on 30 January when eighteen delegates attended, including three packaging suppliers of PET, HDPE and corrugated containers. Samples of international packs were circulated during the packaging presentation. Questions again centred on compatibility of formulations with PET, evaluating tinplate lacquers and the durability of water soluble films.

### 3.0 SITE VISIT TO VOLTAS LIMITED, SECUNDERABAD, 29/2/95

Voltas manufacture technical grade material and formulate organophosphorus products. They were originally formed as a joint venture with Rhone Poulenc but subsequently severed this link and are now part of the Tata Engineering Group. The visit was kindly arranged by Mr W Ramalingam to show the UN experts a good example of a chemical synthesis plant. Constructive criticism was invited to bring about further improvements.

A tour of the chemical synthesis plant showed well-made steel and plastic 210 litre drums being used to receive raw materials, to hold stocks of intermediates undergoing processing and for the dispatch of finished technical grade products. Some were destined for export markets such as

France. A drum crusher was being used to dispose of rinsed empty drums once they became unsuitable for re-use. A recently installed incinerator with flue gas scrubbers could handle solid wastes such as small plastic drums.

The formulation and packing plant filled 250ml, 500ml, 1 litre and 5 litre tins with EC products. Metal and plastic bungs were inserted in the necks and roll-on pilfer proof (ROPP) metal closures applied on two semi-automatic filling lines. They were then packed into outer cases as 20 x 1 litre and 4 x 5 litre packs. Also 20 litre lacquered containers were being filled. Voltas said that the compatibility of available tinplate lacquers with their products is often a problem. Heavyweight HDPE bottles with plastic plugs and ROPP caps were being used for chloropyrifos 20 EC, based on cyclohexanone. Details of more effective barrier container materials for this product, such as PET, co-extruded multilayer polymers and fluorinated HDPE, were given to Voltas.

All filled cases were inverted for 24 hours to detect leaking containers.

#### 4.0 SELECTED SURVEY OF PESTICIDE PACKAGES AND MATERIALS USED IN INDIA

The survey took the form of:-

- a. examining pesticide packs during the site visit to Voltas.
- b. obtaining product leaflets from the regional associations which included illustrations of current packs.
- c. examining samples of packaged products in retail outlets.
- d. scanning copies of "Packaging India", the bi-monthly journal of the Indian Institute of Packaging.
- e. discussions with package suppliers and users during the training sessions.
- f. examining pack samples at the Central Insecticide Laboratory.
- g. a telephone discussion with the Director of the Indian Institute of Packaging,

Mr PV Narayanan, Bombay.

These sources provided information on the respective packs.

##### 4.1 General comments

The Indian pesticide industry experiences similar problems to the industry in other countries. Their annual purchasing requirements for packs is estimated to amount to less than 1% of the tinplate and aluminium containers produced in the country. This creates difficulties when special designs need tooling changes, or non-standard lacquer finishes are required.



#### 4.2 Tinplate containers for pesticides

A convenient size range exists for formulators to buy appropriate containers for their pesticide products to avoid the need for users to decant from larger packs. Although the tinplate sheet itself is usually imported it is readily available in India. Good examples of labelled and litho printed tinplate packs were seen with attractive, clear decoration.

The disadvantages observed were the problems often associated with tinplate containers; notably leakage from seams and closures, corrosion and uneven lacquer application. The grade of tin (99.75% purity), tin coating weight and thickness, passivation, general impact performance formability and grain direction likely to be supplied by the smaller lower cost tinplate container manufacturers contribute to these problems. Cost cutting often results in one or more of these parameters being below the required standard. The heavier the thickness of tin, the higher the resistance to chemical and atmospheric corrosion but the higher the cost. The optimum weight can only be determined after extensive product/container compatibility testing.

#### 4.3 Aluminium containers for pesticides

India has a glut of aluminium produced from its indigenous bauxite deposits and adequate smelting capacity. However, according to the Indian Institute of Packaging, aluminium is still considered to be in its infancy for packing many products in India (1). The aluminium can for beverages is beginning to appear and this in turn will bring about more modern forming techniques and designs for products such as pesticides. Appropriate lacquer systems to internally coat aluminium bottles to make them compatible with alkaline and acidic pesticide formulations are just becoming available.

A comprehensive demand study is currently being prepared (2) for beverage products and needs to tie in with the recommended study for pesticide products. Developments in line with the shifts and trends which have occurred in other parts of the world over recent years should be encouraged. Development programmes for specific lacquers, coatings and printing inks should be initiated. More effective liquid-tight and tamper-evident closure systems need to be introduced to counteract problems in these areas.

#### 4.4 Rigid plastic containers and closures

Most examples of high density polyethylene rigid plastic bottles seen during the commission were of heavyweight construction with poor neck finish. Evidence of inaccurate hand trimming with a knife could frequently be found, with the resultant risk of leakage or failure on impact due to thinning of weld lines. Modern blow moulding technology has dispelled the myth that heavyweight thick walled containers are necessary to transport hazardous goods. Evenly distributed polymer with considerable flexibility has resulted in container weights for one trip HDPE pesticide

containers being halved during the past 8 years and yet passing UN group II performance tests with an adequate safety margin.

Greater attention needs to be paid to closure design and quality to fit the bottles. Tried and tested GIFAP industry standard neck and thread forms have been developed for pesticide use but they do demand that suppliers have the appropriate precision injection moulding and blow moulding machines available to produce the bottles and closures. The evidence is that investment in such equipment is only just being made by suppliers in India.

#### 5.0 VISIT TO THE CENTRAL INSECTICIDES LABORATORY (CIL), FERIDABAD 7/2/95

The objective was to obtain an understanding of the process for package approvals and to see their test facilities. Discussions were held with Er VC Bhargava, Joint Director (Packaging & Processing) CIL and six of his team. The Laboratory is run by the Ministry of Agriculture, Directorate of Plant Protection, Quarantine and Storage, following the introduction of the Insecticide Act 1968, which includes and controls all pesticides in India whether they are imported, manufactured or exported.

The Central Insecticides Bureau, in conjunction with the CIL, are responsible for the registration of formulations and packs. Approval has to be given by the Registration Committee after the biological efficacy, toxicity, safety and pack compatibility claims have been verified by field trials and storage tests over the full shelf life period.

CIL have frequent contact with the UN Food and Agriculture Organization, the American Environmental Protection Agency and GIFAP. Er Bhargava chairs the Indian Packaging of Pesticides Sub-committee FAD 1.1.

The CIL procedures for new pack or change of pack approvals is shown in annex 11.4. Product shelf life claims are checked at three representative locations of temperature and humidity conditions after 6 months, 1 year, 1.5 years and 2 years storage. Transit trials of 3000 km in the proposed sales packs are also made between the three centres. Transport methods range from trucks and bullock carts to bicycles. The approvals process can take up to a total of 3.5 years.

Specification details submitted by pesticide manufacturers are compared with the specifications of packaging components which are known to have performed well in the past.

We were invited to comment on a newly approved top and bottom seamed tinplate can without a closure. It was to contain a solvent based liquid pesticide. The user needed to use a tool which penetrated the can top to gain access to the product. While this pack concept would discourage

reuse of the container when empty, it appeared to suffer from a number of disadvantages. Exposure to high temperature could create a pressure build up, causing the contents to spray out on opening the can. All of the contents would have to be used up on the initial opening and effective rinsing of the empty container would be very difficult to achieve.

Water soluble polyvinyl alcohol (PVAL) film packs were discussed and Er Bhagarva expressed his concern over the ability of the film to withstand storage temperatures of up to 50°C and the rigours of transport methods in India. The author offered to provide technical data from a number of film suppliers to show how these concerns could be overcome. Lever lid tins could be used to protect multipacked PVAL sachets from the metal hooks traditionally used to handle outer cases during transit in India.

Help was also requested by Er Bhargava on the following points :-

- a. Recommended methods for the safe disposal of rinsed empty containers.
- b. Guidelines on the development of new packaging for pesticides.
- c. Specifications for containers which provide tamper evidence and are difficult for children to open.
- d. Details of low cost package test equipment used in other countries.

## 6.0 PROPOSED PACKAGE TESTING LABORATORY AT IPFT

Proposals have been made to establish a package testing laboratory at the Institute of Pesticide Formulation site at Gurgaon. The function of the laboratory would be to carry out storage compatibility tests to determine the effect of pack on product and the product on packs to support the formulation development work carried out by IPFT staff. The tests need to be carried out at the recommended range of temperature and humidity conditions over the time periods required for registration submissions. It is also envisaged that this package compatibility testing service could be offered to the industry members of IPFT who do not have such facilities of their own, on a fee-earning basis.

Other organisations such as the Indian Institute of Packaging have package testing facilities but are neither experienced nor equipped to handle hazardous chemicals, particularly alongside the food products which they currently deal with. The Central Insecticides Laboratory is equipped to carry out such testing, but they see their role as monitoring pack specifications and carrying out confirmatory tests on claims made in registration submissions, rather than in development testing. Suggestions for the necessary IPFT package test equipment, laboratory layout and test protocols have been made by three UNIDO Experts during visits in the past eight years (3,4,5). Some of

the laboratory equipment has already been purchased by UNIDO and is being stored at IPFT, Gurgaon. The package testing laboratory now needs to be established and personnel trained as soon as possible in order to make it operational.

#### 7.0 MEETING WITH DR DHUA, REGIONAL CONTROLLER, UNDP; CHAIRMAN, IPFT 2/2/95

A general discussion took place on the lessons learned from the workshop sessions. The points made with particular reference to packaging were as follows :-

- a. The first priority is to safeguard pesticide users during dispensing, mixing, spraying, pack rinsing and disposal.
- b. More information is required by the authorities and potential users of water soluble films in India. Details were requested on the physical characteristics of the various grades of film available such as tensile strength, puncture resistance and stability at 50°C. Technical data sheets which give this information are available from all of the major American, Japanese and European producers.
- c. A means of providing self destruct packs to prevent the re-use of empty containers is needed.
- d. Data is required on the toxicity risks involved if inadequately rinsed packs are used as drinks containers.
- e. Pack rinsing and disposal is an important issue still to be addressed in India.
- f. It is essential to keep capital costs as low as possible for any pack improvements being proposed.
- g. The Indian pesticide industry associations could be used as the most effective means of bringing about improvements to packaging.
- h. A good starting point would be to conduct a confidential market survey among association members to determine the number and types of packages used per year for the various groups of formulations.

#### 8.0 CONCLUSIONS

Packaging for the pesticide industry in India is divided into two sectors. The synthesis of active ingredients by Technical Grade Material (TGM) manufacturers uses 200 litre drums and intermediate bulk containers (IBCs). The formulation of technical products into useable pesticides for registered field use requires smaller packs, ranging from 100 ml to 20 litres.

It is reported (6) that the higher profit margins of the TGMs allow more money to be spent on packaging. The formulators operate on low profit margins and cost cutting has traditionally taken place on packaging, with consequent safety risks.

Metal and plastic drum manufacture in India meets international standards for quality and adoption of technical advances. This is because global companies such as Van Leer and Mauser have licensed Indian companies (Balmer Lawrie and Time Packaging respectively) to produce drums and hold regular technical exchange meetings.

The design and production of smaller tins, aluminium, high density polyethylene (HDPE) and polyethylene terephthalate (PET) packs in India has not benefitted from technical assistance in the same way as drums. The consequences are that only limited progress has been made with most of these packs during the past 8 years. However, there are companies in industrialised countries who are willing and able to provide technical help. There are encouraging signs that such technical links and investment are about to occur.

#### 8.1 Tinplate containers.

The tinplate pesticide containers do not meet the GIFAP recommended design criteria for liquids and solids (7) on the following points : -

- a. They often fail to pass UN performance tests on sizes greater than 300 ml.
- b. They do not drain and rinse well due to the neck position in relation to the outer rim.
- c. The external rim and recess can trap product during or after pouring.
- d. Roll on pilfer proof closures are widely used, which have sharp edges. Cut fingers and torn protective gloves can result.
- e. The containers are not always liquid tight. Seepage at joints, seams and closures occurs quite frequently .
- f. Neck diameters are not large enough to permit plug free pouring with minimal dripping or splashing.
- g. The handles are not large enough to grip with a gloved hand.
- h. The closure plug cannot be easily removed without the use of tools, when wearing gloves.
- j. Tinplate lacquers are not always inert to the contents.

#### 8.2 Aluminium containers

The narrow necked, internally threaded aluminium containers produced in India have polythene screw plugs and crimped-on overseals. The same designs were being used in Europe in the 1970s. The plugs swelled in the presence of solvents and could only be removed with pliers. The overseals had sharp edges. They have been superseded by wider necked (50 mm) aluminium containers with tamper evident ratchet collars and caps in solvent resistant plastic. Tournaire (France) and Alcan

(Germany) are the main suppliers. Tournaire has assisted developing countries with implementing improved designs and tooling (see brochure annex 11.5) and have received enquiries from Klas in Bangalore, India since the visit.

### 8.3 HDPE blow moulded containers

No custom designed containers specifically for pesticides were seen during the survey. Indian suppliers brochures (Techno Pack) advertise multi-use heavyweight, rigid containers for edible oils and pesticides. Experience has shown that the best performance packs are lighter in weight to provide flexibility on impact to avoid base weld failures. Typical weights are 200 g for 5 litre bottles and 80 g for 1 litre. The bottles need to be produced on modern blow moulding machines with 30 point electronic parison programmer control to get the required polymer distribution, with an in-mould calibrated neck finish to avoid hand trimming and achieve good thread forms.

### 8.4 PET pesticide containers

There are two moulders in India known to have the necessary Japanese single stage injection/stretch/blow equipment (Pearl and Strongpet Polymers). However the Central Insecticides Laboratory has only approved two cypermethrin formulations in PET so far and claims PET is unsuitable for wide scale use. This is contrary to the results obtained by pesticide manufacturers and registration authorities in 14 other countries, where PET is approved for most formulations, apart from those containing ketones and strongly alkaline products. This discrepancy could be that a different grade of polymer is in use in India, the processing conditions are different or there are minor differences in the bottle design or closure methods which allow greater permeation.

### 8.5 New pack approval procedures

It appears that the approval procedures operated by the Registration Authorities in India are considerably longer than those in operation in other countries. Indian pesticide manufacturers carry out storage and transit testing and submit their results. Their claims are then verified by the authorities who repeat these tests, which doubles the time requirement for approvals. No account seems to be taken of registration approvals already given to packed products by countries outside India where similar climatic and transport conditions prevail.

The rate of change in packaging technology worldwide is occurring at a faster pace than the approval process in India. This is inhibiting the adoption of new innovations and safer, environmentally acceptable packaging for pesticides.

## 9.0 RECOMMENDATIONS FOR IMPROVEMENTS TO PESTICIDE PACKAGING IN INDIA

Most of the packaging deficiencies identified during the project could be rectified, with UNIDO's agreement, within a relatively short time span of less than two years and within reasonable cost

limits. Further assistance would be required from a packaging Expert, experienced in implementing changes in developing countries, to act as a catalyst and carry out some of the proposed activities, which are as follows:-

- a. Draw up a questionnaire to be used in a confidential survey among PIA members, to obtain basic information on the range of pack sizes, the materials of construction, quantities purchased per year, approximate costs, sources of supply and their response to the proposed improvements.
- b. Identify pesticide tinsplate, aluminium and rigid plastic container manufacturers in industrialised countries who are experienced in providing technical assistance and licensing arrangements to developing countries. This would enable packaging manufacturers in India to bring about the necessary improvements within a planned time schedule.
- c. Produce an easily understood guide on the packaging legislation applicable to the export of pesticides by the various transport modes. This would be a condensed version of the UN Recommendations "Orange Book", to be specifically targeted at pesticide manufacturers in developing countries.
- d. Urge the United Nations Food and Agriculture Organization (UN FAO), Rome, to finalise and publish the new draft Guidelines for the Packaging of Pesticides to replace the 1985 version.
- e. Produce a Pesticide Packaging Handbook to accompany the UN FAO Guidelines. The basic outline for this handbook has already been drafted and could be completed within a few weeks, once commissioned. It would be of assistance to experienced technologists and those who have occasional need for detailed packaging information.
- f. Investigate the current situation with the World Packaging Organisation (Paris)/UNDP (Geneva) project commenced in 1992 to improve packaging in developing countries and promote understanding and knowledge of packaging's role in international trade.
- h. Provide increased knowledge and experience for senior IPFT/CIL and Industry Association personnel in pesticide packaging by organising a 3 or 4 week familiarisation programme in an industrialised country where international pack designs, materials, filling and handling equipment, laboratory evaluation and registration procedures can be seen (Europe and/or USA).
- j. Form a small Packaging Work Group (5 or 6 members) and a steering committee to bring about the necessary changes within an agreed time frame. The packaging improvement strategy should be owned and mainly implemented by members of the Pesticide Association of India. The same collaborative approach for packaging improvements and standardisation as operates internationally within the pesticide industry needs to be adopted in India .
- k. Establish the proposed package testing facility at IPFT and train the staff to carry out storage test protocols and pack evaluation.

## 10.0 ACKNOWLEDGEMENTS

The author wishes to acknowledge the help provided during the project mission by the Institute of Pesticide Formulation Technology, RENPAP-UNDP, the Central Insecticides Laboratory, the Indian Institute of Packaging and the many people from the Regional Pesticide Associations that he met during the training workshops. Their assistance was invaluable and fully appreciated.



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATIONJob Description

DP/IND/89/128/11-66

- Post title:** Consultant on pesticide packaging
- Duration:** 1.0 m/m
- Date required:** Sept/Oct. 1994
- Duty Station:** New Delhi, with daily travel to project site at Gurgaon, Haryana (around 20 km away from New Delhi)
- Purpose of project:** An institution building project, to assist the pesticide industry in India by developing and promoting safer, new generation pesticide formulations and utilizing indigenous developed technology for the production of formulation and improving the formulation capabilities of the country.
- Duties:** The consultant during his/her visit will give lectures on different aspects of pesticide packaging in a two days workshop at each place at four places in India to be organized by project authorities along with two other UNIDO consultants on pesticide safety and waste disposal.
- He will advise on international guidelines standards on pesticide packaging materials and packages and will make a selected survey of the materials and packs being used by pesticide industry in India and will give his recommendations for improvement under economical limits but without sacrificing safety and transport norms. The consultant will submit a final report regarding his findings and recommendations.
- Qualifications:** A chemist or engineer with extensive experience in packaging of chemicals especially toxic chemicals such as pesticides. He must be familiar with different packaging techniques, labelling and in proper disposal of used containers. Experience in pesticide industry would be an advantage.
- Language:** English
- Background Information:** The Institute of Pesticide Formulation Technology is located on the out-skirts of New Delhi, is a national institute set up by the Government of India with an active assistance of UNIDO. The Centre is devoted to research and training in various aspects of Pesticide Formulation Technology and is playing a central role in maintaining contacts and cooperation with other national and international R&D institutions and also working as technical coordination unit of the regional network on pesticides for Asia and Pacific.

## BACKGROUND

Institute of Pesticide Formulation Technology, a Govt. of India Society has been set up in May 1991 presently engaged in implementing 'Pesticide Development Centre' a UNDP assisted project. The project's aim and objectives are to assist the pesticide formulation industry in the country in the areas of development of newer formulation, upgradation of technologies, industrial safety and pollution control, application of pesticides etc. The Project has access to the international experts as an input from UNIDO to assist the pesticide formulation industry. It has also plans to set up a safety laboratory. It is in this context that in collaboration with Gujarat Pesticides Formulators Association a training cum meet is being organised at Ahmedabad Gujarat to facilitate interaction between the industry and experts in this area.

In the present meet, three reputed international experts Mr. Keith S. Johnson, Mr. C.M. Hammer and Mr. A.H. Gregory are visiting India and IPFT took the opportunity to arrange this programme in collaboration with GPFA for the benefit of pesticide industry. In addition to the international experts, the experts from the industry and IPFT shall be sharing their view on the area of pollution control, industrial safety and packaging of pesticide formulation and during the meet cum training sessions.

The meet will highlight the topics relevant to incineration water and odour related technologies, other important areas of plant designs and safety measures and packaging of pesticides formulations. The full potential of the programme of the seminar is designed to create not only awareness about the present needs but to focus on the serious national efforts required to bridge the technological gaps if any in this vital aspect of pesticide industry.



## INSTITUTE OF PESTICIDE FORMULATION TECHNOLOGY

*Announces*

**Training cum Meet on  
Industrial Safety, Effluent Treatment and Packaging  
in  
Pesticide Formulation Industry**

*21 and 22 January 1995*

at

**Hotel Rivera, Khanpur, Ahmedabad-380 001**

Organised by

**INSTITUTE OF PESTICIDE FORMULATION TECHNOLOGY  
Sector 20, Udyog Vihar, Gurgaon -122016  
Haryana**

In Collaboration with

**Gujarat Pesticide Formulators Association  
Ahmedabad**

## PROGRAMME

21 January 1995

09.00 - 09.30 Registration  
 09.30 - 10.30 Inauguration  
 10.30 - 10.45 Tea/Coffee  
**Session I**  
 10.45 - 12.15 Introduction of IPFT & Presentation of Status paper on pollution control in pesticide industry Indian perspective - Mr. R.P. Luthra, Dy. G.M. HIL  
 12.15 - 13.45 International approach to effluent treatment and disposal in pesticide formulation industry - Mr. Keith Johnson, UNIDO Expert

13.45 - 14.45 Lunch

**Session II**

14.45 - 15.45 Types of treatment and disposal methods - Incineration water and other related technologies, Mr. Keith Johnson, UNIDO, Expert

15.45 - 16.00 Tea/Coffee

**Session III**

16.00 - 17.00 Discussion on experience of Industry in disposal of time barred pesticides and pollution control in industry - Moderator - Mr. R.P. Luthra, Dy. GM, HIL

22 January 1995

**Session IV**

10.00 - 11.15 Presentation by industry representatives on pollution related experiences in design and operation of effluent treatment plant.

11.15 - 11.45 Tea/Coffee

**Session V**

11.45 - 13.00 International Safety standard in Pesticide Industry Implementation and monitoring - C.M. Harmer, UNIDO Expert

13.00 - 14.00 Lunch

**Session VI**

14.00 - 15.00

Packaging of Pesticides Formulation - Indian Industry Perspective - Industry Expert

15.00 - 16.00

Packaging of Pesticides formulation - Mr. A.H. Gregory, UNIDO Expert

16.00 - 16.15

Tea/Coffee

16.15 - 17.00

Summary; group discussions and concluding session

### ADMINISTRATIVE DETAILS

Venue : Hotel Rivera, Khanpur, Ahmedabad-1  
 Dates : 21-22 January 95  
 Time : 09.30 am to 5.00 pm  
 Fees : Rs. 1,500/- per participants including course material Tea/Coffee/Working lunch  
 No. of Participants : 40-50  
 Last date of nomination : 10 January 1995

Nomination along with cheque / demand draft may please be sent in favour of GUJARAT PESTICIDE FORMULATORS ASSOCIATION to

Gujarat Pesticide Formulators Association,  
 20, Embassy Market, Near Dinesh Hall  
 Ahmedabad-380009

Phone : 400558

Telex : 011-74538 AIMC

Outstation participants requiring any assistance for hotel booking etc at Ahmedabad may contact Mr. P.S. Trivedi, Hony. Secretary, Gujarat Pesticide Formulators Association, 20, Embassy Market, Near Dinesh Hall, Ahmedabad-380 009

No. of Participants : 75 -100  
Last date of Nomination : 21st January, 1995  
Mode of payment : Nomination along with Cheque/Demand Draft may please be sent in favour of 'Pesticide Formulators Association of India' to :

Pesticide Formulators Association of India  
B-4, Anand Co-Op Housing Society  
Sitadevi Temple Road, Mahim (West)  
Bombay - 400 016

Phone : 4375279 - Mr. H.J. Kakodkar (Ex. Offr.)  
Fax : 6116736 / 6117761 Tlx. 011-74538 AIMC

Outstation participants requiring any assistance or hotel booking etc. at Bombay may contact Mr. H. J. Kakodkar of Pesticide Formulators Association of India

#### Background

Institute of Pesticide Formulation Technology, A Govt. of India Society has been set up in May 1991, presently engaged in implementing "Pesticide Development Centre" a UNDP assisted project. The Project's aim and objectives are to assist the pesticide formulation industry in the country in the areas of development of newer formulation, upgradation of technologies industrial safety and pollution control, application of pesticides etc. The project has access to the international experts as an input from UNIDO to assist the pesticide formulation industry. It has also plans to set up a safety laboratory. It is in this context that in collaboration with Pesticides Formulators Association of India a training cum meet is being organised at Bombay to facilitate interaction between the industry and experts in this area.

The Pesticides Formulators Association of India (PFAI) came into existence in the year 1988 with a need to provide platform for small scale pesticide formulators, a important sector which represents around 70% production of formulated pesticides in India. PFAI initiated by small scale pesticide formulators has now grown into an effective body whose membership includes medium and large scale industries, basic manufacturers and manufacturers of intermediates required for pesticides. The association represents the pesticide industry on a national basis with a strength over 350 members.

In the present meet, three reputed international experts Mr. Keith S. Johnson, Mr. C.M. Hamner and Mr. A.H. Gregory are visiting India and IPFT took the opportunity to arrange this programme in collaboration with PFAI for the benefit of pesticide industry. In addition to the international experts, the experts from the industry and IPFT shall be sharing their view on the area of pollution control, industrial safety and packaging of pesticide formulation and during the meet cum training sessions.

The meet will highlight the topics relevant to incineration water and odour related technologies, other important areas of plant design and safety measures and packaging of pesticides formulations. The full potential of the programme of the seminar is designed to create not only awareness about the present needs, but to focus on the national efforts required to bridge the technological gap if any in this vital aspects



**Institute of Pesticide Formulation Technology**  
(a Govt. of India Society under department of Chemicals & Petrochemicals)

Announces

Training - Cum - Meet on

**Industrial Safety, Effluent Treatment and Packaging in Pesticide  
Formulation and Chemical Industry**

24 and 25 January 1995 at

World Trade Centre, Hall Wista (30th Floor), Bombay

Organised By

**Institute of Pesticide Formulation Technology**  
Sector 20, Udyog Vihar, Gurgaon 122 016 (Haryana)

in collaboration with

**Pesticide Formulators Association of India**  
B-4, Anand Co-Op Housing Society, Mahim (West), Bombay - 400 016.  
Tel. No. 4375279/Tlx No. C/O : 011-74538 AIMC/Fax No. C/O:022-6116736

**FACULTY: FROM UNIDO & IPFT**

## PROGRAMME

**24 January 1995**

09.00 - 9.30	Registration
0.930 - 10.30	Inauguration/Appreciation Awards by PFAI to Mr. R.D. SHROFF (Chairman & Managing Director) of United Phosphorous Ltd, Bombay for his significant contribution in Pesticide industry.
10.30 - 10.45	Tea/Coffee
<b>Session - I</b>	
10.45 - 11.30	Introduction of IPFT & Presentation of Status paper on pollution control in Pesticide Industry Indian perspective - <i>Mr. R.P. Luthra, Dy.G.M., H.I.L.</i>
11.30 - 12.15	Future of flowables and water dispersible Granules in India World Market and formulation technique - <i>Dr. Ram Das, IPFT.</i>
12.15 - 13.45	International approach to effluent treatment and disposal in pesticide formulation industry - <i>Mr. Keith S. Johnson, UNIDO Expert.</i>
13.45 - 14.45	Lunch
<b>Session - II</b>	
14.45 - 15.45	Types of treatment and disposal methods - Incineration water and other related technologies <i>Mr. Keith S. Johnson</i>
15.45 - 16.00	Tea/Coffee
<b>Session III</b>	
16.00 - 17.00	Discussion on experience of industry in disposal of time barred pesticides and pollution control in industry - Moderator - <i>Mr. R.P. Luthra.</i>

**25th January 1995**

**Session IV**

09.30 - 10.15	Presentation by industry representative on pollution related experience in Design and operation of Effluent treatment Plant.
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10.15 - 11.15	Safety in Pesticide Industry - Indian perspective <i>V.N. Dutta, IPFT.</i>
11.15 - 11.45	Tea/Coffee
<b>Session V</b>	
11.45 - 13.00	International safety standard in Pesticide Industry its implementation and Monitoring <i>Mr. Charles M. Harmer, UNIDO Expert.</i>
13.00 - 14.00	Lunch
<b>Session VI</b>	
14.00 - 14.30	Packaging of Pesticides in Indian Industry perspective, Indian Expert.
14.30 - 15.00	Pesticides Registration in the European Community Council by <i>Mr. Geoff Byrne, CChem, FRSC, Head, New Market Development of Inveresk Research International Ltd., Scotland.</i>
15.00 - 16.00	Packaging of Pesticide Formulation International perspective: <i>Mr. Anthony H. Gregory, UNIDO Expert.</i>
16.00 - 16.15	Tea/Coffee
16.15 - 17.00	Summing up discussions & Concluding session

### ADMINISTRATIVE DETAILS

Venue	:	World Trade Centre, Hall Wista (30th Floor), Bombay 24-25, January, 1995
Date	:	24-25, January, 1995
Time	:	9.30 a.m to 5.00p.m.
Fee	:	Rs. 1200 per participant for PFAI Members Rs. 1500 per participant for non PFAI Members (including Course material, Tea / Coffee & Working Lunch)



**INSTITUTE OF PESTICIDE FORMULATION TECHNOLOGY**

*Announces*

**Training cum Meet on  
Industrial Safety, Effluent Treatment and Packaging  
in  
Pesticide Formulation Industry**

*27 January 1995  
at*

**HOECHST INDIA LIMITED  
LBS Marg, Mullund, Bombay**

Organised by

**INSTITUTE OF PESTICIDE FORMULATION TECHNOLOGY  
Sector 20, Udyog Vihar, Gurgaon -122016  
Haryana**

In Collaboration with

**Association of Basic Manufacturers of Pesticides (ABMP)  
Bombay**

**ADMINISTRATIVE DETAILS**

Venue : HOECHST INDIA LIMITED  
L.B.S. Marg, Mulund (West), Bombay

Date : 27 January 1995

Time : 09.30 am to 5.30 pm

Fee : Rs. 1,000/- per participants including  
course material Tea/Coffee/Working lunch

No. of Participants : 30

Last date for Nomination : 15 January 1995

Nomination along with cheque / demand  
draft may please be sent in favour of  
"ASSOCIATION OF BASIC MANU-  
FACTURERS" to

Mr. D.C. Deo,  
B-9, Saroj, Paralkar Road,  
Shivaji Park, Dadar, Bombay-400 028

Phone : 455238

Outstation participants requiring any assistance for hotel booking etc at  
Bombay may contact Mr. Mr. D.C. Deo, B-9, Saroj, Paralkar Road, Shivaji  
Park, Dadar, Bombay-400 028

## Background

Institute of Pesticide Formulation Technology, a Govt. of India Society has been set up in May 1991, presently engaged in implementing 'Pesticide Development Centre' a UNDP assisted project. The project's aim and objectives are to assist the pesticide formulation industry in the country in the areas of development of newer formulation, upgradation of technologies, industrial safety and pollution control, application of pesticides etc. The Project has access to the international experts as an input from UNIDO to assist the pesticide formulation industry. It has also plans to set up a safety laboratory. It is in this context that in collaboration with Association of Basic Manufacturers of Pesticides a training cum meet is being organised at Bombay to facilitate interaction between the industry and experts in this area.

In the present meet, three reputed international experts Mr. Keith S. Johnson, Mr. C.M. Harmer and Mr. A.H. Gregory are visiting India and IPFT took the opportunity to arrange this programme in collaboration with ABMP for the benefit of pesticide industry. In addition to the international experts, the experts from the industry and IPFT shall be sharing their view in the area of pollution control, industrial safety and packaging of pesticides formulation during the meet cum training sessions.

The meet will highlight the topics relevant to incineration, water and odour related technologies, other important areas of plant design and safety measures and packaging of pesticides formulations. The full potential of the programme of the seminar is designed to create not only awareness about the present needs but to focus on the serious national efforts required to bridge the technological gaps if any in this vital aspect of pesticide industry.

## PROGRAMME

27 January 1995

09.00 - 09.30	Registration
09.30 - 10.15	Inauguration - Opening remarks by ABMP & IPFT
10.15 - 10.30	Tea/Coffee
10.30 - 11.45	Pollution Control in Pesticide Industry Indian Perspective - R.P. Luthra, Dy. GM, HIL
11.45 - 13.00	International Approach to Effluent Treatment and Disposal in Pesticides Formulation Industry - Keith Johnson, UNIDO Expert
13.00 - 14.00	Lunch
14.00 - 15.15	International Safety Standard in Pesticides Industry, its implementation and Monitoring - C.M. Harmer, UNIDO Expert.
15.15 - 15.30	Tea/Coffee
15.30 - 16.30	Packaging of Pesticides Formulations - A.H. Gregory, UNIDO Expert
16.30 - 17.30	Open House Discussion / Summing up.

### ADMINISTRATIVE DETAILS

Venue : VICE ROY HOTEL  
Tank Bund Road,  
Hyderabad-500 380

Dates : 30 January 95

Time : 09.30 am to 5.30 pm

Fees : Rs. 1,000/- per participants including  
course material Tea/Coffee/Working  
lunch

No. of Participants : 30

Last date for Nomination : 15 January 1995

Nomination along with cheque/demand  
draft may please be sent in favour of  
**VOLTAS LIMITED**  
MR. W.V.B. Ramalingam,  
General Manager (operation)  
IDA Phase II  
Patancheru-502319  
Medak District

Phone : 084543-2225-2226

Telex : 0422-232, Fax : 91-0842-821053

Outstation participants requiring any assistance for hotel booking etc at Hyderabad  
may contact Mr. W.V.B. Ramalingam, IDA, Phase II, Patancheru-502319, Medak,  
Dist. Andhra Pradesh, Phone : 084543-2225, 2226, Telex : 0422-232, Fax : 91-  
0842-821053



### INSTITUTE OF PESTICIDE FORMULATION TECHNOLOGY

*Announces*

**Training cum Meet on  
Industrial Safety, Effluent Treatment and Packaging  
in  
Pesticide Formulation Industry**

*30 January 1995  
at*

**VICEROY HOTEL  
Tank Bund Road  
Hyderabad-500 380**

Organised by

**INSTITUTE OF PESTICIDE FORMULATION TECHNOLOGY  
Sector 20, Udyog Vihar, Gurgaon-122016  
Haryana**

In Collaboration with

**Pesticide Association of India  
New Delhi-110 001**

**New Telephone Nos: 08453-42673,  
42622, 42588.**

**Fax Number: 08453-42656**



## Background

Institute of Pesticide Formulation Technology, a Govt. of India Society has been set up in May 1991 presently engaged in implementing 'Pesticide Development Centre' a UNDP assisted project. The project's aim and objectives are to assist the pesticide formulation industry in the country in the areas of development of newer formulation, upgradation of technologies, industrial safety and pollution control, application of pesticides etc. The Project has access to the international experts as an input from UNIDO to assist the pesticide formulation industry. It has also plans to set up a safety laboratory. It is in this context that in collaboration with Pesticide Association of India, New Delhi a training cum meet is being organised at Hyderabad to facilitate interaction between the industry and experts in this area.

Pesticides Association of India is the main representative body of this important agricultural input industry PAI's membership comprises of both Public & Private Sector large scale (including multinationals) medium scale and small scale manufacturers, formulators and distributors.

In the present meet, three reputed international experts Mr. Keith S. Johnson, Mr. C.M. Harmer and Mr. A.H. Gregory are visiting India and IPFT took the opportunity to arrange this programme in collaboration with PAI for the benefit of pesticide industry. In addition to the international experts, the experts from the industry and IPFT shall be sharing their view on the area of pollution control, industrial safety and packaging of pesticide formulation and during the meet cum training sessions.

The meet will highlight the topics relevant to incineration water and odour related technologies, other important areas of plant design and safety measures and packaging of pesticides formulations. The full potential of the programme of the seminar is designed to create not only awareness about the present needs but to focus on the serious national efforts required to bridge the technological gaps if any in this vital aspect of pesticides industry.

## PROGRAMME

30 January 1995

09.00 - 09.30	Registration
09.30 - 10.15	Inauguration - Opening Remarks by PAI & IPFT
10.15 - 10.30	Tea/Coffee
10.30 - 11.45	Pollution Control in Pesticide Industry Indian Perspective - R.P. Luthra, Dy. GM, HIL
11.45 - 13.00	International Approach to Effluent Treatment and Disposal in Pesticides Formulation Industry - Keith Johnson, UNIDO Expert
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14.00 - 15.15	International Safety Standard in pesticides Industry, its implementation and Monitoring - C.M. Harmer, UNIDO Expert.
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16.30 - 17.30	Open House Discussion / Summing up.

PACKAGING OF PESTICIDESTHE CHANGING INTERNATIONAL SCENARIO AND NORMS

## 1.0 Introduction

This paper gives an overview of the current international trends in agrochemical packaging. It is based on the draft revised United Nations Food & Agriculture Organisation (UN FAO) Guidelines for the Packaging of Pesticides, shortly to be published. They were written by a group of industry experts in packaging.

The paper reflects the enhanced profile which packaging technology has earned in this industry during the past 3 years. The emphasis now is on the Formulation and its Package being regarded as a single entity - the Product.

Registration authorities in various countries increasingly require package performance and rinsing data to be presented as part of the Product Registration Submission. It has been known for a product registration to be refused on account of the package selection.

Pack design features, material compatibility, transport regulations, pack rinsing and disposal methods now feature prominently in any discussions on pesticide packaging. Consequently these topics form the major part of this paper.

## 2.0 General requirements

Pesticide containers and related outer packaging should comply with all material standards and regulations which apply to such packaging and where required, with international transportation and safety regulations.

## 2.1 Shelf life

The period during which the product remains fit for use is known as the "Shelf life". This should be established as at least 2 years. Product registration holders (registrants) determine shelf life by intense storage stability testing under a variety of short and long term storage regimes. These regimes are selected having due regard to the geographical regions and climates to which the product and packaging will be exposed during transport, intermediate warehousing and storage by the final user.

## 2.2 Container size

Container size is normally specified in metric units (except within the USA) as net volume for liquids and net weight for solids. The gross size of a container is greater than net size in order to facilitate filling and dispensing, but in the case of liquids this is also necessary to accommodate thermal expansion after filling. Typical maximum degrees of filling are 97% for water based products and 95% for products based on organic solvents. However for smaller containers it is not uncommon to use filling degrees of 80-90% due to other factors such as foaming during filling and the need to dispense without spillage.

2.

Filling degrees for solids have to cover a wide range, due to settlement(de-aeration) after filling and the need for flexible containers in particular to be large enough relative to product volume to permit closure immediately after filling. Special care is necessary when specifying containers for solid formulations due to bulk and packaging density considerations.

### 2.3 Pack design with regard to easy rinsing

The majority of pesticide products are designed for mixing in water prior to application to the crop or target species. There are economic and environmental benefits to be gained from effective rinsing of containers of these products prior to disposal. However these benefits are only realised in full when container rinsing water is transferred into the sprayer and delivered to the target. Effectively rinsed containers may be classified as non hazardous(subject to local regulations) and are therefore preferred for subsequent storage prior to final disposal.

It is important when designing or selecting a container that due consideration is given to avoiding design features such as recesses or an integral hollow handle which are liable to impede easy effective rinsing. Steel and plastic drums should include optimum draining features in their design.

As a general rule it may be assumed that rinsing efficiency will decrease with increasing viscosity of liquid products. This in turn increases the potential contribution of container design and materials of construction to efficient rinsing.

Primary packaging for solids, including flexible materials, should be capable of being rinsed with pressurised water without disintegrating. An exception to this is when water soluble film is a component of the primary package.

The three main rinsing methods to be used prior to pack disposal are described in appendix 1. and in the European Crop Protection Association(ECPA) Guidelines on Rinsing Agrochemical Containers.

### 2.4 Closures

Many pesticide manufacturers have reached a consensus to standardise neck diameters on plastic packaging in order to help to facilitate good neck designs, better operation of filling lines and the introduction and acceptance of closed transfer systems. Some diameters are being phased out over a period. Those expected to remain in long term use are listed below:

Major(Crest) Diameter of Screw Thread *	Bore Diameter of Opening *
mm	mm
63	50-55 **
50	42 or 39 ***
45	39
38(Not in Europe)	28-30 **

\* normal

Tamper evidence is a desirable feature of pesticide containers demanded by many users. It may be divided into two basic types: internal and external. Inner membranes heat sealed to rigid plastic containers for liquids provide internal tamper evidence. This means that screw caps must be removed to permit visual inspection of the inner membrane to establish if the package has been tampered with. Internal tamper evidence is provided in a similar manner on small tinplate containers where a tinplate neck plug(shive) is fitted so that it cannot be removed without being damaged.

External tamper evidence may be provided in a variety of ways and a few examples are described below.

#### Steel Drums

Metal overseals crimped over the traditional screw threaded bung must be destroyed to permit access to the bung. This type of overseal may also be used on HDPE drums and aluminium containers with internal screw threaded bungs.

Retractable plastic pourspouts are available for steel drums with a ring pull cover which must be destroyed in order to remove the screw cap. Such spouts also provide internal tamper evidence as the neck of the spout may be sealed with a ring pull plastic membrane.

#### Fibre Drums

Lever locking bands are provided with a loop of wire which passes through adjacent holes in the band and which is closed with a motto or logo indicating the origin of the product. The wire must be cut to open the band.

#### Cartons

Cartons sealed with external adhesive tape or with adhesive between overlapping flaps are not reclosable without leaving some evidence of damage caused by any previous opening. Some designs include perforated tear strips which are automatically tamper evident if used.

#### Bags and Pouches(Flexibles)

Seams may be sewn, glued or heat sealed which make it necessary to tear, cut or otherwise pierce the container material to obtain the contents.

#### Rigid Plastic Containers.

Various designs of plastic and metal screw caps are available with break-off rings. The ring may be designed to break from the cap by rupture of fragile bridges between cap and ring as the cap is unscrewed. Alternatively it may have a tear off band which utilises more robust connecting bridges which cannot be ruptured simply by unscrewing the cap.

## 2.5 Labelling

The product label is a prime source of technical information concerning the product, its areas of use, methods and timing of application, and

safety precautions to be observed. It may also carry the formal, authorisation number issued by a national registration authority, indicating that the product has been approved for sale in a particular country and that the label text has also been formally approved.

In order to fulfil its function the label must remain firmly affixed and clearly legible throughout the container's life until its final disposal; particularly if the label is exposed on a continuous daily basis to direct sunlight during this period, which could cause inks to fade. It is essential that appropriate adhesives are selected for good bonding. Both pressure sensitive and aqueous based adhesives are in common use.

Where water soluble bags must be printed, direct printing with water soluble or dispersible ink is essential.

## 2.6 National/International standards

Some national registration authorities and the Commission of the European Communities require that applications for product registration include information demonstrating the shelf life of the product. Applicants for product registration may also be required to obtain approval for the type of packaging proposed.

### 2.6.1 United Nations performance tests

Most National and International legislation is now based on the "Recommendations of the Committee of Experts on the Transport of Dangerous Goods" published by the United Nations. Packages must pass the relevant performance tests to obtain a United Nations certificate when the contents they are intended to carry are classified as hazardous. The performance tests are a drop test, a leakproof test, an internal pressure(hydraulic) test and a stacking test as summarised below.

#### UN Package Performance Tests

Test	Applicable to
Drop	All Packs
Leakproofness	Liquids Only
Internal Pressure(Hydraulic)	Liquids in Metal, Plastic and Composite Containers
Stacking	All Packs Except Bags and Sacks.

The procedures for these tests depend on whether the product is a solid or a liquid, on its density at 20 C and vapour pressure at 50 C or 55 C, on the design and construction of the package and, finally, on the packaging group to which the product has been assigned.

Combination packages are only subjected to the drop and stacking tests.

The compatibility of the packaging materials with the proposed contents must also be established in accordance with the regulations. The detailed criteria for packaging liquid products may differ between IMDG

## 2.7 Key design criteria summary

GIFAP has issued design criteria for primary and secondary(outer) packaging which are included in Appendix. 2. These criteria will assist those involved in the design, selection or use of packaging for pesticides to improve ergonomics and safety features whilst reducing the environmental burden of container manufacturing processes and distribution. The reduction of packaging waste is a key objective of the criteria. Improved operator handling characteristics are also a key requirement in reducing the environmental burden.

## 3.0 Selection of Packing Types

### 3.1 Primary Packaging - Introduction

The essential prerequisite is that there is no interaction between packaging material and contents throughout the shelf life of the product.

#### 3.1.1 Selection of Packaging Material for Solid Formulations

Typical representative types of formulated products are:-

- Wettable powders(WP)
- Wettable granules (WG)
- dusting powders(DP)
- granules (GR)

Polyethylene is the preferred material because it has universal application. It is thermoplastic, therefore an ideal sealing medium, and forms a very good moisture barrier. The predominant requirement is the preservation of agrochemical formulations, particularly in humid climates. Flexible pouches or bags are preferable to rigid containers to minimise the amount of packaging used or to be disposed of when empty. If further strength is required, it can be obtained by the use of fibreboard outer packs.

In monolayer film constructions, a thickness of 0.1 mm will be sufficient in most applications.

If shelf life studies show the product to be very hygroscopic or water sensitive, an additional moisture barrier such as aluminium will be required. Aluminium composite foil requires a heat sealable inner layer and external protection against environmental influences. In addition, physical strengthening and print carrier are required.

Specific agrochemical formulation properties, e.g. a strong odour or volatile components require a composite film which consists of LDPE and an additional barrier, not necessarily aluminium. PA or PET are ideal reinforcements for larger packages, e.g. 10-20 kg.

The principle in designing multilayer films is to combine barrier properties.

Film or composite foil packages for powders or granules are usually tubular form/fill/seal(FFS) pouches, pre-fabricated bags or lined cartons. It is essential that seals are designed to minimise retention of formulation after emptying and rinsing.

The choice of packaging must also take account of cost. Container size has considerable influence on the economics of packaging, as does the filling operation. Higher packaging material costs can be absorbed by more economical filling costs.

#### Water Soluble Films

A special type of packaging suitable for agrochemical formulations, such as wettable powders (also gels and solvent based liquid) is the water soluble bag. Typically made of polyvinyl alcohol (PVAL), a variety of grades are available to combine optimum product compatibility with rapid dissolution time in cold water.

These packages do not protect the formulation in the usual sense as the film itself requires protection from moisture or rain. They protect the operator applying the product by preventing dermal contact or inhalation and contain pre-measured doses, leaving outer packages clean.

The polyvinyl alcohol material dissolves to become part of the spray liquid. Sometimes the physical properties of the spray liquid may be altered and need to be checked.

The recommended film thickness is 0.040 mm. Films selected should be free from pinholes.

Care has to be taken with the storage of film (or pre-fabricated bags) prior to use. Follow the instructions of the supplier.

Water soluble bags may be designed to contain from a few grams of a formulation to approximately 25 kg. They must be printed with water soluble or water dispersible inks for identification purposes.

A suitable outer bag of polyethylene film or paper/polyethylene/aluminium foil laminate is necessary to protect the water soluble film.

#### 3.1.2. Selection of Packaging Materials for Liquid Formulations.

Liquid agrochemicals always consist of an active ingredient and a solvent system, which may include water. A surfactant system is usually present where dilution in water is required. All formulation components can influence the packaging choice. Therefore compatibility studies have to be performed in order to prove the suitability of a package (preferably in sales packs). It is essential to evaluate the proposed closure for its suitability.

The most common types of formulations are:-

- emulsifiable concentrates (EC) and soluble liquids (SL)

The presence of hydrocarbon solvents may adversely affect compatibility with certain plastics such as HDPE.

- suspension concentrates (SC) and emulsions in water (EW), usually HDPE-compatible.

The most common packaging materials used for agrochemicals are glass, metal (aluminium, tinplate or mild steel), plastics, or combination containers with removable plastic liners.

It is recommended that pesticide containers should be permanently marked with the word "Pesticide" or the local language equivalent to identify them as agrochemical containers.

#### Glass

In spite of its universal product compatibility and availability, glass is not recommended for commercial packaging for safety reasons as it shatters on impact. Dimensional tolerances are not well controlled and neck thread engagement is frequently variable. However, it is accepted that for bottles below 200 ml they are acceptable where alternatives are not immediately available, providing the closure is leak free.

#### Metal

Metal containers, made from aluminium or tinplate or steel with or without internal lacquer linings, are well established.

Aluminium has the advantage that it can be converted in one or two-piece containers, if a suitable alloy is used. Although its purity should be min. 99.5 % an internal protective lining is required for many products.

Tinplate is a low carbon mild steel sheet coated on both surfaces with tin either by dipping or electro deposition. The grade of tin, tin coating weight/thickness, passivation (treating to stop further chemical reaction), performance specification, formability and grain direction should be borne in mind when specifying tinplate.

The tinplate container is built from three pieces (body top and base) which are joined together by seaming, soldering, gluing, welding or a combination of any of these techniques. A benefit with rectangular shaped containers is that distribution costs are minimised.

Internal lacquer linings are generally required for tinplate, using a roller application to achieve a uniform coating. Freedom from pinholes and good adherence of the lacquer are among the factors which need to be considered.

However corrosion, leakage from seams or closure and denting can cause customer resistance to tinplate. It is also difficult to pass the UN performance tests with sizes over 300 ml. For these reasons the trend has been to replace tinplate with plastic containers where possible.

Closures for metal packages must have equally good barrier and compatibility properties.

#### Plastics

Blow moulded containers of high density polyethylene (HDPE) offer a wider flexibility in design construction, good moisture barrier properties but poor resistance to hydrocarbon solvents.

An improvement in chemical compatibility with solvent based liquids can be obtained by fluorination. As an in-line-process the treatment is done during the blow-moulding of the container. The alternative is to apply the fluorine gas in a vacuum chamber after blow moulding, resulting in a treatment of the internal and external surface of the containers.



Other possibilities are offered by co-extruded, multi-layer plastic containers, which are available up to 10 litre capacity. Here, plastics with different properties can be combined to produce multi-layer packages, ideally "tailored" to suit the product requirements. A typical construction of a 1 litre bottle is HDPE with a minimum layer thickness of 0.7 mm, a bonding agent of min. 0.010 mm and an internal layer of EVOH(ethyl vinyl alcohol) or PA of min. 0.020mm. Reground material from the manufacturing process can be blended with virgin HDPE and used as a fourth layer between the external PE and the bonding agent, without increasing the container weight.

Biaxially oriented polyester(PET) is widely used for packaging of solvent and aqueous based liquid products. However, its water vapour transmission rate is higher than that of HDPE. This can adversely affect compatibility with certain moisture sensitive agrochemicals.

### 3.1.3 Recommended tests to be carried out on the main types of containers.

Irrespective of the type of the final container, in addition to regulatory performance testing, the following tests should always be carried out on filled packs before and after accelerated storage, as a minimum requirement:-

- Weight loss or gain
- Appearance of the container(including internal surface)
- Appearance of the container/closure system.

### 3.1.4 Specifications

Detailed specifications are necessary to ensure the consistent performance of the complete package. Each of the packaging material components must be precisely specified on a separate sheet. It is also important to give clear "packaging instructions" to the filling plant, independent from package specifications, describing how to assemble the package components.

Specifications should be revised from time to time in the light of technical developments in packaging materials or conversion processes.

## 3.2 Secondary Packaging

Defined as outer or transit packaging, used to protect the primary pack(s) from the physical stresses of transport and storage under varying climatic conditions. Product storage and hazard warning information can be communicated using printed text on the second packaging.

### 3.2.1 Types of Secondary Packaging

The most usual forms is corrugated fiberboard cases, made from boards consisting of two or more flat parallel sheets of paper liners separated by a fluted or corrugated sheet. They are held together with adhesive applied to the crest of the flutes, which have considerable strength. The air spaces within the board help to cushion the contents of cases during an impact.

The types of pulp used to manufacture the liners are:-

- Pure Kraft
- Multi-ply test or jute (which has one or more plies of recycled fibre, bonded to a Kraft facing).
- Chip or straw (made from low quality waste paper with short fibres and locally indigenous materials).

Flute forms separated by a liner can be combined to form double wall board or even triple wall for heavy duty cases, combining the advantages of each flute form.

Case design, construction and sealing methods used for closing the filled pack all contribute to its final performance. Internal fitments such as sleeves or dividers improve the strength considerably. Design : and construction options are illustrated in the International Fibreboard Case Code.

Avoiding cases overhanging the edge of pallets prevents between 25% and 40% loss in stacking strength. Software is available for optimising pallet stacking patterns using a personal computer.

### 3.2.2 Unit cartons

Unit Cartons are occasionally used within outer cases to collate primary packs together to form a sales unit. They consist of single thickness carton-board or E flute fibreboard.

### 3.2.3 Methods for protection of Unit loads.

Further strength and protection for complete pallet loads can be provided where transport and storage conditions are particularly severe by the use of corner posts, cages, overcovers or interleaves made from plastic, wood, fibreboard or metal. Load security and stability can be improved by film stretch wrapping or tensile strapping around the palletised goods.

## 4.0 Used container management

A used pesticide container management programme needs to be approached in three ways:-

- Minimising the number of used containers or weight of packaging material for disposal.
- Container decontamination by rinsing.
- Recycling or eventual disposal of used containers by environmentally acceptable methods.

Sections 2 and 3 have emphasized the care and attention needed in each of these areas.

With the increase in environmental concern relating to the disposal of used packaging generally, the agrochemical industry is addressing this problem to give clear guidelines to users for dealing with empty rinsed containers. This task cannot be accomplished by any single agrochemical

The current trends in public awareness and legislation for product liability are tending to shift the responsibility for many types of waste disposal from the end user back to the original producer.

#### 4.1 Container Rinsing and Disposal

Detailed procedures for rinsing have already been given in Appendix 1. While additional operating time is required for triple rinsing compared with the two types of pressure rinsing, it can be used in all rigid pack situations without the need for additional equipment. User education programmes need to be established to promote effective rinsing.

Where containers have not been rinsed there is any doubt over the efficacy of rinsing(eg due to the presence of significant visible residues), such containers should be stored separately from well rinsed containers prior to disposal. It may be necessary to arrange a different method of disposal for such containers taking account of local laws or regulations and local disposal facilities if any. Where specific instructions are provided on the label these should of course be followed. There are several viable methods of final disposal of used packaging. Depending on the locality, open burning of small quantities of rinsed plastic containers or carefully controlled landfill on agricultural land away from water courses may be both suitable and preferable. In some regions however such methods may be illegal. Under no circumstances should used packaging materials be allowed to accumulate as loose surface debris(litter) in rural areas. With the exception of containers which are intended for refilling with a pesticide as part of an organised and dedicated collection and return scheme under no circumstances should used containers be reused for packaging purposes or be traded in the general economy.

#### 4.2 Container reuse

A large proportion of packaging for solid and liquid formulations is designed for single use and should discourage re-use once emptied and rinsed. Features of the pack design which associate them with food or beverage containers should be avoided to reduce the risk of mistaken identity.

The practice of re-using containers is not recommended and is forbidden by most registration and regulatory authorities(apart from the approved packs designed for multi trip use)

#### 4.3 Recycling/Energy Recovery

Attention has been given to the disposal of empty pesticide containers in countries throughout the world. Disposal instructions on labels must stress the need to drain the contents completely and properly rinse packaging which has contained pesticides. Methods of subsequent disposal then depend on recommendations in force in particular countries and are usually stipulated by national registration or health and safety authorities and endorsed by the agrochemical industry.

The simplest methods are to burn or bury the rinsed containers on the farm or smallholding under recommended, carefully controlled conditions such as are currently included in the UK Ministry of Agriculture/Health

In other countries (eg. USA and Canada) efforts are being made to recycle container materials such as steel and plastics but the economics of these activities are questionable, both in financial and energy balance terms. European legislation might eventually permit thermal recovery of plastic agrochemical containers (HDPE, PET, Co-extruded but not PVC) all of which have a high calorific value when using Municipal Waste to Energy Plants operating at 850 C or above and meeting the stringent European Community standards for effluent gas discharges.

Other alternatives are to use the containers as fuel for cement kilns, burning at 2000 C. Any ash residue is neutralised in the cement clinker. Trials have been successfully carried out in the USA and Italy with no harmful emissions. This could well become the preferred method of disposal where viable collection schemes exist.

Whilst it might take a while for newly developed countries to adopt these methods and standards there is growing interest and commitment to safe pack disposal in such countries as Brazil and Mexico.

## Rinsing methods

The three main methods are :

### (a) Manual

- usually known as "triple rinsing" to indicate that the operation should be carried out three times with three portions of clean water (each portion 10-25% of container volume). The pack is drained for 30 seconds on emptying, clean water is added, the closure refitted and the container shaken or rolled to rinse all internal surfaces. The final rinsate is drained for 30 seconds before refitting the closure.

### (b) Integrated Pressure

- requires purpose built equipment attached to or adjacent to a crop sprayer which diverts clean water at 3-5 bar pressure into used containers inverted over a rinsing nozzle and then collects the rinsate for piping into the spray tank. Although suitable for rinsing both rigid and flexible containers which may have contained solids or liquids, it is a prerequisite that the minimum opening (bore) of the container neck is not less than 39mm diameter. This is essential to permit insertion of the rinsing nozzle which is 35mm in diameter. *Closed transfer systems* normally include a facility for integrated pressure rinsing of non refillable containers as a standard feature.

### (c) Pressure

- pressurised water is delivered via a hosepipe through the container neck or alternatively a device is fitted to the hosepipe which is capable of penetrating the base of containers to create a "straight through" method of rinsing.

Each of these techniques requires the use of clean water (not diluted working spray mixtures) to achieve effective rinsing. Further details are given in the European Crop Protection Association (ECPA) Guidelines for Rinsing Agrochemical Containers (6).

No attempt should be made to rinse containers where the product is not designed for mixing with water, such as dustable powders (DP) and ultra low volume liquids (UL). Where the product is diluted in organic solvent prior to application, eg oil miscible liquids (OF) and oil dispersible powders (OP), it may be possible to rinse containers with the diluting solvent. However this should not be done without a prior and detailed assessment of *hazards* which may arise. In particular the electrical safety of any equipment, including any static hazards, must be thoroughly reviewed. If the solvent cannot be safely vented from the container or presents a greater hazard than the pesticide being used, then rinsing should be avoided.

## GIFAP RECOMMENDATIONS FOR ONE-WAY AGROCHEMICAL PACKAGING DESIGN CRITERIA FOR LIQUIDS AND SOLIDS

### Forward

These recommendations have been prepared to help ensure that agrochemicals are packed in such a way as to present a minimum risk to people and the environment. They have been prepared by a working group of specialists with extensive experience in the field of packaging with the intention of helping those involved in the various stages of pack procurement (e.g. design, selection, testing, approval, purchasing). They will also be of help to national authorities and international organisations.

In these recommendations the word **must** is used to indicate the minimum industry standard acceptable and the word **should** to indicate proven good practice.

### 1. Basic requirements

- must comply with all legal requirements where these exist.
- must comply with transport regulations and pass UN performance tests where required.
- must minimise the possibility of operator contamination in opening, transferring, reclosing and rinsing.
- primary pack should not exceed 25 kg/20 litres for manual handling by one person.
- packaging concept should utilise a chemical-specific standardised pallet (e.g. 1000 x 1200mm)
- should drain well and allow easy and effective rinsing to maximise product residue removal.
- should not resemble food or drink packaging
- must be identified as pesticide packaging (e.g. by appropriate labelling)
- should be difficult to counterfeit
- should offer a simple method of quality control
- should facilitate simple and environmentally sound management of post consumer packaging waste
- consideration should be given to the need for separate or integral measure facility or graduated scale

### 2. Container

- must be physically adequate to withstand the required filling, transport, storage and use mode
- should have no sharp edges or projections on container or closure
- external rims or recesses should not trap product during or after pouring: otherwise ancillary dispensing devices may be needed
- should stand up without falling over
- pack must be product tight
- ratio of pack material to product volume should be minimised especially for solids
- should be usable for as many different products as possible with standardised and modular formats
- empty packaging material should occupy minimum storage space

- for liquids the container opening must be large enough to permit plug-free pouring with minimal dripping or splashing
- where a 63mm neck is used it should be consistent with agreed ECPA industry standard

### 2.1 Handle and/or suitable recess in base for large containers

- should be provided for rigid packs of more than 5kg
- should be isolated from the contents (vapour/liquid phase)
- should be large enough for a gloved hand
- should be easily gripped when wet

### 2.2 Closure

- must be leakproof
- re-closure must be safe and liquid-tight
- closure must be removable with gloved hands, preferably without tools
- must be difficult for children to open
- should be tamper evident

### 2.3 Packaging Materials

- must be inert to contents
- must be an effective barrier against diffusion and migration (1)
- materials must be selected with recyclability and/or disposability in mind
- material should be identified by a coding system
- fragile and potentially hazardous materials should be avoided

(1) water soluble packs must be packed in waterproof outer packaging

## 3. Labels and printing

- materials and printing inks must be resistant to the elements, product and physical damage throughout the storage period
- must be firmly attached to the containers
- must comply with legal requirements e.g. hazard labelling
- should be capable of being decorated i.e. by printing or labelling with adequate space for safety instructions, pictograms and directions for use and disposal etc. or for the attachment of instructions which can be referred to before opening the pack
- must survive immersion in sea water where the product category demands it

## Annex 11.4 Central Insecticides Laboratory pack approval procedures

**ANNEX I**  
**[Item 3.1]**  
**MODIFIED GUIDELINES FOR APPROVAL OF NEW/ALTERNATE**  
**PACKAGING SYSTEMS FOR PESTICIDES AND/OR THEIR**  
**FORMULATIONS**

- 1) **General** - The approval of a particular packaging system based on the satisfactory reports of tests and trials as per the guidelines given below shall be restricted to the particular pesticide, technical/formulation on which these tests have been conducted. The data generated out of these tests/trials have to be submitted to Central Insecticides Laboratory, Faridabad (CIL).
- 2) **Packaging of Newly Introducing Products**
  - a) Complete details regarding specification of primary, secondary and transport packaging system shall be furnished to CIL right at the initial stage.
  - b) For products being registered for the first time, the registrant shall undertake tests on compatibility, standard simulated transportworthiness; field trials; comparison of quality and any other tests required due to the peculiar nature of the container/system. The details of the test have been given below.
- 3) **Modification of Packaging or Introduction of New System of Packaging for the Existing Products** - Field trials shall be necessary if highly and moderate toxic compounds are being considered for modification of existing packaging or introduction of new (alternate) system of packaging. However, the field trial shall be done either at Indian Institute of Packaging (IIP), Central Insecticides Laboratory (CIL) or any other laboratory recognized by the Bureau of Indian Standards (BIS)/ Department of Science and Technology, Ministry of Science and Technology, Government of India (DST) in consultation with CIL.
- 4) **Tests** - The details of the tests are:
  - 1) **Compatibility**  
 This test shall be carried out by an independent laboratory as recognized by BIS/CIL/DST. In case, compatibility has already been established, this test need not be carried out.



- ii) Standard Simulated Transportworthiness Test - This test shall be carried out as per the relevant Indian Standard(s), wherever available and shall be conducted by IIP, CIL or any other BIS/DST recognised laboratory.
  - iii) Field Trials - Field evaluation on at least three selected locations by transporting the package system, shall be done by IIP, CIL or any other BIS/DST recognised laboratory in association with CIL. The locations shall be selected to adequately represent the different climatic conditions (temperature/humidity etc) as prevalent in India. The quantum of consignment, mode of transportation, location of destination etc shall be decided by IIP or the particular laboratory in consultation with the manufacturers and CIL.
  - iv) Comparison of Quality - For the purpose of comparison of quality of initial and transported product with reference to the requirements given in the relevant Indian Standard, samples shall be drawn at the start and also from the final destination during the field trials. Samples shall be drawn by the team consisting of the representatives of the manufacturer, IIP and CIL as involved in conducting the field trials. One set of samples is given to the manufacturer or independent laboratory and the other to CIL for carrying out the ~~comparative tests~~.
  - v) Any other test required due to the peculiar nature of the container/system to be also carried out. This will be ascertained/confirmed by IIP or CIL.
- 5) Requests for introduction of modification of existing/addition to the existing/totally new packaging systems in the relevant Indian Standards shall be made to BIS only after obtaining approval of CIL (which shall be given after all the tests detailed above have been completed).
- 6) If the Packaging of Pesticides Subcommittee (FAD 1:1) of BIS feels necessary to conduct the field trials on any proposed system of packaging, the field trials may be conducted by CIL. Field evaluation at 3 selected locations by transporting the packaging system shall be done by CIL in collaboration with the manufacturer/formulator. The locations shall be selected to adequately represent the different climatic conditions (temperature, humidity etc.) as prevalent in India. The quantum of consignment mode of transportation, location/ destination etc. shall be decided by CIL in consultation with the manufacturer/formulator.

**Annex 11.5 Bibliography**

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- 7 GIFAP Recommendations for One-way Agrochemical Packaging Design Criteria for Liquids and  
Solids Revised February 1995 (Copy included as Appendix 2 in Annex 11.3 of this report)

UNIDO COMMENTS

The expert's report No 1 on packaging requirements for pesticides is a concise document covering all aspects related to packaging of hazardous materials. While Indian pesticide industry is marching towards globalization, its packaging standards are very much below international standards. Again as pointed out by the author, there are so many formulators that there is no way of standardizing packaging materials and sizes.

The various recommendations made in the report should be looked into and necessary action taken during the life time of the project to improve the national standards. Previous reports on this subject did recommend strengthening IPFT packaging department and linking it with the Indian Institute for Packaging located in Bombay.

If IPFT is to become a national centre of excellence in pesticide packaging it can easily assist pesticide industries to meet the standards.

UNIDO could discuss with FAO regarding updating of their Pesticide Packaging Guidelines. Before the completion of the project IPFT should organize a national seminar/workshop on pesticide packaging.

The report should be combined with other two reports submitted by Mr. M. Harmer and Mr. K. Johnson.