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STRENGTHENING OF PESTICIDE DEVELOPMENT CENTRE

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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 C. M. Harmer, consultant on
operational safety with pesticides including warehousing*

Backstopping Officer: B. Sugavanam
Chemical Industries Branch

United Nations Industrial Development Organization
Vienna

* This document has not been edited.

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1. SUMMARY:

The report outlines the work completed during the second and final phase of a commission initiated by the Institute of Pesticide Formulation Technology (IPFT) and designed to improve safety standards within the pesticide formulation industry in India. This included the completion of a Safety Manual for use within the industry country-wide and the organisation of training workshops in order to provide first-hand input to plant staff, on safety related issues.

To meet these demands, this second phase of the commission was attended by three UNIDO appointed experts, namely:

- MR. K. S. JOHNSON - Effluent Treatment and Waste Disposal
- MR. A. H. GREGORY - Packaging of Formulated Pesticides
- MR. C. M. HARMER - Operational Safety, including Transport and Storage.

2. RECOMMENDATIONS:

2.1 That final publication of the IPFT Safety Manual be expedited as soon as possible and its circulation supported fully by the Pesticide Association of India (PAI).

2.2 That the contents of the Manual be the subject of debate within local pesticide industry association meetings, with the object of encouraging self-assessment leading, where appropriate and necessary to a further improvement in the standards of operation in formulation plants.

2.3 That, with the support and encouragement of the PAI, the IPFT Centre at Gurgaon be identified as a meeting point for train-the-trainer courses on specific issues addressed by the Manual.

3. INTRODUCTION:

The commission was designed, essentially, as a follow-up to a previous visit, in November 1993, when work began on the preparation of a Manual, to be published by IPFT. In addition, arrangements were made to extend the safety training programme, started at Ankleshwar in 1993, to other centres of pesticide formulation activity, elsewhere in India. To this end, IPFT arranged a series of one and two-day workshops in Ahmedabad, Bombay and Hyderabad, in conjunction with representatives of the local industry associations. A total of 134 delegates from the formulation and manufacturing industry attended these workshops which, together

with the first such event, at Ankleshwar, means that almost 200 senior and middle managers from the industry have now taken part in the discussions.

Opportunities were made to visit the VOLTAS plant, near Bombay, and the laboratories of the Central Insecticides Board, at Faridabad. The matters arising from these visits, together with the outcome of the workshops and details of the work done to finalise the IPFT Safety Manual, are discussed in the paragraphs which follow.

Since this commission was very much complimentary to that fulfilled in 1993, readers of this report may find it helpful to cross-reference with the report of the earlier visit, prepared by C. M. HARMER and dated December, 1993.

4. TRAINING CUM MEET ON INDUSTRIAL SAFETY, EFFLUENT TREATMENT AND PACKAGING IN THE PESTICIDE FORMULATION INDUSTRY:

4.1 Locations and Attendance:

4.1.1 Hotel Rivera, Kanpur, Ahmedabad - in collaboration with the Gujarat Pesticide Formulators' Association - 30 delegates in attendance.

4.1.2 World Trade Centre, Bombay - in collaboration with the Pesticide Formulators Association of India - 81 delegates in attendance.

4.1.3 Hoechst India Limited, Bombay - in collaboration with the Association of Basic Manufacturers of Pesticides (ABMP), Bombay - 23 delegates in attendance.

4.1.4 Viceroy Hotel, Hyderabad - in collaboration with the Pesticide Association of India - 18 delegates in attendance.

4.2 Content of Safety Input:

The safety input at each workshop included the following titles:-

- (i) Developments in legislation
- (ii) Dust and vapour control
- (iii) Safety in the handling of flammable powders
- (iv) Safety during the storage and transport of pesticides.

4.2.1 Developments in Legislation: Summary of Content.

On the basis that the framework of industrial legislation in India closely parallels that of Western Europe, as evidenced by the titles of current

statutes, e.g. Factories Act, Environmental Protection Act, etc., the input was concentrated on the changing format of legislation, today, which lays emphasis on the broader responsibilities of industry within the community. Thus, while the employer's duties are concerned, in the first instance, with the safety of operations within the plant, the Environmental Protection Act and legislation concerned with the control of major hazards, for example, underlines the need to consider also the impact which such operations may have on the general public and the environment at large.

Stress, too, was laid on the importance of the industry being able to demonstrate its commitment to safety by the development of codes and practices in support of its role within the community. The self-imposed inspection scheme for the safe storage of pesticides in the U.K. (the British Agrochemical Standards Inspection Scheme, or BASIS) developed jointly by the formulators' and distributors' trade associations, was outlined as an example of one such initiative. Also, the Fire Liaison Panel, chaired by the British Agrochemicals Association (BAA) and with representation from the industry, emergency services, water and environmental services and the Regulatory Authority, has shown the value and benefit to be obtained from the establishment of such links.

In the broader term, the examples as outlined, above, may be seen as constituting a duty of care, very much in keeping with the principle of Responsible Care adopted by chemical industries in the U.S.A., Canada and West Europe.

4.2.2 Dust and Vapour Control:

The input on this subject concentrated on those design features of local exhaust ventilation systems which are essential to good performance, yet seem not to be well understood by many plant staff and, sometimes, even by the designers of such equipment. These include: the design of enclosures for the collection and containment of dusts and vapours at the point of generation, and bends, junctions and expansion or contraction joints in the ducts used to transport contaminants away from the working area. It was pointed out that, given a basic understanding of the subtleties of good design, it is neither more difficult nor more expensive to construct these items properly, than to make them to an unsatisfactory design which can only reduce the efficiency of the system's performance.

4.2.3 Safety in the Handling of Flammable Powders:

This part of the presentation concentrated on the principal factors involved when determining the flammability and sensitivity to ignition of organic powders, as well as other criteria which influence their ignition and the means by which plant and people can be protected from such hazards.

There followed an explanation of the term Minimum Ignition Energy (MIE) and the significance of particle size and dust concentration, as contributing factors to the occurrence of dust explosions.

Potential sources of ignition were outlined with particular reference to the hazard, in this context, of static electricity.

The presentation concluded with an explanation of the means to prevent dust explosions or to protect plant against such risks and their consequences.

4.2.4 Safety in the Storage and Transport of Pesticides:

The experience of one major incident was used to illustrate the hazard to the aquatic environment from fires involving pesticides. Moreover, because the risk of fire can never be wholly eliminated, the importance of pre-planning in order to control such risks was seen as paramount. Aside from their direct consequences, such incidents present a threat to the reputation of the industry and demand a positive response if further unwanted criticism is to be avoided.

An example was also given of an industry initiative whereby accidents occurring during the transport of pesticides can be better controlled by establishing effective communications with the emergency services.

4.3 Discussion:

With some notable exceptions, the author found it difficult to encourage open discussion within the groups of delegates but interest was clearly demonstrated by the enquiries made on a one to one basis, outside the formal sessions.

Dealing with each of the main headings, in turn, the concerns raised by the delegates and the author's comments may be summarised as follows:-

4.3.1 Legislation and the Development of Voluntary Codes and Practices:

It was encouraging to note that the Association of the Basic Manufacturers of Pesticides (ABMP) had already taken steps to establish what might properly be described as a Stewardship Programme, aimed at better farmer education by the means of train-the-trainer programme. Additionally, the same Association have promoted other initiatives, including:

(i) the provision of support to medical services in the form of information and antidote kits, made available to doctors and hospitals.

(ii) driver training by means of a video package on safety during the transport of pesticides, including the steps to be taken in the event of a transport emergency.

(iii) the issue of safety kits, containing instructions and personal protective equipment, to regular drivers.

(iv) communication with police services along those routes used regularly for the delivery of pesticides to the main distribution centres. The use of TREMCARDS was also mentioned in this context.

Clearly, such initiatives should be applauded and extended wherever possible and practical. In this respect, emphasis was laid on the role of trade or industry associations and the part which they can play in promoting industry links with outside authorities. How and to what extent this can be done is a matter for debate within each association with, it is suggested, an overall co-ordinating role being provided by the Pesticide Association of India.

It was stressed that any developments of this nature can only be seen as long term projects. However, experience elsewhere, for example, the schemes mentioned earlier which have been successfully developed in the U.K., under the auspices of the British Agrochemicals Association has shown that they can contribute to the more effective control of incidents and, at the same time, enhance the reputation of the industry as a responsible body.

In essence, it is also a recognition of the fact that, in the event of an accident occurring in any circumstance, there will be an inevitable interdependence between the representatives of the industry and the external authorities, necessary if such incidents are to be handled safely and with the least possible danger to people and the environment.

4.3.2 Dust and Vapour Control:

This subject was selected for debate because, as evidenced by the less than satisfactory design of local exhaust ventilation systems seen in so many plants in numerous countries, it is generally not well understood. The deficiencies may arise from a lack of understanding of the laws governing air movement but it is a fact that many such systems cannot, by virtue of their poor design, work well, if at all.

Weaknesses in design seem for the most part, though not exclusively, to relate to the construction of dust and vapour collection hoods and the trunking used to carry contaminants away from the working area. In many cases, the modifications needed to achieve a significant improvement in system performance are neither complex nor expensive. This presumes, of course, that the extraction capacity of the system is adequate, in the first instance.

Although the information provided during the presentation was necessarily brief, and designed only to stimulate initial interest in the subject, further details will be

provided in the Operational Safety Section of a new Manual to be published by the Institute of Pesticide Formulation Technology (IPFT).

It was emphasised, however, that the information to be provided could not be considered adequate for the design of complete local exhaust ventilation systems, nor was this the intention. Conversely, by drawing attention to certain basic elements of good design, it should allow plant managers and engineers to assess existing systems, or the design criteria for new systems, in an informed manner and thus identify and rectify the design weaknesses.

4.3.3 Safe Handling of Flammable Powders:

Considerable interest was generated by this part of the presentation, the subject matter of which appeared to be generally not well understood.

As in the case of Section 4.2, above, the presentation merely provided the means by which to stimulate interest and, again, further and more detailed information on the subject will be contained in the forthcoming IPFT Manual.

The extent to which the explosion protection of plants handling powder formulations in India will be necessary, remains unknown. It will depend on an assessment of the flammability and sensitivity to ignition of the materials involved. For technical materials, flammability data should be available from suppliers but, where this is not forthcoming, or in the case of formulations, it should be noted that two centres of expertise are available in Bombay. Both of these laboratories are understood to provide a contract service, by means of which samples of product can be tested and the necessary data generated.

When raising the issue of static electricity as a potential source of ignition, cross-reference was made to MR. V.N.DUTTA's paper (IPFT) on the same subject. Both stressed the importance of ensuring that the conductive elements of all plants used to process flammable materials, whether powders or liquids, must be effectively earthed. The extreme danger of allowing any conductive material to become insulated from earth was stressed and any subsequent plant maintenance or modifications which could conceivably interrupt the earth path, must be carefully monitored. Further advice on earthing standards will be contained in the IPFT Manual.

The flammability of mancozeb was raised as a specific issue by several delegates and, in this case, a distinction was drawn between the explosion hazards of flammable dust clouds and the separate risk of flammability within the mass of powder, generated spontaneously. In the latter respect, the peculiar properties of dithiocarbamates were discussed against a background of experience involving the spontaneous combustion of these products, chiefly maneb and to a lesser extent zineb. The importance of using only high grade technical material in order to combat this risk, was stressed. Emphasis was also laid on the need to quarantine

freshly processed product, until it can be certain that no incipient heating is taking place. This is generally done by stacking the freshly processed material in small lots, allowing access between each lot in order to monitor the temperature of the product. Freshly processed product should not be moved from the quarantine area until it is clear that it is safe to do so; moreover, formulated product must not be left in the bulk state, that is, in a mixer, hopper or bulk container where, due to its reduced ability to lose heat when held in a large mass, the risk that spontaneous ignition may occur, will be much increased.

5. PREPARATION OF THE IPFT SAFETY MANUAL:

This was a major project undertaken by IPFT, the object being to provide a reference on safety and environment related issues, for use throughout the pesticide formulation industry in India and, possibly, in neighbouring countries in the region.

When published, the Manual will provide a distillation of the experience gained by its authors over a period of many years in the industry, including the lessons learned as a consequence of some of the major incidents that occurred during those years.

Given the will to learn, the Manual should be especially useful to the smaller and medium sized operators in the formulation industry. Even in the case of some of the larger formulators, however, the Manual may also prove helpful. For without wishing to appear overly critical, the evidence gained from visits to some factories, made during the commission, revealed a gulf between some of the standards of operation observed in India and those seen elsewhere.

Such criticism does not imply any perceived lack of goodwill on the part of the many people with whom discussions were held during the visits. Rather, it suggests the existence of a technology gap, exacerbated by economic considerations, which is to blame. The ultimate aim must be to overcome any differences in standard and this is a view clearly shared in common with IPFT, as well as the representatives of many of the companies and industry associations with whom discussions were held.

Some, at least, of the issues considered in the Manual can only be progressed through the good offices of the PAI, as well as the affiliated regional associations, in the country. For whereas many of the topics covered by the Manual can be pursued by individual companies, in order to improve standards within their own operation, participation on an industry basis will be fundamental to the implementation of the other matters, for example, improvements in the areas of storage and transport, where activities are largely external to the factory premises.

The current commission will see the completion of the Manual, in its first draft, and proof-reading can be done on a home-base, in what remains of the author's contracts. Thereafter, it will be the responsibility of the IPFT, at Gurgaon, to arrange for printing and publication, at the earliest moment.

6. ISSUES ARISING FROM FACTORY VISITS:

Although there was opportunity to make only one factory visit, the combined experiences of this visit, together with others made during the earlier commission, underline certain fundamental weaknesses of design and practise.

6.1 Flameproofing Standards in E.C. Plants :

This was an area of weakness and concern. Of the six factory visits made during the two commissions, potentially hazardous situations in flammable liquids plants were observed in no less than three locations. These were, of course, pointed out to the managers concerned but examples included :-

- (i) the use of non-flameproof cable glands in flameproof equipment.
- (ii) the use of minor items of non-flameproof equipment, for example torches, in an otherwise flameproofed plant.
- (iii) the inadequate segregation of flameproof and non-flameproof areas within the same building.

In all of these cases, the plants concerned had clearly been equipped initially with electrical equipment of flameproof standard and the weaknesses observed had most probably been introduced subsequently, as a consequence of a lack of understanding of the flameproofing requirement, or inadequate maintenance.

In what was perhaps the worst example, a naked electric light bulb had been installed within the plant to provide a visual indication that the telephone in the adjoining supervisor's office was ringing. This totally negated the flameproof standard of the plant, which was handling solvent within a flashpoint of 35 degrees centigrade in an area of the country where it must be assumed that ambient temperatures of the same order could exist in the summer months. The office itself, moreover, contained non-flameproof equipment, including the telephone, and was connected to the working area by a door which was likely to be more open than closed.

In the same plant, a non-flameproof hand torch had been provided with which to examine the inside of formulation vessels, through the inspection hatch!

All of these points were noted during a very quick, almost cursory examination of the plant, leading to the inevitable conclusion that the management concerned could not have appreciated the fundamental importance of flameproofing to an exact standard.

In later discussions it also became clear that in the matter of the relationship between ambient temperature and flash-point, no allowance was being made for the inevitable variations in the latter figure which can arise when different samples of the same flammable liquid are tested. When relating ambient temperature to flash-point, a margin for safety must be allowed by deducting at least 5 degrees centigrade from the stated flash point.

Although time did not permit the flameproofing issue to be adequately addressed during the training workshops, further details will be included in the Safety Manual. The purpose in mentioning the subject here is simply to underline its importance, in the belief that the examples quoted above seem unlikely to be unique and may be repeated elsewhere, in other formulation plants.

6.2 Standards of Local Exhaust Ventilation in Formulation Plants:

The combined series of plant visits revealed both good and bad examples of local exhaust ventilation equipment and the subject was addressed at each workshop and will be dealt with in more detail in the forthcoming Manual.

The failure to appreciate the subtleties of design in local exhaust ventilation systems, that is to say, the finer but essentially simple design features which affect the efficiency of such systems, is not peculiar to the industry in India. Similar shortcomings have been witnessed by the author in many countries, both developed and developing, and, in every case, this may be said to represent the basic lack of understanding of the laws governing the movement of air by induced ventilation, that is, by suction.

Since the subject will be covered in some detail in the Safety Manual, it is sufficient here simply to underline its importance to the maintenance of good plant hygiene standards and the protection of the health of workers and plants handling potentially hazardous substances.

7. VISIT TO THE LABORATORY OF THE CENTRAL INSECTICIDES BOARD, AT FARIDABAD:

Discussions with MR. V. C. BHARGAVA and some of his senior staff, fell somewhat short of expectations, the emphasis being focussed on the work of the laboratory, with seemingly little effort being made to extract maximum benefit from the experience of the visiting specialists.

Much of the discussion revolved round the packaging issue and the obvious implications which this has for safety and, in this context, concern was expressed over the design of one pack, in particular, which it was understood was being developed for use with emulsifiable concentrates.

In the considered opinion of all three visiting experts, this pack exhibited obvious disadvantages and, under field conditions, could even be hazardous to the user.

Designed with the object of preventing its being used for other purposes, the pack could only be opened by puncturing the end of the tinsplate container, at the point of use. The fact that a special tool (not seen) was required for this purpose, was in itself a contradiction of FAO Rules, which demand that all sales packs containing pesticides must be capable of being opened without the aid of such devices.

Once opened, the container can not be re-sealed and, notwithstanding the claim that by making the container available in a wide range of sizes, to accommodate all requirements on a single dose basis, it was difficult to believe that there would not be occasions when users would attempt, somehow, to seal the can and some of its contents for future use. Moreover, by its very nature, a hole or holes punctured in the top of the container, would make efficient rinsing and draining very difficult.

Whether these views, expressed at the time, will have any impact on the design or future use of this pack, remains to be seen.

8. CONCLUSIONS:

(i) That the objective of completing the initial draft of the IPFT Safety Manual may now be considered to have been met in full and any work remaining in order to achieve final publication of the Manual can be fulfilled by staff at IPFT.

(ii) That thanks to IPFT, the recommendation of the previous report, namely, that further workshops be organised on the pattern of the Ankleshwar Meet, has been progressed in a very satisfactory manner.

(iii) That some of the concerns expressed during the initial commission, regarding the standards observed in some formulation plants, for example, flameproofing standards, were further supported by observations made during this visit and underline the need for the sort of guidance which will be provided by the Safety Manual.

(iv) That the workshop discussions would have benefited from the attendance of delegates from external authorities, for example, the Factory Inspectorate, as was the case at Ankleshwar.

(v) That the continued input of the PAI and its affiliated associations, in conjunction with IPFT, will be essential to the overall improvements of standards within the formulation industry in India. For if the author may be permitted a quotation from the words of Lord Krishna, it would be to say that:

'Whatever a great man does, that very thing other men will do. Whatever standard he sets, the generality of men will follow the same'.

These words summarise, succinctly, both the challenge and the solution to what lies ahead.

9. ACKNOWLEDGEMENT:

The author acknowledges with gratitude the help so willingly provided by members of IPFT, RENPAP-UNDP and the many people whose acquaintance he made during the course of the commission.

**C. M. HARMER
02.95.**

UNIDO COMMENTS

The report No. II which deals with operational safety including transport and storage concentrates on national perspective but applicable to all developing countries because the majority of accidents happen during storage and transport.

The safety manual to be published by IPFT should be an extension of UNIDO global guidelines on pesticide formulation in developing countries. The report highlights the importance of coordination and mutual trust between IPFT and the industry associations to be successful in implementing safety issues. IPFT being used as the training place for the trainers would be very advantageous to the pesticide industry.

The author's note on the initiatives taken by the Basic Manufacturers of Pesticides, clearly indicates that there is great awareness to safety both at the production and user ends and also at the transport, loading/unloading and storage interfaces.

The safety manual mentioned by the author should go as a supplement to UNIDO guidelines so that this could be made available as a worldwide publication and should be cleared by UNIDO before publication.

This report should be linked to the reports I and III in order to make it a comprehensive document.