



Farm Management

Handout 8

Pesticide Storage and Stock Control

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3



Pesticide storage and stock control manual



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**Pesticide
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Foreword

This manual was prepared by the Food and Agriculture Organization of the United Nations (FAO) under project GCP/INT/572/NET: "Prevention and Disposal of Unwanted Pesticide Stocks in Africa and the Near East", funded by the Government of the Netherlands. It was written by the National Resources Institute (NRI), Chatham, United Kingdom, with added and editorial input from the FAO Plant Protection Service (AGPP). All the drawings were contributed by an NRI graphic artist.

Despite the limited geographical scope of the project, the manual is considered applicable and useful in many countries, particularly in the management and stock control of stored pesticides.

It had been published for distribution to Member Countries of FAO. In view of the fundamental importance of pesticide management, it would be useful to have feedback that could be used in future revisions of this manual. Reference should also be made to FAO's *Provisional guidelines: prevention of accumulation of obsolete pesticide stocks*, published at the end of 1995, and *Technical guidelines on disposal of bulk quantities of obsolete pesticides in developing countries*, a joint FAO/UNEP/WHO publication expected in 1996. Comments or suggestions may be addressed to:

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Abbreviations

DLCOE-A

Desert Locust Control Organization for
Eastern Africa

ec

emulsifiable concentrate

FAO

Food and Agriculture Organization of the
United Nations

GIFAP

International Group of National
Associations of Agrochemical
Manufacturers

ILO

International Labour Organisation

LD₅₀

the dose of a substance that causes death in
50 percent of a sample of test animals

NRI

Natural Resources Institute

OP

organophosphate

PVC

polyvinyl chloride

UNEP

United Nations Environment Programme

WHO

World Health Organization

wp

wettable powder

Introduction

Most pesticides are chemicals that are used to kill pests. Among these are insecticides, fungicides, herbicides, nematicides, rodenticides, acaricides and molluscicides, which are used to kill, respectively, insect pests, fungal diseases, weeds, nematodes, rats and mice, mites and ticks and snail disease vectors. They may also kill other organisms, and most are poisonous to humans.

The World Health Organization estimated (WHO, 1986) that 1 million people are affected by insecticide poisoning every year and that 20 000 die as a result of being unaware of the risks involved in handling insecticides. Pesticides are classified by WHO on the basis of their oral or dermal lethal dose (LD). A measurement called the LD₅₀ is calculated by measuring the number of milligrams of active ingredient per kilogram of body weight required to kill 50 percent of a test sample of animals – often rats. Each insecticide is then put into one of four classifications: Class Ia is extremely hazardous; Ib, highly hazardous; II, moderately hazardous; and III, slightly hazardous.

Pesticides usually have to be stored before use. The following account illustrates how essential careful pesticide storage practice and stock control are, especially when extremely hazardous chemicals are involved.

The incident was recounted in 1978 by a storekeeper. He had heard that metal drums of the pesticide dieldrin (a very dangerous organochlorine which is no longer used because of its detrimental effect on the environment), had been kept for some years in a pesticide store with a leaking roof. The drum lids had partially rusted and corroded. When, in order to inspect outdated drums at the rear of the store, a storekeeper's assistant climbed up and jumped across the drums at the front, the lid of one gave way as he landed on it. The assistant plunged down into the dieldrin solution which came up to his waist. Within a few hours he had died of poisoning as a result of pesticide inhalation and absorption through the skin.

Chapter 1 Pesticide stores

CHOICE OF SITE

The site for a new pesticide store should not be close to dwellings or to hospitals, schools, shops, food markets, animal feed depots and general stores (Figure 1).

It should be faraway from water courses, wells and other supplies of water for domestic and stock animal use because these could be contaminated by spillage and leaks from the store (Figure 2).

The site should not be in an area with high groundwater levels, which may be subject to seasonal flooding (Figure 3), nor should it be adjacent to a seasonal flood course.

There should be easy access for pesticide delivery vehicles. Ideally, there should be access on at least three sides of the building for fire-fighting vehicles and equipment in case of emergency (Figure 4).

FIGURE 1
The pesticide store should be located far from human dwellings

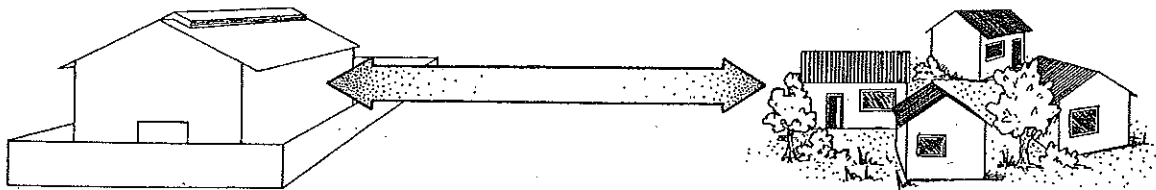


FIGURE 2
The pesticide store should be sited far from rivers and bodies of water, to prevent chemical contamination from entering and poisoning the water

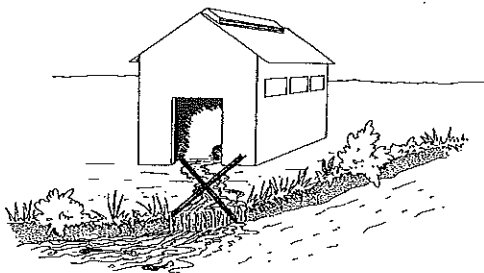


FIGURE 3
The pesticide store should not be sited in an area subject to flooding, especially during seasonal rains

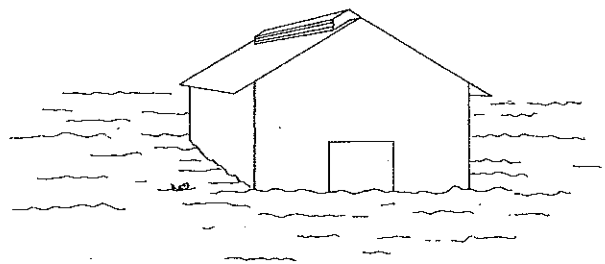
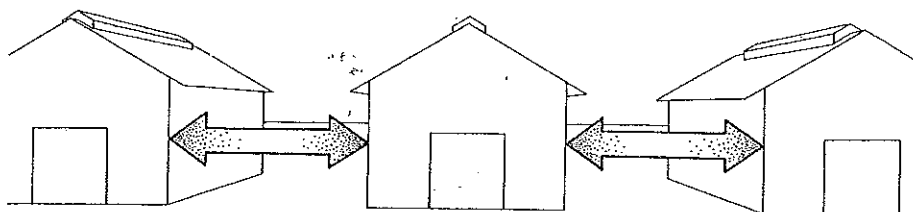


FIGURE 4
The pesticide store should have three sides free to allow access for fire-fighting equipment in an emergency



DESIGN AND STRUCTURE OF BUILDINGS

General principles

The store should be large enough to accommodate the quantities of pesticides planned for storage. A further 15 percent capacity should be included to allow for stock movement and possible future needs, in addition to space for dispensing and repacking insecticides and for empty containers. It should also be well ventilated, to prevent the buildup of pesticide vapour and to stop temperatures getting too high, especially in tropical and subtropical countries with a normally high daytime air temperature. The floors should be of smooth, impermeable concrete to avoid absorption of spillages and to allow easy cleaning (Figure 5).

Layout

The layout (Figure 6) should allow for:

- minimum handling of pesticide containers to avoid causing leaks and spills;
- direct access to the outside without passing through another building;
- a well-lit and ventilated working area for dispensing and repacking pesticides some distance from the store entrance;

- space for storing empty containers and out-of-stock awaiting disposal.

The storekeeper's office should be separate from storage area.

Washing facilities should be provided, with alternative arrangements if there is no piped water supply.

Protective clothing should be stored separately from pesticides.

Herbicides should not be stored together with insecticides or other pesticides such as rodenticides or fungicides (Figure 7) so that those that are not poisonous to humans are not contaminated by hazardous chemicals.

Structure

Ideally, the roof should be of light material, such as asbestos substitute or glass fibre, which collapses in event of fire to allow smoke and fumes to get out and to avoid explosions. The material should not be so flammable, however, that it is blown away during severe sea storms or cyclones.

The store walls should have outside sills that direct spilled chemicals into a sump.

Internal walls should be smooth and free from cracks and ledges to allow easy cleaning.

FIGURE 5

Diagram of a pesticide store showing building features, with storekeeper's office separate from the store (not to scale)

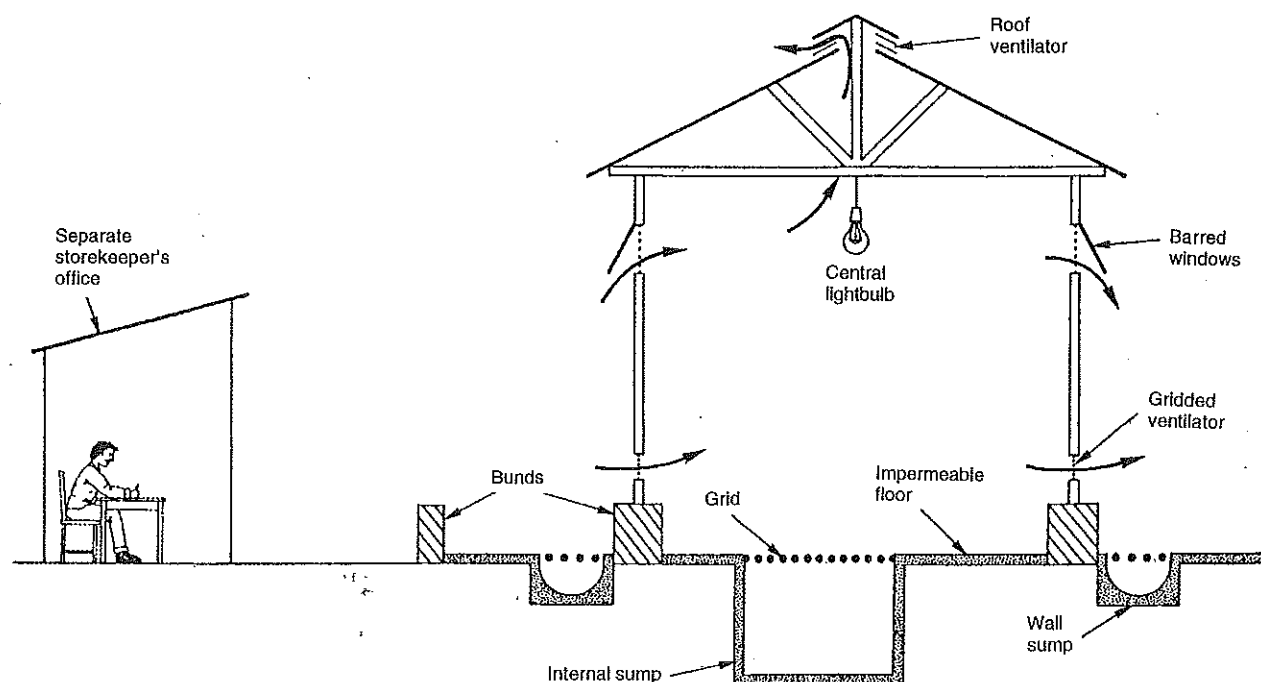


FIGURE 6
Store layout to show arrangement of facilities (not to scale)

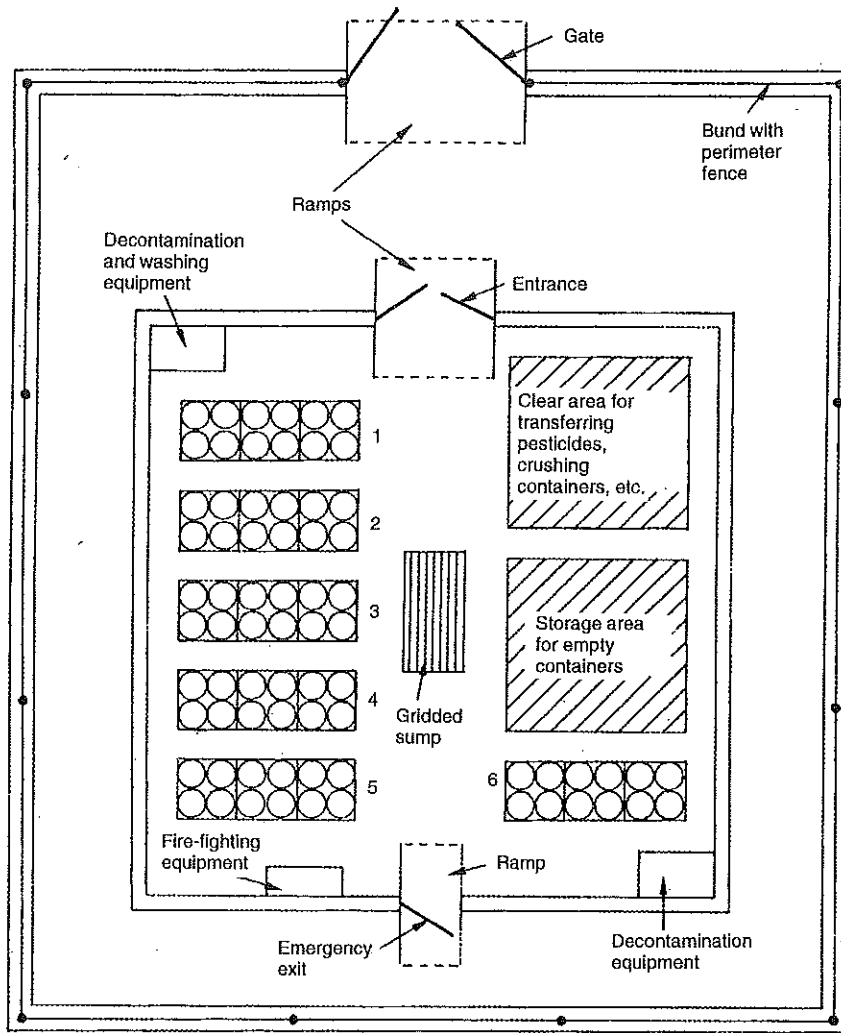
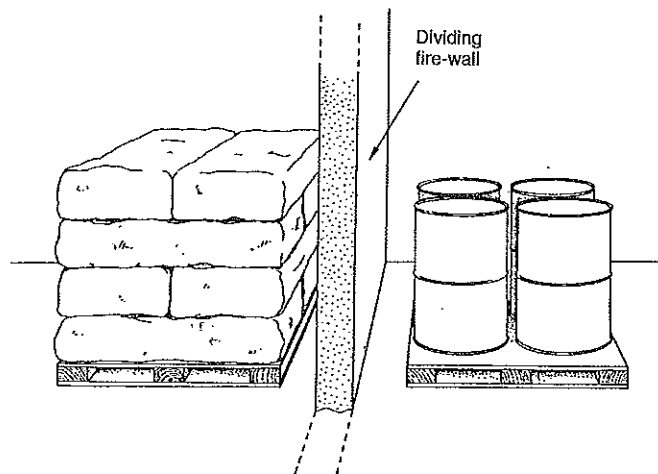


FIGURE 7
Store dividing wall separating different types of pesticides and acting as an internal fire-break



Windows should not be built if there are alternative means of ventilation and lighting; otherwise they should be shaded (to prevent sunlight from heating the chemicals and causing them to degrade) and barred against unauthorized entry.

The store should be well lit with natural or electric lighting (200 lux) to permit container labels to be read easily.

As sparks can cause fires, electrical fittings should be mineral insulated or armoured cable should be used with flame/dust-proof fittings.

The floor should be made of impervious material or of slats over a concrete-lined sump into which chemical spills can drain to be neutralized. The floor area should be slightly raised at the edges to prevent spills from leaking out of the building and floodwater from getting in. Store walls should be set on bunds, lined to a height of 14 cm with impervious material. A bund around the whole area to contain the store contents is desirable as a further precaution to reduce the risk of gross environmental contamination. Store and perimeter fence

bunds should be fitted with concrete ramps to all vehicle access (Figure 8).

A static or piped water supply, with soap, should be available for hand and face washing and for decontamination of personnel accidentally splashed with chemicals.

There should be a concrete-lined exterior sump in which spills and leaks can be directed for neutralization and removal. Contaminated water should not be allowed to enter the main drainage system or water courses, it should be directed by sills into sumps.

There should be walls between sections to act as fire breaks (Figure 9).

There should be an emergency exit in addition to the entrance doors, preferably at the other end of the store.

Ventilation is one of the most important requirements within the store as it prevents the buildup of vapour. Toxic vapours may affect the health of store-workers and inflammable vapours are a fire risk. Ventilation also keeps the store as cool as possible. This is important as pesticides deteriorate more slowly and therefore last

FIGURE 8
Pesticide store with bunding of walls and perimeter fence including ramps

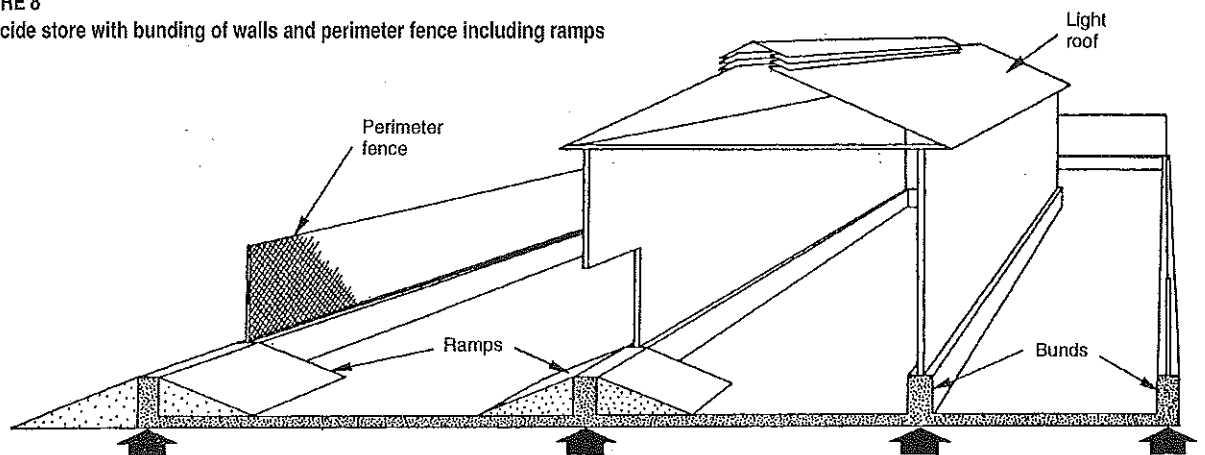
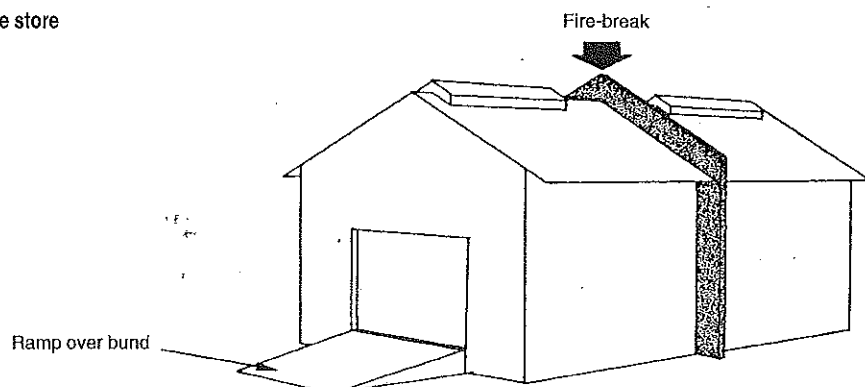


FIGURE 9
Fire-break in a pesticide store



longer in a cooler environment. Many pesticides are destabilized by high temperatures, which in exceptional cases may even cause explosions.

The ventilation area should be equivalent to 1/150 of the floor area, or outside doors should be open for at least six hours per week. Exhaust fans should be fitted to large stores, preferably on a time switch. Roof- and floor-level ventilation (gridded to prevent the entry of birds and rats) is required to extract light fumes, hot air and heavy vapours.

Temporary storage

Temporary storage of pesticides away from a main store may be required during certain operations such as locust control. The basic principles still apply: keep the pesticides secure (fenced-in or locked inside a vehicle); store them indoors or under a roof to avoid direct

sunlight exposure; keep them dry, cool and well-ventilated, especially when they are stored in a vehicle which may become hot if left in the sun.





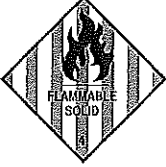
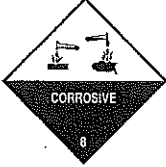



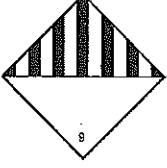
Notices

A notice should be displayed on the outside of the store in the local language(s) with a skull and crossbones sign. The notice should read: "Danger pesticides. Authorized entry only".

Strategically placed signs should be visually obvious and placed on the inside and outside of pesticide stores. These should read: "No smoking: no naked or half-dressed flame".

There should also be a list of colour codes on display in the store and on containers. Sticky labels for placing on metal and plastic containers are available. The lists in Figure 10 are included with GIFAP (1988a).

FIGURE 10
Warning signs for display in stores and on containers

HAZARD LABEL	HAZARD CLASS	METHOD OF STORAGE	HAZARD LABEL	HAZARD CLASS	METHOD OF STORAGE
	2 (In)flammable gas (red background)	Segregate; explosion-proof equipment or open-air storage needed		5 Oxidizing substances (yellow background)	Separate from flammables or combustibles
	3 (In)flammable liquids; flashpoint 55°C or lower (red background) 3 Combustible liquids; flashpoint over 55°C	Not to exceed 250 tonnes unless fire-protected Recommended not to exceed 250 tonnes		6.1 Poisonous substances (white background)	Legal requirements may demand segregation if highly toxic (LD ₅₀ oral < 25 mg/kg)
	4.1 (In)flammable solids (vertical red and white striped background)	Recommended not to exceed 250 tonnes		8 Corrosives (white and black background)	Separate from pesticides packed in metal
	4.2 Spontaneously combustible (lower half red, upper half white)	Segregate, open-air storage recommended		(White background) Various dangerous substances	
	4.3 Dangerous when wet (blue background)	Segregate; no sprinkler! protect from rain		(White and black background)	No limit; if non-combustible, use as a barrier for separation

Notes:

Inflammable and flammable have the same meaning (British and American usage).

Segregation means storing apart in different rooms with a fire-wall as barrier. Separation means storing apart in different parts of the same room.

After GIFAP, 1988.

Chapter 2 Storage of pesticides

As a general principle, systems of storage should be flexible and adaptable.

STACKING POSITIONS AND HEIGHTS

Stock should be arranged to use the oldest first ("first in – first out" principle) and to prevent obsolete stock from accumulating. Containers should be arranged to minimize handling and thus avoid mechanical damage

giving rise to leaks. Floor spaces should be uncluttered, with marked, 1-m wide, gangways between shelves or stacks (Figure 11) that permit easy inspection and allow free air flow (Figure 12). This also enables immediate clean-up in the event of any leakage or spills, which can be seen quickly. Climbing on pesticide containers to reach other containers should not be necessary – damaged or corroded metal drums can easily give way

FIGURE 11
Marked and numbered rows of stacked metal containers of pesticides with pallets below

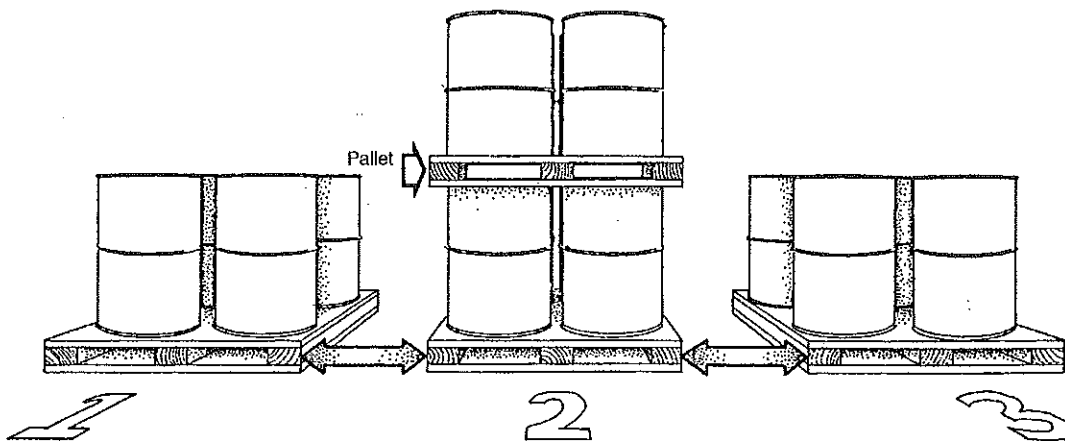
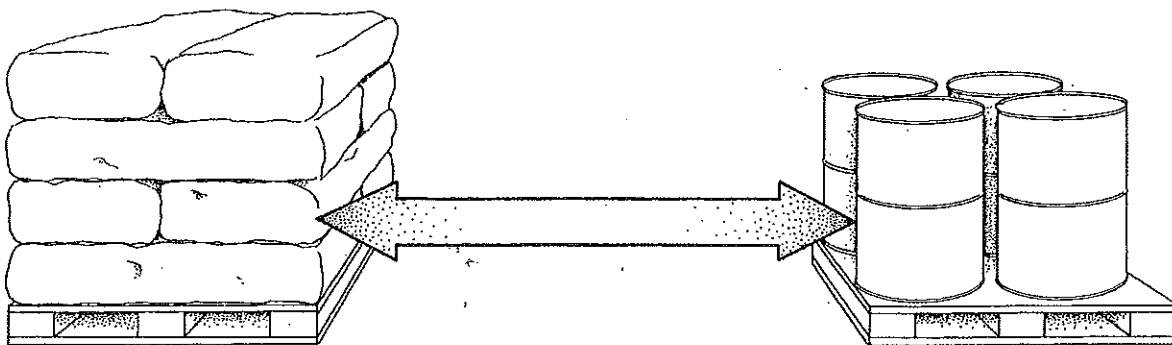


FIGURE 12
Aisle space to allow free air flow and access between rows of stacked pesticides



under a person's weight and this leads to potentially fatal gross contamination with pesticide.

Dunnage (timber and bricks) should be used so containers are not placed directly on the floor. Stacked containers should be on pallets (Figure 13). Corrosion resulting from rising damp or leaking chemicals should be promptly observed and dealt with appropriately.

Dust, granule and wettable powder formulations should be kept in cartons during storage to avoid caking. Concentrate formulations, especially those in glass bottles, should also be kept in cartons to avoid breakage.

Storage shelves should not exceed a height of 2 m to avoid the use of ladders.

Containers should not exceed a height of 107 cm on each pallet. Containers and cartons should be stacked at safe heights ensuring that they are stable (Figure 14). The safe height depends on container material (Table 1).

TABLE 1
Maximum stacking of containers on top of each other

Package type	Number of layers on basal pallet	Palletized: number of packages on each pallet ¹
Steel drums (200 l)	1	3-4
Steel drums (smaller than 200 l)	2	3-4
Fibre drums (200 l)	1	3
Fibre drums (smaller than 200 l)	2	3
Plastic drums (200 l)	1	2
Plastic drums (smaller than 200 l)	2	2
Paper sacks	4-5	3
Plastic sacks	4-5	3
Fibre case containing tins	4-6	3-4
Fibre case containing soft packages (plastic bottles, sachets)	4-6	2
Wooden cases	2-4	3-4

FIGURE 13
Outside storage (temporary) of pesticides with perimeter fence and arrangement of pallets similar to that inside

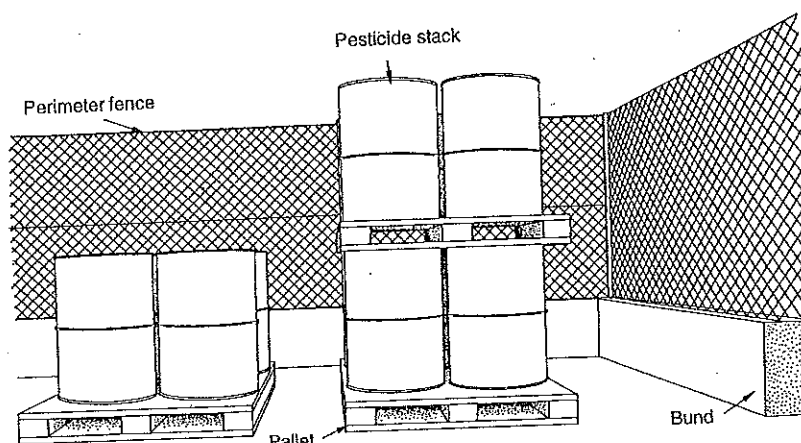
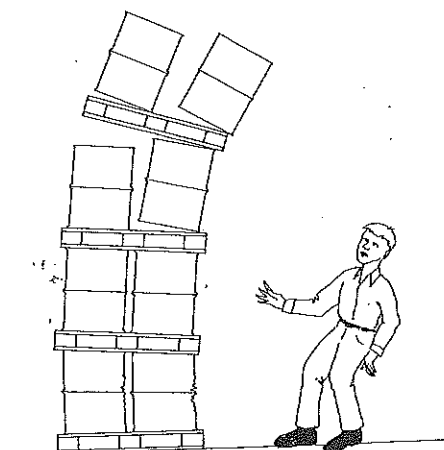


FIGURE 14
Stacks that are too high become unwieldy and containers lower down are crushed



Chapter 3

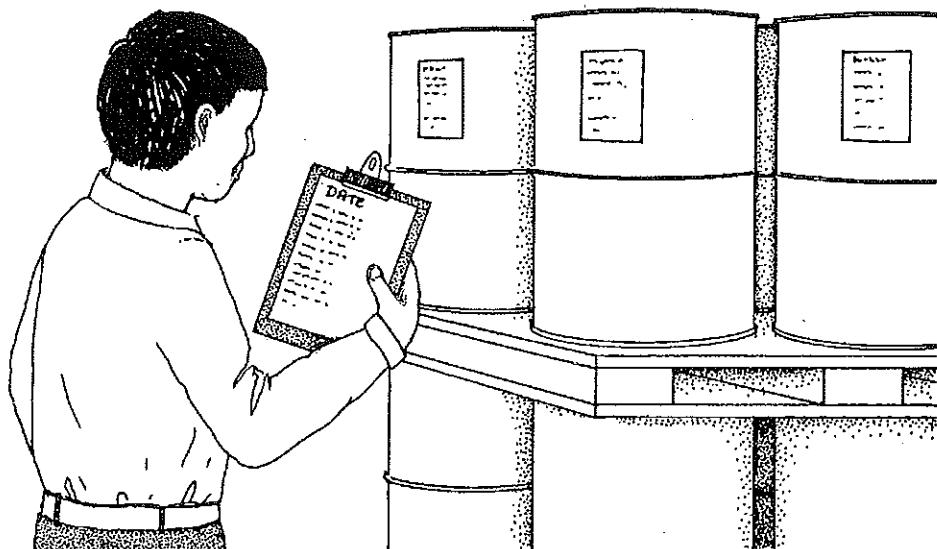
Pesticide shelf-life

The biological efficacy of pesticides gradually decreases with time. The pesticide shelf-life is the period of time that a pesticide can be stored before it deteriorates. Nearly all pesticides have a limited shelf-life. As part of modern pesticide formulation technology, packing methods and storage practice aim to prolong shelf-life as much as possible. Manufacturers indicate the shelf-life of the pesticide on the container, but many pesticides may still be usable long after the indicated shelf-life has expired. Most pesticides have an indicated shelf-life of at least two years from the time of manufacture, but shelf-life will be shortened if pesticides are not stored properly (e.g. if they are stored at high temperatures). Stock turnover organization needs to take into account the time that pesticides may have been in transit between manufacture and reaching the store.

Pesticides in sealed containers may change over time in two main ways:

- The active ingredient may change chemically and break down into products that may no longer have pesticidal properties, thus decreasing the concentration of the original active ingredient.

FIGURE 15
Storekeeper checking dates from labels on containers in a pesticide store



- The formulation of the pesticide may break down and a precipitate of flakes, crystals or sludges may form, making it impossible to mix or use in sprayers.

An organochlorine such as endosulfan is chemically very stable, but some formulations may break down more rapidly. Organophosphates are much less stable and therefore generally have a shorter shelf-life. Dust and wettable powder formulations tend to break down and cake together, as a result of high temperature, high humidity, strong sunlight or compaction under pressure, more than liquids in sealed containers.

PESTICIDE ORDERING AND SHELF-LIFE

The shelf-life and rate of use must be taken into account when ordering pesticides (Figure 15). Do not order more than one year's requirement. The date of manufacture and shelf-life should be on the outside of the container. If a larger quantity is ordered than can be used during the period of shelf-life, outdated stocks will accumulate and present disposal problems, as well as financial loss.

STOCK INSPECTION AND SHELF-LIFE

Stocks in a pesticide store should be inspected regularly for signs of deterioration, such as caking of powders, sedimentation or gelling of liquids and discoloration through oxidation. Shelf-life declines rapidly after containers have been opened and left partially empty. Stock turnover must be organized to ensure that the contents of a container are used as quickly as possible once the container has been opened. Unsealed containers of dusts and wettable powders should not be kept for more than one year.

Containers are not only subject to deterioration caused by external factors (climatic, biological and mechanical), but can also be corroded internally through the action of the pesticides they contain. Emulsifiable concentrate formulations are particularly likely to affect weak spots, especially along seams (Figure 16) or where there are imperfections on the internal coating of the container. Some pesticides increase in acidity during storage and this makes them more likely to corrode containers from within. Discoloration of pesticide is a sign of corrosion of this type and should be looked for during stock inspections.

OUTDATED PESTICIDE STOCKS

Often there is no information on shelf-life on the pesticide container label. When this is the case, a two-year shelf-life should be assumed, unless more precise

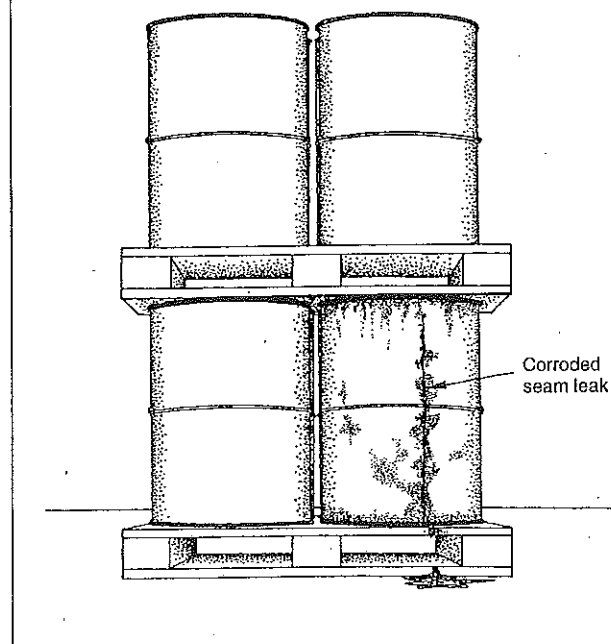
information can be obtained from the manufacturer or distributor at the time of purchase.

Outdated stocks may still be usable if the formulation has not broken down. The only way that this can be verified is by having a sample of the product analysed by the manufacturer or at an independent laboratory and the dose measured accordingly. The date of the test must be attached to the drums after samples have been analysed. Trial and error methods that assess the pesticide's efficacy by using more concentrated doses or higher application rates are not recommended.

DISPOSAL OF OUTDATED AND UNUSABLE PESTICIDES

The main aim of good storekeeping is to minimize the need to dispose of stocks since the disposal of pesticides presents many problems. However, on occasion, it will be necessary to dispose of old stock. Store accounting procedures should allow for old stocks to be written off, that is there should be some system by which unusable pesticides can be removed from the store. Unfortunately the storekeeper does not always have the authority to do this and stock tends to remain on record whether it is usable or not. If there is no system whereby pesticides can be written off and subsequently disposed of, old pesticides soon present hazards as their containers deteriorate and start to leak. The disposal of unwanted pesticides is considered on p. 20.

FIGURE 16
Pesticide container corroded and leaking from a side seam



Chapter 4

Pesticide stock planning and recording systems

Pesticide stores should have a proper system of stock planning and should keep records of stocks received, held and issued. No more pesticide should be ordered than is required or than can be stored in an appropriate way. Major problems have been caused where there was no system or where the storekeeper had not been trained in, or failed to use, an existing system. Without a record system, orders for excessive quantities of pesticide can be made and the most recently received stock tends to be issued first because older stock is less accessible or the customer wants "fresh" pesticide.

As pesticides have a limited shelf-life, it is essential that only sufficient pesticide is ordered for requirements and that issues are made on a "first in – first out" basis. If such a procedure is not followed, old, out-of-date stocks of pesticide accumulate in deteriorating containers, particularly in dark recesses of the store.

Not only do these stocks represent a financial loss to the store-owner (government, marketing board, agricultural cooperative, pesticide wholesaler or retailer or individual farmer), but they also constitute a hazard to personnel working in the store and present an environmental problem when they are eventually disposed of. The movement of chemicals into and out of the store must be carefully recorded. This information may also be required for emergency services, such as the fire brigade, in the event of a disaster so that the volume of pesticides involved can be assessed.

RECORD SYSTEMS

The record system adopted will depend on the size and function of the store and on the accounting requirements of the store-owner. Records should be kept separate from the pesticide store.

Small store

No elaborate system is required or usually possible at the minimum level of, for example, a small-scale farmer storing only a few pesticides. But even the small-scale farmer should adhere to the following practices, which are essential in all pesticide stores of whatever size:

- The date of purchase or arrival should be written on each container as it is deposited in the store.
- Ensure that all containers have proper labels and that these remain attached to the containers and are clean and readable; labels in poor condition should be replaced.

In addition, the small-scale farmer should keep invoices, delivery notes or receipts obtained in connection with pesticide purchases separate from the store. This will enable the farmer to contact the pesticide supplier in the event of an emergency or if further advice is needed. The farmer should also have a supply of material safety data sheets, which the supplier or manufacturer can provide.

Large store

Any store above the size of a small-scale farmer's will require some sort of formal records system. The system adopted depends on circumstances. Records should be kept separate from the pesticide stock so that they are not destroyed in the event of a major disaster (such as fire, flood, earthquake, hurricane or destruction during civil unrest).

Records may be kept as sheets in a ledger or in card index form. Duplicate records adjacent to the stock itself may also be required, perhaps in simplified form. Again, a supply of material safety data sheets should be requested from the supplier or manufacturer.

Records should be accurate and sufficiently detailed to enable a replacement storekeeper to take over responsibility without needing to refer to the previous storekeeper.

Pesticides have a limited shelf-life, and stock batches bought at different times may vary in formulation and packaging. It is important that a completely separate record be allocated to each consignment of different pesticides as it is received by the store.

The national authority responsible for the procurement of pesticides needs to be regularly updated on stocks kept in various locations in the country and stores should be able to supply this information.

A possible layout for a pesticide store record sheet is given in Box 1. The store record sheet allows the progress of each consignment of a particular pesticide to be followed from receipt, through inspections, stocktaking and checking to issues, analysis of stock after the shelf-life has expired and disposal when deterioration has been established.

Well-kept records are the sign of a properly run store and are essential for minimizing wastage of stock or damage caused by accidents. The store supervisor should ensure that there is an adequate system being followed by the storekeeper at all times. The storekeeper should be trained in the use of the records system and must be responsible for its upkeep.

BOX 1

Sample pesticide store stock record sheet

Pesticide group *Insecticide OP* Ref. no. *Inv 29/5[R3]*
 Common name *Chlorpyrifos*
 Trade name *Dursban*
 Formulation/concentration *% ec, 400 g/litre*
 Manufacturer/supplier *Dow Elanco, USA*
 Quantity (agreed issuing quantity/package) *1 000 2.5-litre plastic containers*
 Primary packaging quantity *Four containers of 250 cartons*
 Date received *20 December 1994*
 Use-by date *1 December 1996*
 Notes (shelf-life; special storage conditions; inspection frequency) *Two-year shelf-life; keep cartons sealed; inspect every six months; look out for breakdown of plastic containers*

Date	Quantity issued (litres)	Balance in stock (litres)	Notes (stock inspection; notes on condition etc.; storekeeper's initials)
25 December 1994	650	1 850	
6 June 1995			Stock inspected, no damage. MRKL
10 June 1995	1 300	550	Stock check. MRKL
10 September 1995		548	Stock inspected – two containers leaking; disposed of. MRKL
30 September 1995	548	nil	

Record of disposal of outdated stock *Leak absorbed by sawdust and burnt, split containers relocated to store II and contents transferred*

(MRKL are the storekeeper's initials)

Notes on the sample record sheet

Reference number. Cross-reference should be made to the invoice or delivery note; location of the pesticide in the store (bin, shelf or row number).

Identification of the pesticide. Pesticide group, common and trade names with details of formulation and concentration should all be recorded.

Source of the pesticide. Where possible information on primary manufacturer or formulator, as well as local source, should be recorded (with local telephone number where available in case of emergency). Where the pesticide came from should also be recorded since many stocks are shifted around.

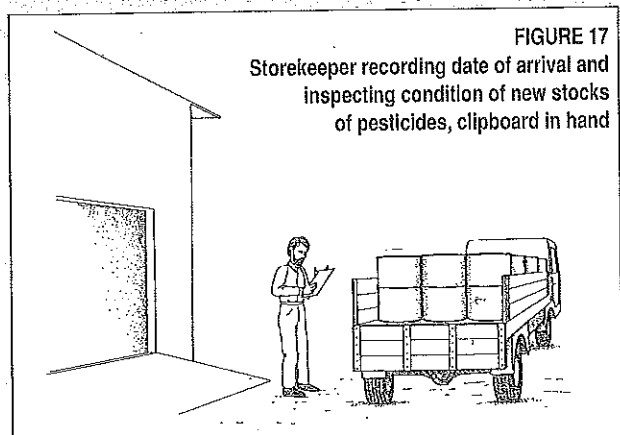
Packaging and issuing units. These may differ; the pesticide may be in 200-litre metal drums or in 1-litre cans packed in boxes of 20 with sales or issues being made in units of the 1-litre can.

Date received. Possibly the most important item of information; it is essential that this should be documented. It must also be recorded on the actual pesticide containers together with the use-by date (Figure 17).

Notes. Information should be obtained from the supplier on shelf-life (use-by date), any special storage requirements, particular hazards and other details, which should be incorporated as instructions to the storekeeper on the record form.

Stock operation and management. Details of receipts and issues must be meticulously recorded and records of periodic stock inspections should be kept initialled by the inspector. Careful notes should be made on the state of containers and contents at the time of inspection.

Disposal. When outdated stock is eventually disposed of it should be recorded, with notes on the method of disposal of the pesticide and its containers, the location of dumps, etc.



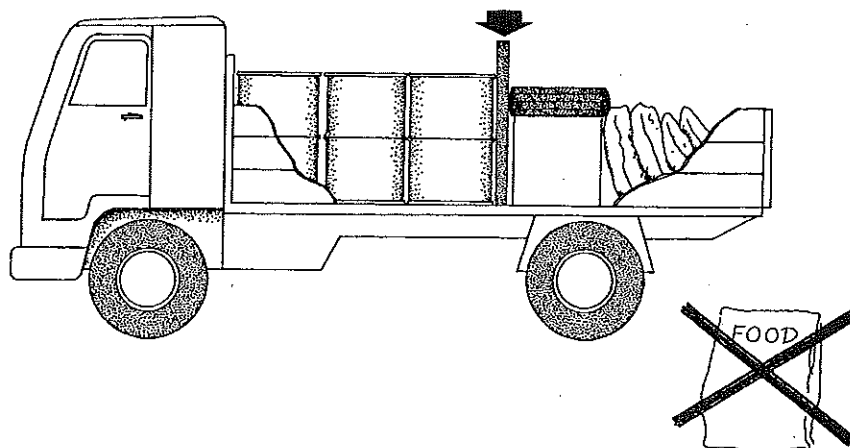
Local transport of pesticides

Severe cases of poisoning have been caused by the transportation of pesticides with other commodities. Containers of pesticides have leaked during movements, contaminating foodstuffs such as flour and rice packed in sacks and carried in the same truck. People have eaten the food after it has arrived at its destination and have become ill; thousands of deaths have resulted from poisoning in this way. There are several basic points to be remembered:

- Food, animal feed or general consumer goods should not be transported in the same truck as pesticides (Figure 18).
- Open or leaking containers of pesticides should never be transported.
- If pesticide containers must be transported with other goods, they must be separated in sealed partitions and securely fixed with straps or rope.
- Pesticide containers should be loaded in such a way that they will not be damaged during transport, that their labels will not be rubbed off and that they will not shift and fall off the truck on rough road surfaces (the load must be securely fixed).
- The truck driver or railway officials should be informed that the load consists of toxic pesticides and should be given instructions on what action to take in the event of an emergency (crash, fire,

FIGURE 18

Local transport of pesticide on a goods vehicle – other materials are partitioned off but food must not be carried



- spillage). Material safety data sheets should be provided if possible.
- The pesticide load should be checked at intervals during transportation and any leakage, spills or other contamination should be cleaned up immediately. In the event of leakage while the means of transport is moving, the vehicle should be brought to a halt immediately to stop the leakage and the leaked product should be cleaned up.
 - With a major spill, people should be kept away and the spill covered with earth, sand, etc. (Figure 19); no attempt should be made to wash away the spill with water or other substances.

- The truck, including tarpaulins and other goods, should be checked for evidence of spills or leaks after the pesticides have been unloaded, and then decontaminated of pesticide before it next departs.
- Pesticide containers should be loaded and unloaded carefully (Figure 20); most leaks from containers in storage are caused by damage during transportation and handling.
- Newly arrived consignments should be checked for leaks and loose lids, and repacked immediately if necessary. Replace torn or unreadable labels. A supply of empty new containers should be available for repacking from damaged ones.

FIGURE 19

Spill, caused by a pesticide drum falling off a vehicle, being covered by soil – people are kept away from the spill

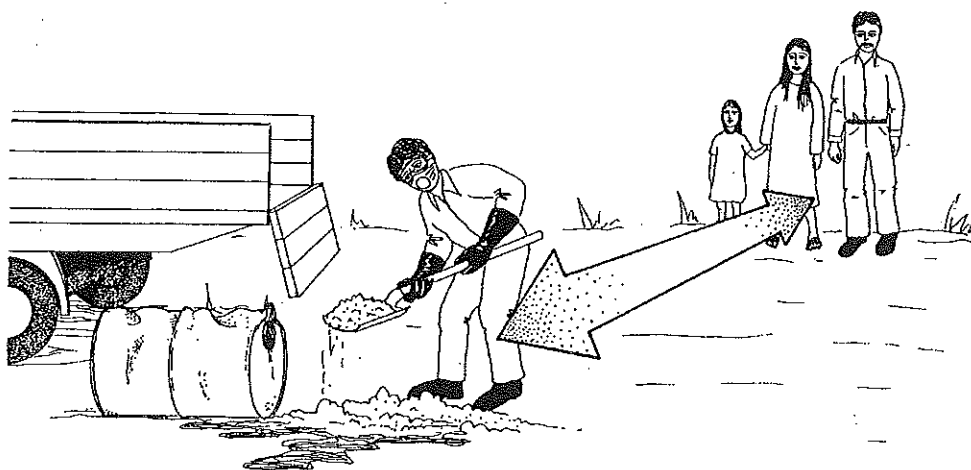
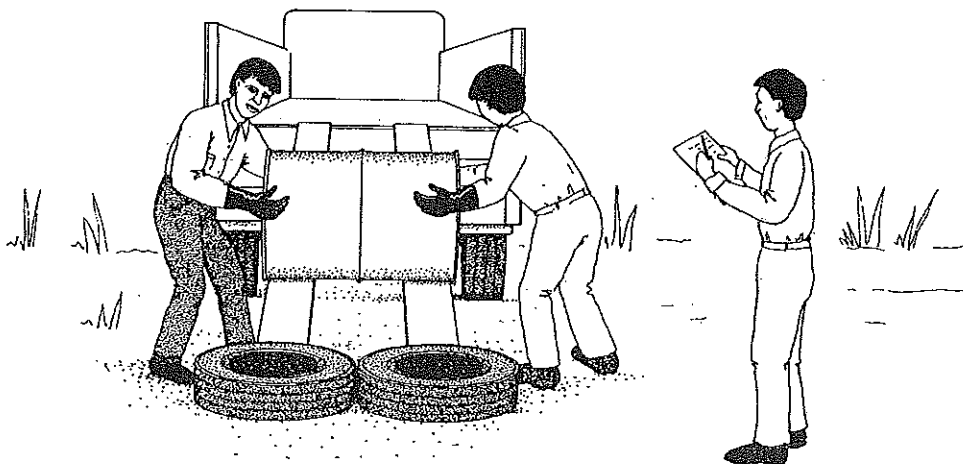


FIGURE 20

Careful unloading of pesticides from a delivery vehicle to avoid leaks resulting from damage to containers; the storekeeper is examining the delivery note



Chapter 6

Spills, leaks and disposal of containers and chemicals

Pesticides are biologically active materials and potentially hazardous to human health and the environment. Complete decontamination and effective disposal are often very difficult to achieve. One of the most important objectives of good store management is therefore to minimize the occurrence of leaks, spills and outdated stock.

SPILLS

There will occasionally be spills, even in the best run stores, especially where concentrates are repacked and transferred into other containers. Spills must be cleaned up immediately. Always have two people working when handling severe spills.

Untreated spills may corrode other containers, become trodden in and contaminate store personnel and may produce toxic or inflammable fumes. If not removed quickly, the spilled chemicals may be absorbed by the floor. Floors therefore need to be made of impermeable (sealed) concrete or other non-absorbent material – removing the contaminated part and replacing it may be the only way to decontaminate absorbent brick, earth or wooden floors.

Liquid spills

The spill should not be hosed down as this merely disperses the pesticide over a wider area.

A supply of absorbent sawdust, sand or dry soil should be kept in a container in the store.

Nitrile rubber protective gloves and face-mask should be worn.

Sawdust, sand or dry soil should be scattered over the area of the spill and left for a few minutes to soak up the chemical.

The sawdust, sand or dry soil containing absorbed spilled chemical should be swept or shovelled up and placed in a marked container for disposal (Figure 21).

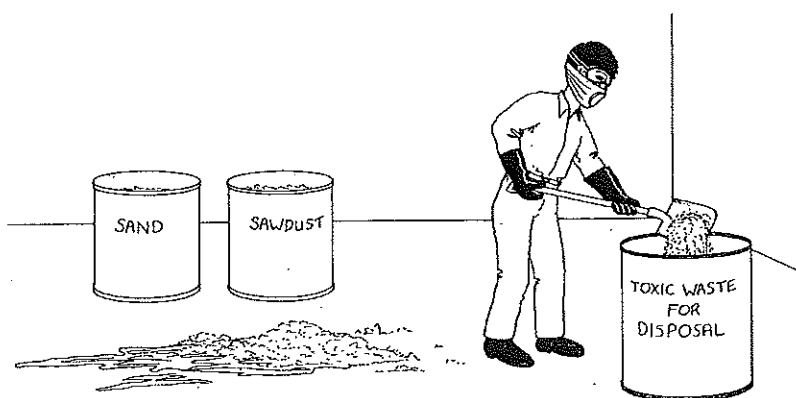
After sweeping, more than once if necessary, a scrubbing brush at the end of a stick should be used to scrub down the area of the spill with water and strong soap or detergent. Excess soapy water should be removed with a rough floor cloth and not hosed down.

Solid spills

Dusts, wettable powders or granules can create dust when swept up without the use of an absorbent material. A supply of absorbent sawdust, sand or dry soil should

FIGURE 21

Spill soaked up by sand or sawdust being carefully swept up by the storekeeper and placed in a container to be collected and taken for central disposal by the national authority



be kept in a container in the store where they can easily be reached for use in an emergency.

Nitrile rubber protective gloves and face-mask should be worn.

The sawdust, sand or dry soil should be dampened and applied with a shovel over the area of the spill.

The damp sawdust, sand or soil containing spillage material should be swept or shovelled up carefully and placed in a marked container for disposal (Figure 21).

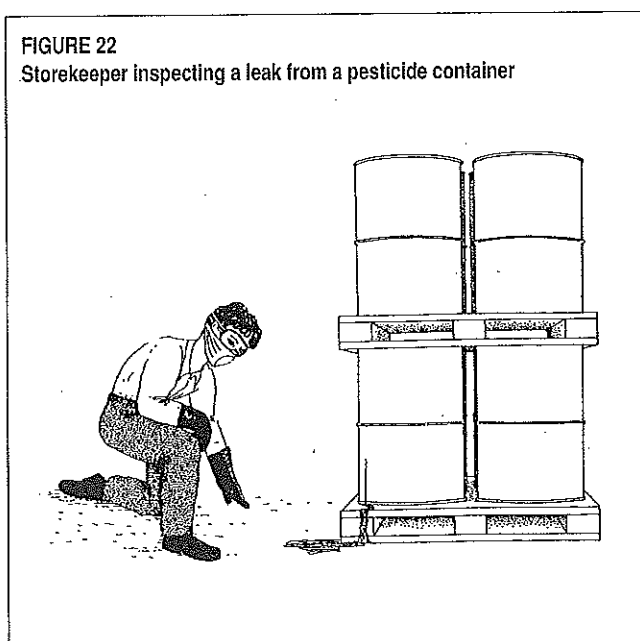
After sweeping, more than once if necessary, a scrubbing brush at the end of a stick should be used to scrub down the area of the spill with water and strong soap or detergent. Excess soapy water should be removed with a rough floor cloth and not hosed down.

LEAKS

Leakage from containers is a major problem in the storage and transport of pesticides (Figure 22). The main cause is rough handling which dents drums, weakens or splits seams and weakens closures (lids, caps and stoppers). Other causes of mechanical damage are puncturing or abrasion during transport when packages and containers rub against one another or against the sides of the truck travelling over uneven surfaces and rough roads.

Leaks also result from corrosion of the container, which may be accelerated by mechanical damage (dents may rupture drum linings, for example). Corrosion may start internally, the pesticide itself or its breakdown products being the primary cause. Alternatively, corrosion may begin externally, as a result of rusting in damp storage conditions or contamination from pesticide

FIGURE 22
Storekeeper inspecting a leak from a pesticide container



leaking from nearby containers. Many emulsifiable concentrate (ec) formulations are very corrosive. Some, including monocrotophos, dicrotophos, dichlorvos and phosphamidon are incompatible with steel, so they should be packed in plastic or aluminium containers or in steel containers lined with inner coatings. Some pesticides are dissolved in organic solvents that cannot always be packed in plastic drums.

Containers may leak for other reasons; for example, strong sunlight can degrade some plastic containers, including bottles and plastic sacks. Rodents may damage paper, board or fibre containers. Termites may attack paper and card.

Stores should be inspected regularly, at least every two months. Old, rotting and leaking containers are extremely difficult to move safely, so any leaking containers should be dealt with immediately.

Usually, the only way to deal with a leak is to repack the material in a sound container. New containers are preferable, if available, but old containers of various types and sizes may be used for this purpose (old containers are also useful for temporarily storing the products of spills). They must have been thoroughly decontaminated (see next section) and their old labels completely removed.

Pesticides should be repacked in containers made of the same materials as the original containers as some chemicals are not compatible with different materials. Ideally a drum that contained the same product should be used. If unavailable, the container must have been properly cleaned of previous contents to avoid cross-contamination. New labels must be written out

immediately with all the information on the old label and fastened securely to the new container. Write the date of repacking (and the date of the original receipt) on the replacement container and ensure that the repacked material is used first.

DISPOSAL

Disposing of pesticide containers

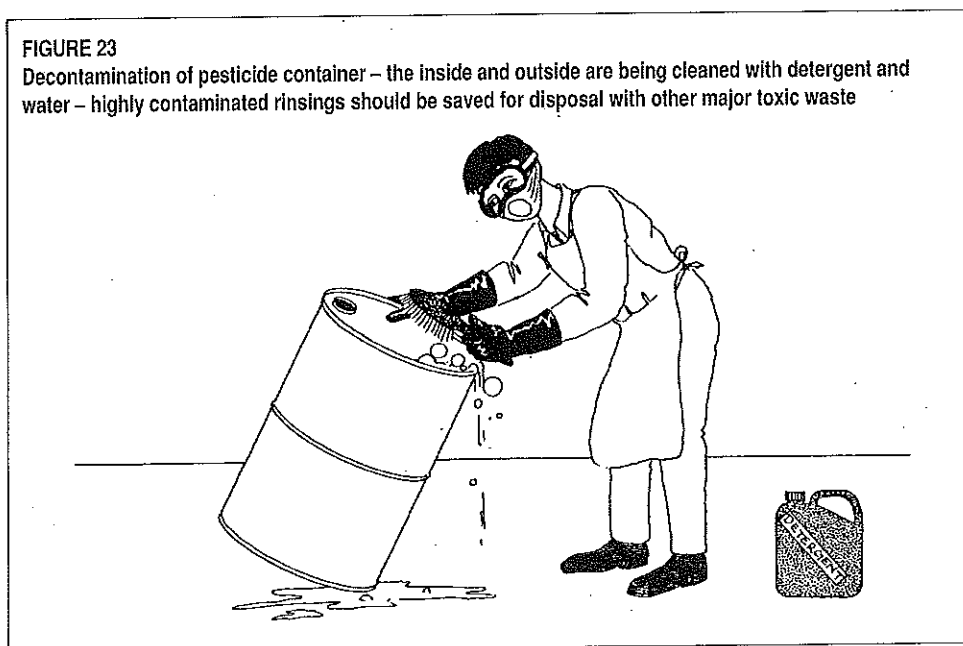
Many accidents have been caused by empty pesticide containers being used to store water and food. An empty pesticide container can never be cleaned completely of pesticide and should be disposed of in a way that ensures it cannot be used for other purposes. It is, however, wise to retain samples of various types of container, which have been carefully cleaned, in the pesticide store for use in repacking the contents of damaged containers and storing cleaned up leaks and spills prior to final disposal.

Empty containers awaiting disposal should be stored in a special, secure area in the pesticide store to ensure that they are not stolen and used for other purposes.

Empty containers should always be cleaned out, as far as is practicable, before disposal to minimize both hazard and waste of residual pesticide. Containers that have contained ec or wettable powder (wp) formulations should be rinsed with water several times and the rinsings added to the spray tank before it is topped up to the required volume. Following this, containers can be washed out with a mixture of water, detergent and caustic soda (Figure 23). Containers of liquid formulations may be cleaned with kerosene (paraffin) or diesel fuel and the washings (small quantities of

FIGURE 23

Decontamination of pesticide container – the inside and outside are being cleaned with detergent and water – highly contaminated rinsings should be saved for disposal with other major toxic waste



about 5 litres) collected for sending later to a central location for disposal by the national authority in a safe and environmentally sound manner.

As long as they are not heavily contaminated paper, cardboard and fibreboard containers should be burnt on a fire in the open (Figure 24). However, cartons that have contained phenoxy acid herbicides should not be burnt because the combustion products can damage crops at long distances. Highly contaminated cardboard, paper and jute materials should be collected and sent to the central disposal centres along with other toxic waste.

Containers rendered unusable, the products of decontamination procedures, leaks and spills, and container rinsings (where these have not been added to the spray tank) should all be collected for sending later to a central location for disposal by the national authority.

Glass containers should be smashed and steel drums and metal and plastic containers punctured (Figure 25) and crushed (do not puncture aerosol containers) before being sent to a central location for disposal by the national authority.

Disposing of unwanted pesticides

Using pesticides for their intended purposes according to label instructions is the most satisfactory means of disposing of them. For this reason, no more than one year's requirement of pesticides should be ordered and stored, so that none will remain at the end of the product's shelf-life of two years. Only as much pesticide as can be used in a day's operations should be withdrawn from the store and only as much as will go into the sprayer tank should be mixed.

Occasions will arise when it will be necessary to dispose of pesticide concentrates, either because the stock is outdated and has been found to be unusable or because the product is no longer registered for the original purpose. Where very large quantities are to be disposed of, professional advice must be sought from the suppliers and national authority.

If only a few kilograms or litres of pesticide are involved, they should be collected for sending later to a central location for disposal by the national authority. Larger quantities of pesticides are best disposed of by burning in a special incinerator (at 1 200°C) – this does not mean that it would be safe to burn them at a lower temperature on a fire. Incineration requires special equipment with provision for “scrubbing” the combustion products, but this is beyond the capacity of pesticide storekeepers and should be referred to the relevant national authority.

Other means of disposal are to return the pesticide to the supplier or pass it on to a specialist disposal agent elected by the national authority.

Returning the pesticide to the supplier or to the national authority is the safest means of disposal. Disposal involves chemical methods such as alkaline and acid hydrolysis. Oxidation, reduction and spraying on to the ground or allowing to escape into the atmosphere may also be employed, but require specialist skills. The end product in most cases is still toxic. Storekeepers should not become directly involved with pesticide disposal and should refer to the relevant national authority.

FIGURE 24

Disposal of lightly contaminated cardboard pesticide container on a fire, ensuring that fumes travel away from personnel

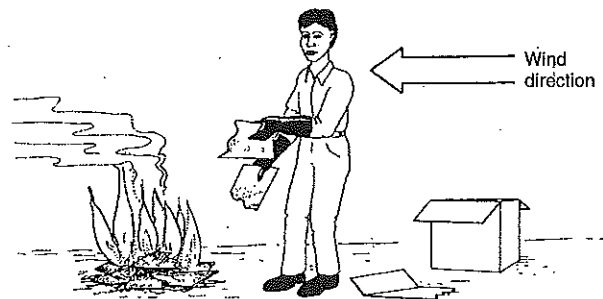
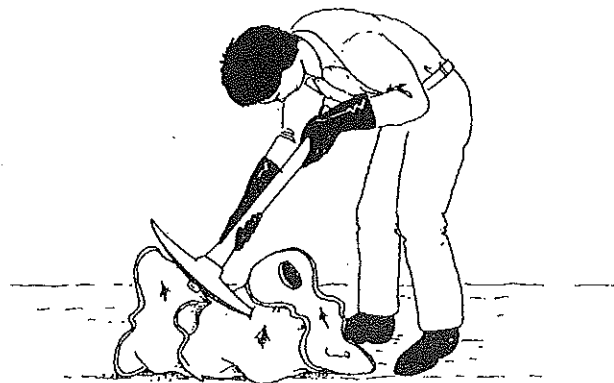


FIGURE 25

Metal container being crushed so that it cannot be reused – it will be collected for central disposal by the national authority



Chapter 7

Decontamination

PERSONNEL

Pesticides coming into contact with the skin can rapidly enter the body. Successful decontamination of body surfaces requires:

- prompt action and rapid application of plenty of soap and water;
- extremely thorough washing.

Anyone contaminated with pesticide should strip off their clothing and quickly and thoroughly scrub the affected part of their body with soap and water. This should be followed by careful rinsing and towelling dry (Figure 26).

PROTECTIVE CLOTHING

Contaminated protective clothing should be thoroughly washed using industrial grade detergent followed by several rinsings. Protective clothing should not be washed with the family wash. Gloves should be worn when washing protective clothing. Hot water should be used when available. Washed clothes should be hung to dry in full sunshine.

Where there is a large patch of fabric that has been contaminated by toxic concentrates and replacement clothing is available, it is best to destroy the affected clothing by burning.

STORES AND VEHICLES

When dealing with leaks and spills, water, soap or detergent are usually the most readily available materials for decontamination. However, other chemicals sold for domestic or common commercial purposes may be useful too.

Organophosphorus compounds can be treated by sodium hypochlorite (bleach) and sodium carbonate (washing soda), which are useful for decontamination and can be applied following initial scrubbing with soap and water.

Organochlorine compounds are persistent chemicals and household ammonia and washing soda can be used, but the main method is to scrub with water and detergent.

Carbamates should be scrubbed with washing soda or strong soap.

Transport vehicles should be decontaminated thoroughly as soon as spills or leaks are seen, otherwise there is a danger that when used subsequently for other goods, including foodstuffs, the goods could become contaminated (Figure 27). Spills are cleaned up in the same way that they are in stores. The contaminated washings from the vehicle should be absorbed by sawdust, sand or dry soil and placed in a container for collection and central disposal by the national authority.

FIGURE 26
Storekeeper decontaminating himself by washing thoroughly with soap and water – his protective clothing, washed separately is hanging out to dry in full sunshine

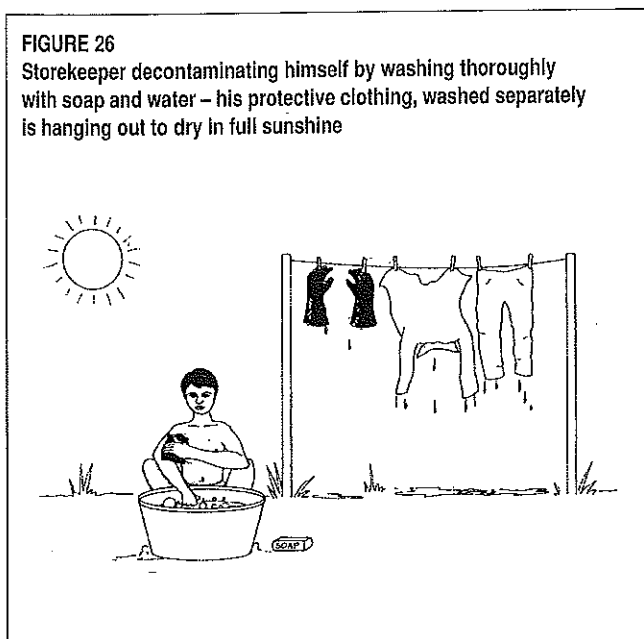
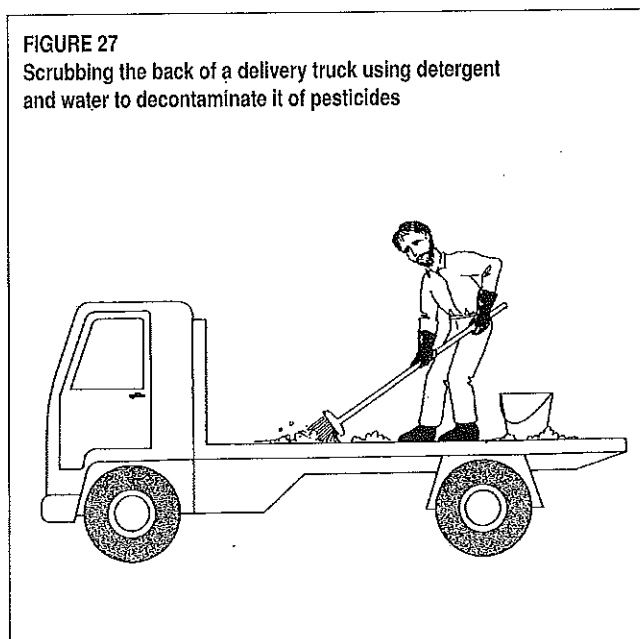


FIGURE 27
Scrubbing the back of a delivery truck using detergent and water to decontaminate it of pesticides



Major emergencies

Major emergencies are a far greater risk for pesticide stores than they are elsewhere.

FIRE

The primary objective in the design and management of pesticide stores is to reduce the risk of fire. Prevention is better than cure!

Pesticides, especially those formulated as liquids, present major fire hazards because the solvents used in formulations (oils and petroleum distillates) have low flashpoints and may be readily vaporized at normal temperatures. In poorly ventilated stores heavy vapours may accumulate near the floor if drums are left open or if leaks and spills are not cleared up. An electrical spark, naked flame or even the sun's rays concentrated by a glass container may cause an explosion followed by the spread of fire.

Some wettable powders are suspected of starting fires through spontaneous combustion, while sodium chlorate (used as a herbicide, defoliant, desiccant and soil sterilant) is a powerful oxidizing agent that easily catches fire and should only be supplied with a fire suppressant in the formulation (once sodium chlorate

containers have been opened their entire contents should be used immediately).

The outside of pesticide stores should bear prominently displayed warning notices stating "Danger pesticides: authorized persons only" and "No smoking: no naked flame" as well as symbols. These rules should be strictly followed.

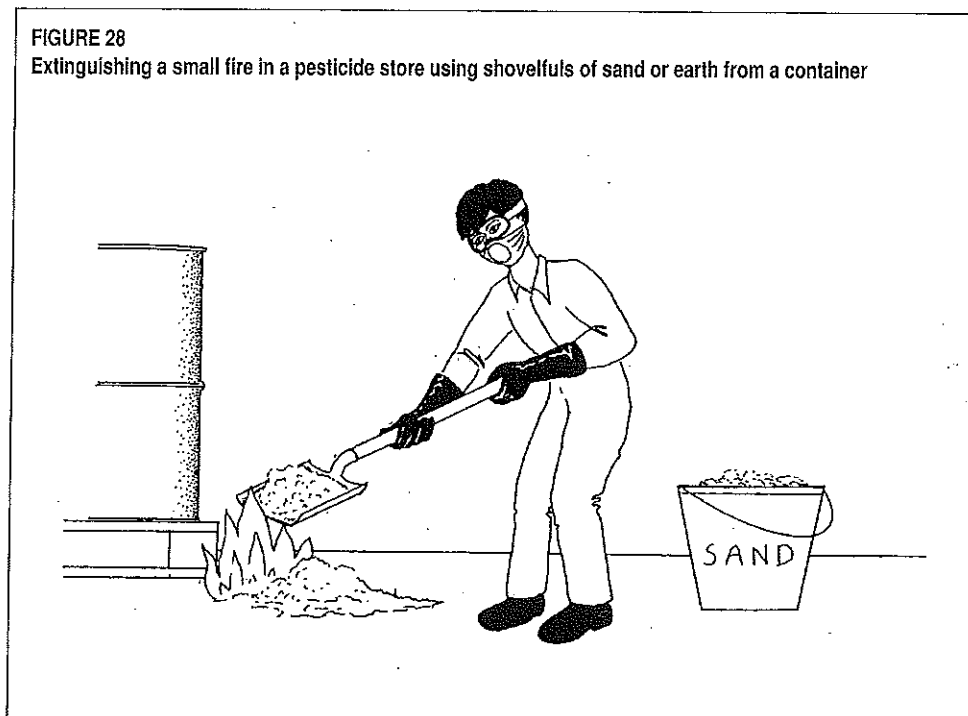
Fire extinguishers (powder or carbon dioxide, not water) should be available in the store and should be regularly checked. Static or running water (required, together with soap, for decontamination purposes anyway) should also be available and buckets of sand or earth (also required for absorbing any liquid pesticide spills or leaks) are useful for putting out small fires (Figure 28).

The local fire brigade should be informed of the store's existence and the hazards involved. It is very useful to place a notice on the outside of the store giving names and addresses of those responsible for the store (including key holders) who can be contacted in an emergency.

In the event of a fire it is essential to try to contain the pesticides that leak from burning and exploding

FIGURE 28

Extinguishing a small fire in a pesticide store using shovelfuls of sand or earth from a container



containers in the store. Hence the need for bunding of some kind to be provided when the store is built; bunds also prevent the water used to fight the fire, which inevitably becomes contaminated with pesticides, from contaminating the neighbourhood and thus the environment generally.

Contamination of the environment from combustion products such as smoke and fumes cannot be prevented. A light roof designed to collapse easily in a fire will at least permit the fumes to be carried upwards away from the fire-fighters (Figure 29).

Fires in pesticide stores that contain organophosphorus compounds and carbamates can be extremely dangerous to fire-fighters, who should never go downwind of the fire and should always wear breathing apparatus.

Solid water streams from fire-fighting hoses should be avoided since they can disperse the pesticide, especially powder formulations, over a wide area. Care should also be taken to avoid dragging fire hoses through contaminated water.

Protective clothing and equipment used by fire-fighters should be thoroughly decontaminated after use.

FLOODING

Flooding during seasonal rains is a common event in tropical countries. Flooded pesticide stores are subject to special hazards.

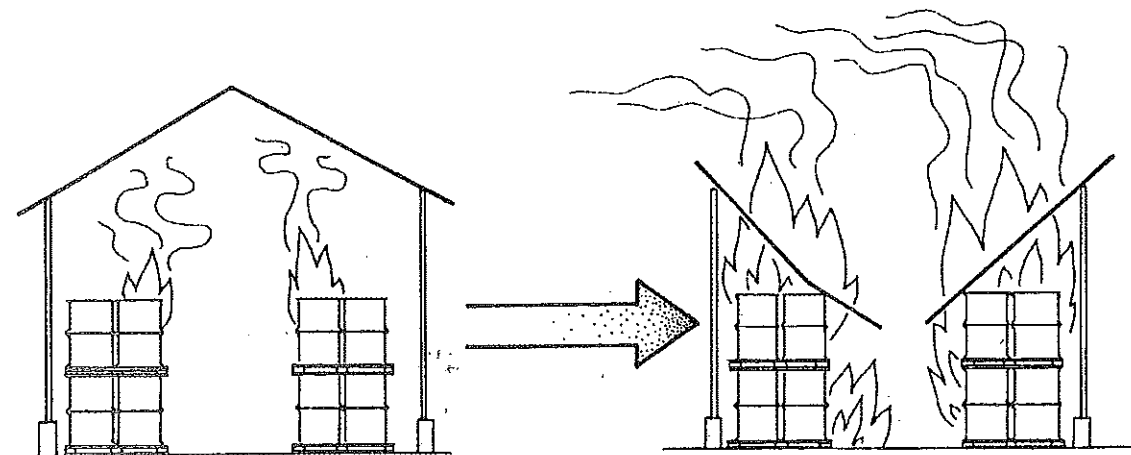
Cardboard or paper containers in which many pesticides are packed lose strength and may leak or

burst open when wet. Other containers, especially partially empty drums of liquid, may be swept away with a flood. Environmental contamination over a wide area may result from either of these events; water supplies may become polluted and pesticide containers may present a hazard to people who find them.

DESTRUCTION

Dangers from fire, flooding and destruction during civil disturbances emphasize the value of keeping records of stocks in a place where they will be safe in an emergency. Records of the quantities and types of pesticide involved prove invaluable in subsequent efforts to clean up, trace missing containers and assess the environmental risk and financial loss caused by the emergency.

FIGURE 29
Pesticide store in flames – the light roof has collapsed, thus preventing an explosion



Chapter 9

Personal safety and protective clothing

When working with pesticides, do not eat, drink or smoke. Wash hands and face thoroughly with soap and water before smoking or eating. Also wash your hands before using the toilet. Some form of protective clothing is required when handling and transferring pesticides in stores. In warm, humid tropical climates, wearing additional protective clothing may be uncomfortable. Ideally, therefore, only pesticide types and formulations which do not require additional protective clothing should be stored. This is unlikely to be possible in most cases however.

GENERAL BODY PROTECTION

The garments worn should have long sleeves and covering for the lower body and legs. Footwear (boots or shoes) and some kind of head covering should also be worn. Many kinds of normal clothing in tropical and subtropical countries provide good general body protection in any case, but work clothing should be in a good state of repair and should not have tears or worn areas through which pesticides can enter and contaminate the skin. Work clothing, including footwear, must be washed in water with soap or other detergent after each day's use, separately from other clothing.

HAND PROTECTION

When pouring and otherwise transferring pesticides from one container to another, chemical-resistant gloves should be worn (Figure 30). They must fit the hands comfortably and be flexible enough to grip pesticide containers firmly. They must be long enough at least to cover the wrists.

Gloves made of nitrile rubber or neoprene offer good protection against a wide range of pesticide products, especially those dissolved or suspended in water, granules or dusts. Gloves made of natural rubber do not provide sufficient protection against products such as emulsifiable concentrates and ultra-low-volume pesticides.

The outside of gloves should be rinsed with water before removal and the gloves should be washed inside

and out and allowed to dry after each day's use. They should be examined for signs of wear and tear, particularly between the fingers.

FOOTWEAR

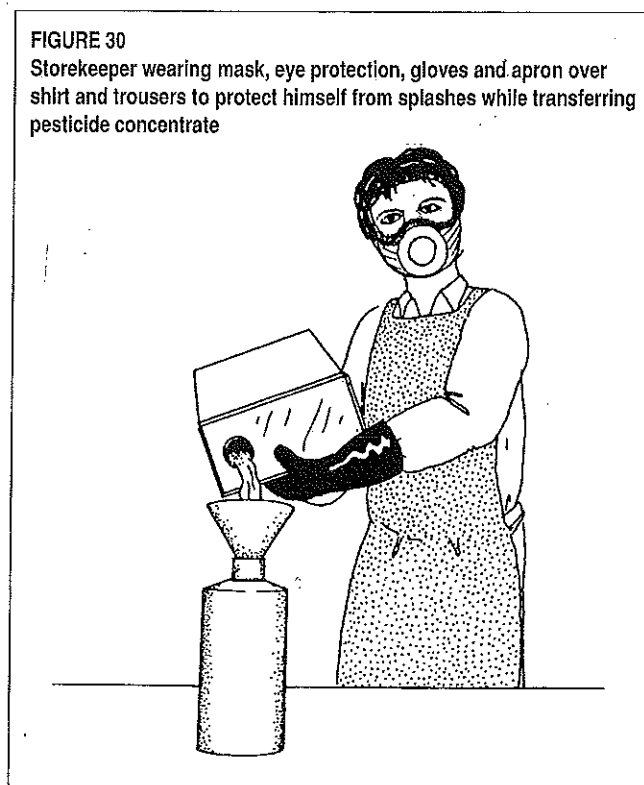
Calf-length rubber boots give protection against a wide range of dilute pesticide products. Leather footwear is unsuitable because it absorbs some pesticide products and cannot be decontaminated. Trousers should be worn outside the boots so that spills and splashes do not fall into them.

EYE PROTECTION

Goggles or face shields are used to protect the eyes from splashes (Figure 30) and when transferring dusts. Face shields are cooler to wear in hot, humid climates and do not mist over as easily as goggles. Although they provide less satisfactory eye protection, the use of safety spectacles is preferable to no protection.

FIGURE 30

Storekeeper wearing mask, eye protection, gloves and apron over shirt and trousers to protect himself from splashes while transferring pesticide concentrate



Wash after use to remove any contamination.
An eyewash set should also be available.

PROTECTION AGAINST INHALATION

There should be a sufficient stock of lightweight disposable masks that cover the mouth and nose when handling dusts. The masks must be discarded after use. Vapour masks or half-face respirators with organic vapour cartridges should also be available.

APRON COVERING

Aprons are useful additional protective items for loading operations, handling concentrated formulations and

cleaning out containers before disposal. Aprons made of PVC, nitrile rubber or neoprene, or disposable ones made of polyethylene materials, provide adequate additional protection for operations of this kind. The apron should cover the front of the body up to the neck and down to the knees. As with other protective equipment, aprons must be washed after use and inspected regularly for signs of damage.

If items of protective clothing are not available, the national authority responsible for supplying or distributing pesticides should ensure that they are provided. Donors and suppliers of pesticides should be asked to provide them.

Annexes

1. ESSENTIAL EQUIPMENT FOR A PESTICIDE STORE

Thick polyethylene sheeting on floor (if surface is not concrete or otherwise impermeable)

Floor dunnage (bricks, timber)

Wooden pallets

Ramps at entrance to contain leakage

Entrance door with lock to prevent unauthorized entry

Bars across windows and ventilators to prevent unauthorized entry

Container of absorbent sand, sawdust or dry soil

Shovel

Long-handled brush with stiff bristles

Short-handled brush and pan

Water supply, or container of water, with soap

Detergent solution

Drum spanners

Metal funnels

Fire-fighting equipment:

- fire extinguisher
- fireproof blanket

Protective clothing:

- helmet or cloth cap
- safety spectacles, goggles or face shield (attached to helmet)
- dust or light fume masks
- emergency vapour masks or half-face respirators with organic vapour cartridges
- nitrile rubber or neoprene gloves or gauntlets
- overalls
- nitrile rubber or neoprene aprons
- strong rubber or neoprene boots

Empty pesticide containers (preferably salvage drums that can contain a whole 200-litre drum)

Empty bags to repack heavily damaged or leaking containers

Self-adhesive warning labels for marking drums

Emergency first aid equipment:

- first aid box
- stretcher and blanket
- eyewash set

Stock record sheets

2. ROUTINE PESTICIDE STORE MANAGEMENT PROCEDURES

General

1. The storekeeper should put on essential protective clothing (overalls and boots) on arrival at the pesticide store.
2. There should be a quick daily inspection of drums and containers to ensure that there have been no overnight spills or leaks.
3. Spilled and leaked pesticide must be cleaned up immediately, using the methods described on p. 17-19.
4. Drums and containers should be thoroughly inspected monthly for leaking seals, split seams and corrosion.
5. Leaking or old drums should be removed and their contents transferred to empty containers. Appropriate protective clothing should be worn and precautions taken as described on p. 25-26. Replacement containers should be sealed and relabelled.
6. Transfer of chemicals to new containers should be recorded on the stock record sheet.
7. Dates on labels of containers in the store should be checked monthly and outdated stock separated for disposal. Any labels in poor condition should be replaced.

Arrival of a consignment of pesticides at the store

8. The back of the transport vehicle should be checked for spills and the containers for leaks or broken seals; the vehicle should be decontaminated of any spills. Chemicals from containers with leaks or split seams should be transferred to empty containers in good condition and relabelled.
9. Pesticide containers should be carefully unloaded from the delivery vehicle. The delivery note should be examined and a check-list of chemicals arriving at the store should be prepared on a stock record sheet.
10. Containers of chemicals placed in the store should be set on floor dunnage and stacked using wooden pallets as necessary.
11. The location of chemical containers in the store should be recorded on the stock record list.

Taking pesticides from the store for pest control purposes

12. The condition of the transport vehicle should be checked before placing containers of pesticides in it. It should also be ensured that no foodstuffs are to be carried on the same vehicle.

13. The removal of pesticides from the store should be recorded on the stock record sheet.
14. The stock first deposited in the store should be the first to be taken out.
15. Pesticide containers should be carefully loaded onto the despatch vehicle and the driver provided with a delivery note.

3. TEN RULES FOR PROPER PESTICIDE STORAGE AND STOCK MANAGEMENT

1. Pesticide stores should not be located in or near densely populated urban areas or near water bodies.
2. The storage capacity (total storage surface) should be sufficient to store the total stock of pesticides at any time.
3. Each store should have at least the following:
 - sufficient ventilation openings to avoid unnecessarily high temperatures;
 - floors made of, or covered by, impermeable concrete or cement (as a temporary measure, floors may be covered by a large and thick polyethylene sheet);
 - ramps at entrances to contain any major leakage within the store;
 - doors that are lockable and bars across ventilation holes and windows to prevent unauthorized entry.
4. The floor of the store should have a layout of separate blocks with aisles between them. Ideally the outline of the blocks should be painted on the floor. Each block should contain only one product. There should be sufficient space between blocks to move containers freely, enable the inspection of containers and treat leakages. Drums should be stacked in such a way that each can be inspected from the aisles between the blocks. Drums and bags should be stored on pallets. The number of containers stacked on top of each other should not exceed the stacking recommendations for the type of container concerned. Overstacking may lead to rupture of containers lower down and reduces access to containers.
5. Pesticide stores should only contain pesticides. All other goods or objects should be removed.
6. Obsolete pesticides should be separated from operational stocks.
7. Each store should have the following for dealing with emergencies:
 - a few bags of sawdust and/or sand to absorb leaked or spilled pesticides;
 - a number of empty containers (preferably salvage drums that can contain a whole 200-litre drum) and empty bags to repack heavily damaged or leaking containers;
 - spade and brush;
 - fire extinguisher;
 - protective gear for staff to enable them to deal with emergencies (nitrile rubber or neoprene gloves, rubber boots, overalls, goggles, vapour masks or half-face respirators with organic vapour cartridges);
 - water supply from a tap, or a container of water, to wash hands and face if these become contaminated;
 - eyewash set.
8. The contents of leaking or heavily damaged containers should be repacked in appropriate replacement containers. Repacked pesticides should be labelled immediately. Stores should be inspected regularly. Any leakage or contamination should be cleaned up immediately.

9. Storekeepers should keep a record of the stocks in their custody and a separate record of stocks in the country should be kept centrally. Recorded data should include: for incoming pesticides, the arrival date, formulation, quantity, unit size, date of manufacture, supplier and origin; for outgoing pesticides, the date, formulation, quantity, unit size and destination. Records should be updated regularly.
10. A "first in – first out" principle should be applied consistently. In other words, always finish old consignments before using newly arrived consignments.

4. REFERENCES

- FAO.** 1985. *Guidelines for the packaging and storage of pesticides*. Rome, FAO.
- GIFAP.** 1984. *Guidelines for emergency measures in cases of pesticide poisoning*. Brussels, International Group of National Associations of Agrochemical Manufacturers (GIFAP).
- GIFAP.** 1985. *Options for ensuring quality in stored pesticide products*. Technical Monograph No. 10. Brussels, GIFAP.
- GIFAP.** 1987. *Guidelines for the safe transport of pesticides*. Brussels, GIFAP.
- GIFAP.** 1987. *Guidelines for the avoidance, limitation and disposal of pesticide waste on the farm*. Brussels, GIFAP.
- GIFAP.** 1988a. *Guidelines for safe warehousing of pesticides*. Brussels, GIFAP.
- GIFAP.** 1988b. *Pictograms for agrochemical labels: an aid to the safe handling of pesticides*. Brussels, GIFAP.
- GIFAP.** 1989. *Guidelines for personal protection when using pesticides in hot climates*. Brussels, GIFAP.
- ILO.** 1991. *Safety and health in the use of agrochemicals: a guide*. Geneva, International Labour Organisation (ILO).
- NRI.** 1994. *Training supplements, Pesticide Management Training Course*. Chatham, UK, Pest Management Department, Natural Resources Institute (NRI).
- Shell International Chemical Company Limited.** 1982. *Pesticides: a safety guide*. London, Shell.
- UKASTA.** 1979. *Agrochemicals storage handbook*. London, United Kingdom Agricultural Supplies and Trade Association (UKASTA).
- UNEP.** 1990. *Storage of hazardous materials: a technical guide for safe warehousing of hazardous materials*. Technical Report Series No. 3. Paris, Industry and Environment Office, United Nations Environment Programme (UNEP).
- WHO.** 1986. *Informal consultation on planning strategy for the prevention of pesticide poisoning*. 25 to 29 November 1985, Geneva. Unpublished World Health Organization (WHO) document WHO/VBC/86.926.