



Obsolete and unwanted pesticide stocks

Practical guidance on
safeguarding, disposal
and prevention



CropLife International is a global federation representing the plant science industry. Our activities are supported by both our regional and national member associations and our research and development-driven member companies. This booklet is an example of our commitment to provide transparent and useful product stewardship support to the stakeholders of those in, and associated with, our industry.

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Disclaimer statement

The contents of this booklet are intended to complement the requirements of any local, national and international laws, regulations and conventions, and also the International Code of Conduct on Pesticide Management, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal and the Stockholm Convention on Persistent Organic Pollutants.

The information contained in the booklet is accurate to the best of the knowledge of CropLife International. No liability whatsoever can be accepted in respect of the use of this information nor in respect of any advice contained herein.

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The problem of obsolete and unwanted stocks of pesticides, mainly in lesser-developed countries, came to global prominence in the late 1980s, culminating in a multi-party conference in Niger in 1990. One of CropLife International's member companies responded immediately with a joint local project with USAID and GIZ. CropLife International also responded with a guidance booklet on how to deal with the disposal of such stocks, published in 1991. In the intervening 25 years, significant progress has been achieved by many parties with the collection, safeguarding and disposal of these stocks, and prevention of their accumulation.

Large stocks of obsolete and unwanted pesticides are known still to be held by national authorities and others in various areas of the world. Indeed, the United Nations Food and Agriculture Organisation (FAO) estimates the quantity to be around 500,000 tonnes, 40 percent of which FAO believes to be in twelve former Soviet Union Republics. This latest guidance booklet is intended to communicate recommendations distilled

from the considerable experience that has been accumulated to date. It is aimed at all those who may be interested in the issue, whether they are national authorities, aid/donor organisations, UN and other global agencies, NGOs, crop protection companies, members of the media, or other parties.

The intention is to present easy to understand guidance with links to websites and literature providing a more in-depth exposition of particular areas. Contact and website details of key parties are listed for additional assistance.

This guidance booklet complements the range of other publications from CropLife International on good practices to minimize product-related risk to mankind and the environment. I am confident it will be a valuable resource to reduce the quantity of obsolete and unwanted pesticide stocks, and prevent further accumulation.

Howard Minigh
President & CEO of CropLife International
February 2017

1. History and introduction

Following the wide-scale introduction of synthetic pesticides in the late 1940s in the post-war drive to eradicate hunger and disease, unused stocks, predominantly insecticides, slowly started to accumulate. In these early days they were mainly organochlorine (OC) insecticides, such as DDT, aldrin, dieldrin, heptachlor and BHC. All were used in agriculture and some had significant public and animal health uses. One particular reason for the accumulation problem was desert locust control, where strategic stocks often remain for many years in isolated locations, under extreme climatic conditions and sometimes in the open, awaiting the emergence of the pest. In more recent years, some products were banned and so existing stocks could no longer be used. Although the OCs typically had a long shelf-life, deterioration of both the drums and the contents eventually occurred. Even today, occasional stocks and empty drums can be found that are over 50 years old.

In the 1960s, insecticide chemistry moved more towards the organophosphates and carbamates, which were generally less persistent in the environment and had a shorter shelf-life. This latter property added to the potential for obsolescence. In the early-to-mid 1970s, these were followed by the synthetic pyrethroids, and so the evolution of pesticide chemistry continued, up to the increasingly benign, but highly insecticidally-active, molecules of today. Other classes of pesticides, such as herbicides and fungicides, have not featured so prominently among known obsolete stocks.

Packaging has always had a significant impact on the problem because even though a particular pesticide might remain usable, over extended periods well beyond the normal shelf-life the container might start to leak. This was commonly a problem with early steel drums because they were coated internally with special lacquers to prevent interaction between the bare metal and the contents. Rough handling in the field sometimes led to damage to the early internal lacquers, resulting in corrosion of the drum and eventual leakage.

Problem regions of the world have included particularly Africa and the Indian sub-continent, and to a lesser degree Latin America and the Far East. In these regions the problem was often associated with pesticide donations, poor local storage conditions and poor management practice. The overriding common factors have been that the stocks were owned by national or other authorities, rather than the private sector, and the nations involved had neither suitable local means of safe disposal, nor the skills and equipment for undertaking the hazardous associated work.



Obsolete stocks manufactured in 1951, disposed of in 2005, safeguarded by FAO in 2007

A number of countries of Eastern and Central Europe, the former Soviet Union and Central Asia have a particular problem associated with legacy pesticides, most commonly organochlorine insecticides originating from state manufacturing initiatives within the regions. This includes the remains of many now-defunct state-owned production plants and their contaminated sites, and large burial locations that were the result of local 'safeguarding' initiatives.



A number of the more highly-developed nations, particularly in Northern Europe and the Americas, have and continue to run collection and disposal campaigns for farmers, and a few nations have their own high temperature incinerators that are suitable for the destruction of many of the stocks.

The magnitude and associated risk of the obsolete pesticide stocks problem started to become apparent in the late 1980s, highlighted particularly by a number of NGOs. Individual member companies of CropLife International¹ responded to calls for assistance specific to pesticides they had manufactured or supplied. However, usually the stocks originating from CropLife member companies comprised only a part of the overall stocks held by national and other authorities, with the majority originating from commodity and state producers, and at that time there were no concerted multi-party initiatives.

In 1990 a multi-party conference took place in Niamey, Niger, sponsored by USAID and involving 15 African governments, FAO, UNEP, USEPA, GIZ², Greenpeace International, WWF, CropLife International and others. It considered all aspects associated with the accumulation of the obsolete and unwanted stocks, how to prevent a recurrence and how to dispose of the existing stocks. It filled all of the participants with a common resolve to take action. One small outcome was the production by CropLife International in 1991 of its guidance booklet “Disposal of Unwanted Pesticide Stocks”, which this latest edition now replaces.

Major milestones and developments during the intervening period include:

- The UN *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal* came into force in 1992
- FAO formed its *Programme on Prevention and Disposal of Pesticides*, with an early database of the locations and quantities of some global obsolete stocks
- CropLife International formed a special working group tasked with liaising with the key interested parties, collecting stock data via its national associations and affiliates, rendering assistance where practicable and communicating best practice
- Destruction in special high temperature incinerators with suitable emissions treatment facilities became the default general disposal process for most pesticides
- A small number of European professional hazardous waste management companies with their own incineration facilities, set up ‘field teams’ for dealing with the potentially hazardous activities of repacking the pesticides, prior to shipment. Others formed alliances with independent field teams.
- Collection and disposal costs stabilised around US\$3,500-5,000 per tonne of pesticide and associated waste, depending on the size of project and location. Small projects proved considerably more expensive per tonne due to the small tonnage having to bear high fixed costs
- Standard project process steps became established
- The UN *Stockholm Convention*, aimed at the eventual elimination of Persistent Organic Pollutants (POPs), entered into force in 2004 and this led to the production of National Implementation Plans (NIPs) by many nations and these often contained useful inventory information which became a major driver for projects
- The *Africa Stockpiles Programme (ASP)* was launched in 2005; a multi-stakeholder initiative that aimed to tackle the clean-up and disposal of an estimated 50,000 tonnes of obsolete pesticide waste reported to be stockpiled across the African continent
- Pesticide collection and disposal projects are costly undertakings and beyond the means of most of the stock-holding authorities of lesser-developed countries. Various funding mixes were successfully applied on a case-by-case basis during the period, with funds originating from, *inter alia*, World Bank/Global Environment Facility, Germany, the Netherlands, Belgium, US, CropLife International member companies, Finland, European Union, Denmark, UN agencies, Japan and others. The Netherlands has funded the FAO obsolete pesticides programme since its inception in 1994, as well as some national disposal and inventory initiatives
- Various guidance documents and project reports were produced by a range of stakeholders, including FAO, GIZ and CropLife International
- FAO launched its *Pesticide Stock Management System (PSMS)*, an Internet-accessible, password protected database of detailed inventories for nations that is a considerable improvement on earlier databases (access to the database needs to be requested from FAO and agreed by the country that ‘owns’ the obsolete pesticide stocks)
- Small, medium and large multi-party projects were undertaken in many countries, including (in no particular order) Niger, Mozambique, Pakistan, Uganda, Zanzibar, Yemen, Zambia, Tanzania, Madagascar, Namibia, South Africa, Mauritania, Senegal, Cape Verde, Mali, India, Nepal, Ethiopia, Algeria, countries in Latin America and countries of Eastern and Central Europe, the former Soviet Union and Central Asia.

¹ CropLife International was known previously as the Global Crop Protection Federation (GCPF) and before that as Groupement International des Associations Nationales de Fabricants de Produits Agrochimiques (GIFAP) and is the global federation representing the research based Plant Science Industry that manufacture and sell plant biotechnology and crop protection products. The members of CropLife International are BASF, Bayer, Dow AgroSciences, DuPont, FMC, Monsanto, Sumitomo Chemical and Syngenta, as well as, regional biotechnology and crop protection associations. Through the regional members there are additional company members and CropLife national associations in 91 countries across the world.

² The Deutsche Gesellschaft für Internationale Zusammenarbeit (German Agency for International Cooperation), formerly GTZ.



A public/private partnership dieldrin-disposal project - Mauritania - 1997.

- CropLife International began a programme of safeguarding (repacking and secure storage) of high-risk obsolete stocks, beginning with Kenya, Cameroon, Malawi and Ghana, while FAO and other partners looked to securing funds to export and incinerate them
- CropLife International, as part of its commitment to stewardship, has helped to establish container management programmes in many countries across the world, which are aimed at dealing with the problem of contaminated empty pesticide containers (see Jones, 2014).

After almost a quarter of a century of effort by many parties there is still a long way to go. The first ten years saw some 3,000 to 4,000 tonnes of stocks and associated waste destroyed. However, the Desert Locust Campaign of 2003-2005 was left with over 7,000 tonnes of unused stocks, which required considerable effort to re-validate their quality and relocate the usable stocks to other locations, the remainder becoming obsolete.

By 2016 it is estimated that the ASP, in the ten years since its launch, has removed over 4,000 tonnes of obsolete pesticides and contaminated soil, against a background of an estimated 50,000 tonnes of obsolete pesticides and contaminated soil in Africa. By 2019, it is estimated that over 8,000 tonnes will have been removed. The separate efforts of other parties, including FAO, GIZ, the Netherlands and CropLife International member companies are known to have destroyed at least another 5,000 tonnes, mainly from Africa, but also from Asia and Latin America. Additionally, around 15,000 tonnes has been collected and destroyed in OECD countries, notably, Canada, France, USA and Australia. Further stocks from a range of other

countries have also been collected and destroyed by a mix of partners.

An important development has been with the issues of leadership and collaboration by, and among, key players. FAO has assumed a natural global coordination role by virtue of its *Programme on prevention and disposal*, its successful history of projects, its global network and its custodianship of the *Pesticide Stock Management System*. Although only a part of the known obsolete stocks originated from CropLife International member companies, the companies know their products far better than others, have stewardship resources and contribute towards collection, safeguarding and disposal initiatives involving them. So-called Public-Private Partnerships have emerged. The International HCH and Pesticides Association (IHPA) has established a leading communicating, coordinating and facilitating role for the countries of Eastern and Central Europe, the former Soviet Union and Central Asia. Other key 'leading' players have included World Bank (WB), the Global Environment Facility (GEF), UNEP and GIZ, with additional contributions and support from many other stakeholders, including NGOs.

The history of the obsolete stocks issue and lessons-learned in the past 25 years, with a particular focus on Africa, have been outlined in a recent article by Dollimore and Schimpf (2013). Information related to the situation in the countries of Eastern and Central Europe, the former Soviet Union and Central Asia can be found via the website of IHPA - www.iropa.info. As recently as 2014, FAO has estimated that perhaps 40% of the world's obsolete pesticide stock burden can be found in 12 former Soviet Union republics. The situation in OECD countries is summarised on the OECD website (<http://www.oecd.org/chemicalsafety/pesticides-biocides/obsoletepesticides.htm>). In these countries obsolete pesticides are mainly held by private users.

It is emphasised that the collection, safeguarding and disposal of obsolete pesticide stocks is invariably potentially hazardous and requires special expertise and resources. The guidance in this booklet cannot provide such expertise but does provide essential awareness and information on how and where it can be obtained.

One factor that is critical to success is to have a local influential and energetic 'champion'. This has been typically a key party within either the Ministry of Agriculture or Ministry of Environment. Without such a 'champion' a project can take much longer than necessary and even fail to be successful.

THERE MUST BE A LOCAL 'CHAMPION' BECAUSE A SUCCESSFUL PROJECT REQUIRES BOTH INTERNAL 'PULL' AS WELL AS EXTERNAL 'PUSH'

2. Scenarios

The detailed process steps to be followed depend on the circumstances surrounding the stocks. There is a continuum of stock scenario gradations, ranging from:

Scenario 1

A single-product stock that is in good visible condition and in a well-managed store, but is 'unusable' locally for a number of reasons, including:

- it has exceeded its normal shelf-life
- the anticipated pest has not appeared or has been less severe than expected
- its use has been banned.

The solution here may include verifying the quality of the stock and packaging, with the possibility of extending the shelf-life date and then using the stock locally or finding an alternative location or use where the stock can be used.



Scenario 2

A large multi-pesticide stock that has accumulated over many years is spread over a large number of locations, is in poor condition, is definitely not reusable and is presenting a potential risk to nearby communities and the environment. This scenario presents a far different set of circumstances and requires a different set of remedial actions and probably a different source of technical and financial support.

Scenario 2 has been the most common encountered and is the main focus of this guide.

3. Risk assessment

Stocks of obsolete pesticides can present a significant risk to those who have to enter the stores.



A typical contaminated store of obsolete pesticides

Risk assessment therefore forms an important and common theme throughout this guide and so a special section is dedicated to it.

The basic principles are:

ALWAYS COLLECT AS MUCH INFORMATION AS POSSIBLE ABOUT STORE CONTENTS BEFORE ENTERING THE STORE

THEN DO A RISK ASSESSMENT TO DETERMINE WHAT SPECIAL PROTECTIVE MEASURES ARE REQUIRED

The risk associated with the contents of a store of obsolete pesticides is a combination of the hazards associated with the individual pesticides in the store and the likelihood, period and degree of exposure to them.

RISK = HAZARD x EXPOSURE

The **hazard** refers not only to the acute and chronic toxicity (severity and consequence) of a pesticide or its formulation, but sometimes includes other hazards such as flammability and explosivity. Factors related to **exposure** include the likelihood of it occurring, the degree and period of exposure, and the route by which it occurs, such as ingestion, inhalation or skin contact. The normal means of avoiding exposure is containment, whether it be within a steel drum, plastic container or something else. A common situation with obsolete pesticide stocks is a failure of containment, such as leaking from corroded or physically-damaged drums and rotted sacks. There is, therefore, a high potential for exposure. This is made worse by the large quantity of leakage found in some stores. The physical form of the pesticide also has a bearing on the potential for exposure. A solid, such as a rodenticide wax block, has a lower exposure potential than a gas such as methyl bromide. Ambient temperature is also relevant because high temperature will result in higher vapour concentrations.

The final containment is the store itself. So, provided a store has intact walls and a roof, then any doors and windows can be sealed/locked, thus providing a degree of safeguarding until the contents can be safely repacked.

This figure provides some examples of pesticide types that require special care to avoid exposure.

FUMIGANTS:

such as methyl bromide, ethylene dibromide, metal phosphides and metal cyanides

ORGANOPHOSPHATES:

such as mevinphos, parathion and methyl parathion

ORGANOCHLORINES:

such as endrin, chlordane and heptachlor

Finally, people entering an area containing obsolete pesticides, or working with obsolete pesticide need to wear appropriate personal protective equipment (PPE) to avoid exposure.

An example of special measures required for work on some obsolete pesticides in East Africa.



There are various ways of quantifying risk assessments that take due account of all the points of hazard and exposure mentioned above. They go beyond the scope of this guide. Information about the toxicity of pesticide active ingredients and formulations can be found in:

1. The WHO Recommended Classification of Pesticides by Hazard
2. The Pesticide Manual (BCPC publication, see section 7)
3. Safety Data Sheets provided by original manufacturers of pesticides (these will often be specific to individual formulations and normally can be accessed on-line).

HOWEVER, it achieves little by trying to calculate precisely the risk associated with the contents of a store. The 'unknowns' are too many. Common-sense should prevail. So if, for example, a store is known to contain liquid organophosphate insecticides and there are visible signs of leakage, then assume that entry into that store presents a significant risk and professional assistance should be sought.



The evident signs of leakage in the entrance indicate that this store could be hazardous to enter without special training and personal protective equipment.

Occasionally, deteriorated and unstable explosive materials, originally acquired for agricultural use, have been found in pesticide stores and this has necessitated military intervention to remove this unusual hazard.



Deteriorated and unstable explosive material found in a pesticide store

4. Process steps

The detailed process steps to be followed depend on the circumstances surrounding the stocks. For the most common situations encountered, this is typically Scenario 2 in Section 2 (*a large multi-pesticide stock spread over a large number of locations, in poor condition, definitely not re-usable and presenting a potential risk to nearby communities and the environment.*)

A common factor is that the stock-holding nation or authority rarely has sufficient funds of its own to bear the cost of a stock collection and disposal project. One or more sponsors are therefore required.

The main process steps can be summarised as follows:

Preliminary data collection
(see Section 4.1)



Remedial action initiation
(see Section 4.2)



Selection of disposal options
(see Section 4.3)



Project implementation
(see Section 4.4)



4.1. Preliminary data collection



This is the stage where a problem with obsolete or unwanted pesticide stocks has been identified and the owner of the stocks needs to collect sufficient information about the stock and associated circumstances to be able to progress towards remedial action being taken.

The stock may be well-packed, in good condition, in a well-managed store and be well documented but be unwanted. However, this would be unusual and the typical cases of unwanted and obsolete stocks finds them to be often in a poor condition and with leakage, occasionally having already been repacked in a previous age and sometimes having lost their original labels. Such circumstances would make it hazardous for a non-expert without suitable personal protective equipment, training and special handling equipment to be able to enter such stores. This initial data collection must therefore be pragmatic. This includes:

Store locations and stock ownership

A national map, and perhaps larger-scale regional and local maps, should be marked to show store locations/ names and nearby buildings and other features that would be relevant to an environmental/health risk assessment. This would include schools, dwellings and waterways. Ownership of the stocks and stores should be recorded.

Stock quantities and identity

Stock 'book records' can be useful as a start although they are rarely accurate, especially for stocks that may be tens of years old and where containers, commonly sacks and bags, may have disintegrated over the years. But such 'book records' can give an indication of what to look for when entering a store.

If a store is judged safe to enter then a rough inventory can start to be created and at this early stage it is only to get an indication of:

- gross contents of a store (tonnage)
- types and quantities of pesticide categories contained within the store, such as insecticides, herbicides, fungicides etc.
- class and quantities of the pesticide types within a category, such as for insecticides it could be organochlorines, organophosphates, pyrethroids etc.
- common names and/or trademarks and respective quantities of each individual pesticide
- indications of the source of the stocks, such as an aid organisation, a donor, or the original manufacturer
- an indication of the packaging and its condition, and particularly the extent and severity of any leakage
- the general condition and security of the overall store.

At this stage, one of the objectives is to identify potential sources of technical assistance and project sponsorship, which could include a UN organisation, one or more donors, one or more manufacturers, country or entity that owns the stocks or even a country of origin. Usually more than one funding source is approached.

Photographs

As good a photographic record as practicable should be made of the stocks and locations during the preliminary data collection stage. The purpose includes to:

- give a visual image of the condition of the stocks and store
- aid general identification of pesticides and their suppliers/origin
- give an overall view within the store to facilitate risk assessment for those who will need to undertake a detailed inventory at a future stage
- give an indication of external factors in the risk assessment.

A GOOD PHOTOGRAPH
IS WORTH A THOUSAND
WORDS

For more detailed information, see Annex 1 – guidance on photographic needs.

Other information

This includes:

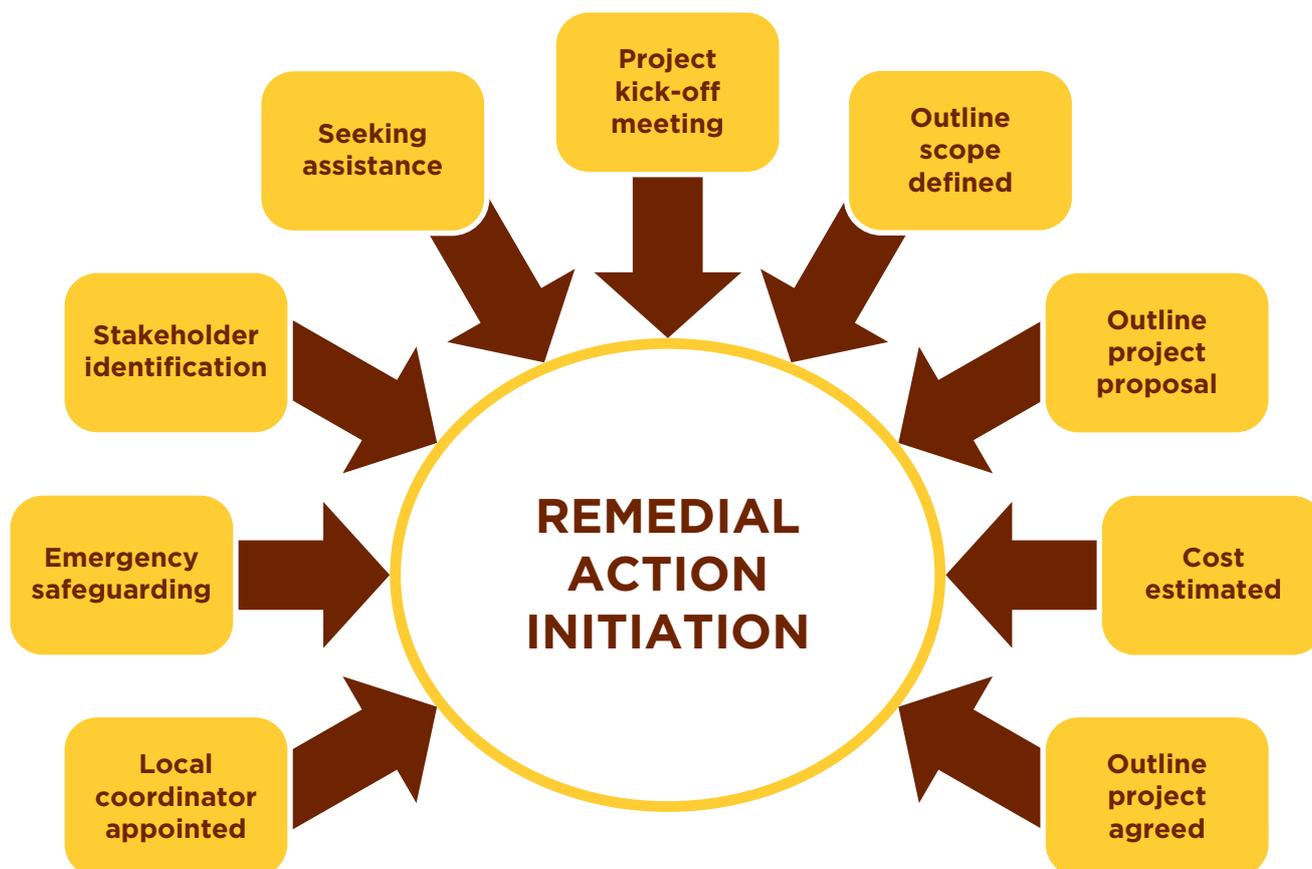
- whether the country has ratified the *Basel Convention* and *Stockholm Convention* (the status of ratifications is on the web sites of the two Conventions, see section 7)
- typical annual climatic conditions
- any special security circumstances that might have a bearing on personnel safety during in-country activities
- whether there is any legislation or pending legislation that might prevent the exportation of obsolete pesticides (hazardous material) for disposal.

Emergency situations

If any of the stock situations are considered to be a clear and present danger to nearby communities and/or the environment and require immediate action then the relevant details should be documented, with an explanation (including supporting evidence) for why the situation is exceptional and urgent.



4.2. Remedial Action Initiation



Local coordination

A local coordinator responsible for overseeing the remedial action needs to be appointed. It is usually someone within either the Ministry of Agriculture or Ministry of Environment. It could be the so-called 'local influential and energetic champion' that is mentioned in the Introduction, but may also be a competent subordinate. The local coordinator needs to have the delegated authority for dealing with the issue within the country and also for contacting external parties who may be able to assist.

Emergency safeguarding

This may be required in circumstance where a particular stock is considered to be a clear and present danger to a community or the environment. Since, at this stage, the stock owner may not yet have access to the expertise needed to repack the stock, then gross containment of the stock may be all that can be done. This can take the form of sealing and securing the store, and even posting a guard. Bulk storage tanks can be padlocked.

Past cases are known of the local 'safeguarding' of obsolete stocks by burying them. This action **MUST** be avoided because it leads to potentially extensive contamination of soil and perhaps groundwater and

is considerably more expensive to deal with than would have been the stocks on their own.

Safeguarding may also be required to prevent theft. There have been instances of stocks 'disappearing' when project intentions have become known locally. Consequences could include pesticides being used for unapproved uses, possibly resulting in prohibited residues in export crops, and produce being rejected or banned by importing nations.

Stakeholder identification

The purpose is to identify those significant stakeholders who were involved with the supply of stocks that have become obsolete or are otherwise not wanted, because they may be willing and able to offer technical assistance and/or financial sponsorship. The main stakeholders will become apparent from scrutiny of the information provided from the preliminary data collection phase.

Such stakeholders include:

DONORS AND AID AGENCIES

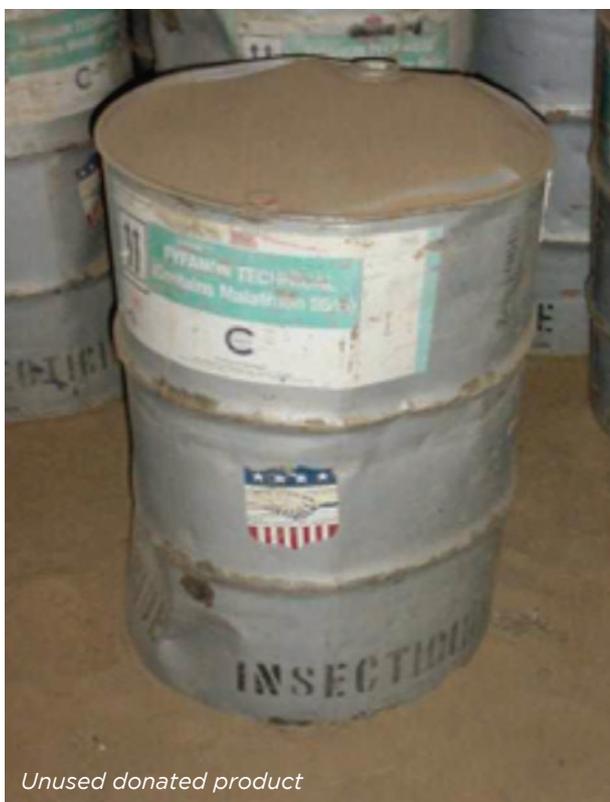
National donors, multilateral or international aid agencies and others are commonly associated with large quantities of pesticides that have been

NEVER BURY OBSOLETE PESTICIDE STOCKS

4. Process steps

supplied for particular agricultural and/or public health campaigns, such as for locust or tsetse fly control. Some of the associated stocks may be many years old but others may be relatively recent and be surplus to requirement because an anticipated pest invasion has not arrived or has been less than expected. Such stakeholders have included in the past:

- UN agencies such as FAO, WHO and UNDP
- World Bank
- National aid agencies such as USAID and the aid/donor organisations³ from the Netherlands, Belgium, Germany, UK, Japan, France, Canada, Sweden and elsewhere
- Regional bodies such as the European Union.



Unused donated product

ORIGINAL MANUFACTURERS

The names of the original manufacturers and formulators can usually be obtained from the labels on pesticide stocks. Trademarks and tradenames can also help identify the original manufacturer by referring to reference sources such as the *Pesticide Manual* – even Google or similar search engines can often help with identification. In some cases original manufacturers no longer exist but may have been acquired by other manufacturers who can then be approached.⁴

Seeking technical assistance and financial sponsorship

Assistance is almost always required with obsolete pesticide stock projects, at both the technical and financial sponsorship levels, namely:

Technical assistance, this may include:

- Data and information assessment
- Drafting the project proposal
- Drafting terms of reference, memoranda of understanding, and agreements between parties
- Estimating project costs
- Sourcing further expertise
- Management of project implementation, including:
 - Tendering and contracting (hazardous waste company etc.)
 - Contract management
 - Monitoring adherence to appropriate standards
- Drafting communications with stakeholders and the media.

Financial sponsorship can be from a single or multiple parties.

DEFAULT SOURCE OF ASSISTANCE

FAO has become the default source of information and technical assistance and since 1994 it has operated *The FAO Programme on the Prevention and Disposal of Obsolete Pesticides*. It meets all of the above technical criteria and has a good track record of working with nations, donor agencies, CropLife International and numerous others to deal with the issue. In addition, it developed and hosts the pesticides inventory database in the *Pesticide Stock Management System* (PSMS).

FAO is also skilled and experienced at sourcing funding for obsolete pesticide stock disposal projects.

DONORS AND AID AGENCIES

If the problem relates to a stock provided by a single donor or aid agency, then a direct approach to the donor or agency would be recommended. National donors can be approached via the local embassy of the donor nation, or directly to the donor organisation itself. Aid agencies are best approached directly.

Donors and agencies sometimes have in-house expertise and resources, or may use consultants. They may also prefer to work via FAO and direct their funding via that route.

³ Many national donor and affiliate names and acronyms have changed over the years and so only the parent countries have been mentioned.

⁴ Phillips McDougall, the crop protection and agricultural biotechnology consultancy company, has produced a chart called *Evolution of the Leading Agrochemical Companies*, which shows the interrelationship between past and present multi-national and major agrochemicals companies. However, full interpretation at the product level requires expert knowledge because certain products and related obligations may not have been sold/acquired under the terms of a company's sale/acquisition.

ORIGINAL MANUFACTURERS

If the problem stock relates to a single original manufacturer that is, or has been, affiliated with CropLife International, then a request for assistance can be directed via CropLife International for routing to the original company, or if it no longer exists, to a company that might have assumed stewardship obligations for the product concerned. CropLife International has agreed an obsolete pesticide policy that states that on a case-by-case basis it may contribute to the destruction of obsolete pesticide stocks that originate from its member companies or company predecessors. All companies, including those not members of CropLife International, can be approached directly.

ALTRUISTIC PARTNERS

Occasionally a party, such as the local embassy of an OECD nation, may be willing to assist with the funding of an obsolete pesticide stock collection and disposal project when it, or the nation it represents, has not been involved with the donation of any of the stocks concerned. The reason might be, for example, that the embassy is implementing an environmental policy that is applicable to the nation holding the stock. Evidence that at least a portion of the stocks originated in the OECD country can help the funding decision. The three-nation West Africa case history in Section 4.4 is an example of such an initiative.

Project kick-off meeting

A common approach would be for the host country, or perhaps a potential funding partner, to convene a meeting of key parties with a view towards setting up a project for the collection and disposal of the obsolete or unwanted stocks. The presence of obsolete stock project expertise at the meeting is crucial and could be provided from in-house resources by one of the participating sources of technical assistance, such as FAO, a donor organisation or CropLife International. On some occasions, independent expert consultants have been used.

The agenda for such a meeting might typically include:

- presentation of the scope of the obsolete stock problem within the host country
- presentation by the obsolete stocks expert of how such projects are undertaken
- presentation of a proposal for the undertaking of a project for the host country, together with an indication of the likely cost components and total cost
- expressions of interest on funding
- project Terms of Reference agreed
- Implementing Agency agreed, key project team members appointed and modus operandi agreed
- plan of action agreed.

The preferred implementation model is to make available to the host nation the services of a specialist hazardous waste management company that will undertake the field work, transportation and destruction of the stocks and associated waste. The national counterpart would normally be expected to make a contribution towards the project cost, and typically at least the free provision of local labour and its transport, accommodation and living costs. The national counterpart would also be expected to:

- provide free access to all sites/stores and make available any necessary temporary working and storage areas
- write-off the obsolete stocks and not seek any compensation
- facilitate the importation and re-exportation of all equipment required by the project
- give full export approval and necessary documentation for the stocks and associated waste
- undertake those activities necessary for compliance with the Basel Convention, and specifically the Trans-Frontier Shipment (TFS) procedures
- facilitate communications within the country, including with the police, hospitals, general public, relevant Ministries etc.

It would be normal practice for there to be a Memorandum of Understanding or similar legal instrument, which details the roles and responsibilities of the main project partners.

4.3. Selection of disposal options



Product use and recycling

This situation applies to unwanted pesticide stocks rather than obsolete pesticide stocks. One of the best known cases followed the Desert Locust campaign of 2003-2005, which was left with over 7,000 tonnes of unused stocks when a continuation of the locust outbreak failed to materialise due to shorter than expected rains and a particularly cold 2004/2005 winter. The stocks were mainly organophosphates, with a smaller percentage of pyrethroids. Although the stocks had reached the end of their two-year post-manufacture shelf-life period, many of the stocks were still potentially usable. A collaborative programme between FAO, CropLife International and national and regional authorities resulted, and involved:

- verifying the quality of the unused stocks
- finding locations where the stocks could still be used
- getting the stocks to these locations
- destroying some unusable stocks.

All of these activities were complex and time-consuming but finally resulted in a significant minority of the stock being redistributed and used. This subject goes substantially beyond the scope of this booklet. In cases where there are significant stocks of a variety of unwanted but potentially usable pesticides associated with a major campaign, first contact could be made with FAO. In the case of a potentially still usable stock of a pesticide from a single manufacturer then the manufacturer should be contacted to check whether the stock might still be usable.

Stock destruction and disposal

The inherent hazards associated with obsolete pesticide stocks, especially the potential toxicological hazards, have already been outlined in Section 3. However, when selecting a disposal route, physio-chemical properties and factors also need to be considered.

Synthetic pesticides are most commonly organic chemicals. In addition to carbon, hydrogen and oxygen, they often contain chlorine, phosphorus, nitrogen, sulphur and other less common elements such as bromine and fluorine, and even metals/metalloids such as mercury, manganese, copper, chromium and arsenic.

All purely organic materials can be destroyed by high temperature incineration. However, it is the associated elements mentioned above that can present problems, particularly with respect to emissions and residues that result from incineration. The concentration of these associated elements is critical. For example, undiluted DDT contains around 50% by weight of chlorine. Undiluted parathion contains around 11% phosphorus and 11% sulphur. However, the overwhelming majority of pesticides that are found as obsolete stocks are in the formulated form and so they have been diluted with, for example, organic solvents, water or inert clays, and may also contain other formulation ingredients to make them usable by farmers. In addition, they will have their associated packaging, which can range from steel drums to plastic or natural fibre sacks. Furthermore, the size of the contents of each pack can range from a few kilograms to 200 litres or more. All of these factors put a particular burden on the incineration facility.

HIGH TEMPERATURE HAZARDOUS WASTE INCINERATORS

High temperature incineration in a dedicated hazardous waste facility has become the default technique for the destruction of most obsolete pesticide stocks. The primary aims of incineration are to break down the pesticides into inert inorganic products (solids and gases) and to do so without the formation of new hazardous compounds. Efficient incineration requires both a good supply of oxygen and the so-called 'three Ts' of combustion, namely:

- Temperature
- Time
- Turbulence.

Temperature – The higher the temperature at which the pesticide is burnt, the more completely it will be destroyed. The halogenated pesticides are among the most difficult to incinerate and temperatures in the region of 1,100-1,200° Celsius are required for their destruction.

Time – The longer the time the pesticide is held at high temperature, the greater will be the degree of destruction. The residence time of the pesticide in its gaseous phase is of particular importance and at least two seconds is generally considered necessary.

Turbulence – The higher the degree of turbulence in the incinerator, the higher is the destruction efficiency. This is simply because there is more intimate contact between the pesticide and the oxygen in the combustion air and a reduced likelihood of significant temperature gradients.

The incineration of pesticides produces gaseous emissions and it is here that the chemical elements chlorine, phosphorous, nitrogen, sulphur and the others can present problems. Chlorine can be converted to hydrogen chloride, and phosphorus, nitrogen and sulphur to their oxides. Metals and metalloids will be found in various forms. Some toxic materials may even be formed after the thermal destruction of chlorinated pesticides has occurred, such as dioxins and furans. The emissions-control component of a modern high temperature incinerator is a necessary and expensive addition. It includes:

- a quench unit to cool the hot flue gases rapidly and to reduce the hydrogen chloride level and the likelihood of dioxin and furan formation
- an alkaline scrubber unit to remove remaining acidic gases such as sulphur dioxide
- a de-dusting unit.

The emissions from such incinerators are strictly regulated and monitored within OECD countries in order to safeguard nearby communities and the wider environment. Within the European Union the relevant regulatory instrument is the EU Directive on Industrial Emissions.



A modern hazardous waste high temperature incineration facility

In addition, there are the storage facilities for the hazardous waste, the dosing equipment for entering the different types of waste (liquids, solids etc.) into the high temperature kiln, the laboratory for checking elemental composition, calorific value and emissions, and the highly skilled staff required to run such a facility. Something that is also not always appreciated is that once a high temperature incinerator has started operating, it needs to have a regular base-load of waste to keep it running because the incineration kiln cannot easily be stopped and started without incurring high costs and risking damage to the kiln's refractory lining. The financial investment and operating costs incurred by such a facility are considerable and this requires a high and steady throughput of waste to justify these costs.

A consequence of these background factors is that there are only a small number of such incinerators in operation. Many have failed to survive in the past 25 years. Incineration capacity in the USA is not available to the international market because the USA has not ratified the Basel Convention and so importation of obsolete pesticide stocks into the USA is not possible.

CEMENT KILNS

Cement kilns can provide the ideal technical conditions for the destruction of pesticides because they operate at 1,400 to 2,000° Celsius and the residence time of the gas phase is between six and ten seconds. The cement process also absorbs acidic gases. Cement kilns exist in many countries and the additional investment required for their technical adaptation may be relatively minor. Indeed, there are a number of examples where a cement kiln has been used successfully to destroy obsolete pesticide stocks, including in Malaysia (Schimpf, 1990), in Pakistan (Huden, 1990), in Tanzania (Schimpf 1998) and Poland (Stobiecki *et al*, 2003) – all reported by Karstensen (see Reference in Section 7). However, particularly for developing countries and those in transition, there are concerns about health, safety and environmental standards, the handling of toxic materials by an

industry not accustomed and trained for dealing with such products, and perceived adverse effects on cement quality. The issue of co-processing has been considered in detail by a public-private partnership of GIZ and the Holcim Group (a worldwide leading supplier of cement) and published in 2006.

However, in certain circumstances, the concerns of local communities and NGOs can override the purely technical considerations. This happened in Mozambique in 2000, where a Danish-sponsored cement kiln pesticide disposal project was eventually abandoned following the expression of such concerns both locally and in Denmark.

SMALL AND MOBILE INCINERATORS

Small incinerators – There are small-scale units, such as the Michaelis incineration system. Whereas these may suit chemical manufacturing facilities with clearly-specified waste streams, they are not appropriate for dealing with the capacity, variety and forms of hazardous waste and packaging that typically arise from national obsolete stock disposal campaigns.

Mobile incinerators – such incinerators certainly have a valuable use in large soil-decontamination projects, which might take several years to undertake and where it would be impractical and prohibitively expensive to ship such large quantities of soil to a hazardous waste facility in an OECD country. However, the cost and complexities of importing such a unit and the skilled operating crew could not be justified by a typical obsolete pesticide stock disposal project.

SPECIAL TECHNIQUES

Certain materials can present particular problems, including:

Pressurised gases – methyl bromide is a commonly-found example. It is classified as toxic and dangerous to the environment and in accordance with the *Montreal Protocol on Substances that Deplete the Ozone Layer* (Montreal Protocol) it should have been totally phased out by 2015. It was supplied in pressurised steel cylinders, which over the passage of many years often became corroded.

Sometimes cylinders have even perforated and the contents have been lost to the atmosphere. One disposal option is to put the pressurised cylinders into salvage containers and transport them to a special handling and disposal facility, usually in Europe. However, this is expensive and involves transporting the gas over large distances. An elegant field method was used for a project in Nepal in 2011 where the gas was transferred from cylinders to an imported reaction vessel and hydrolysed to produce methyl alcohol and sodium bromide, which could then safely be disposed of locally. The emptied steel cylinders were recycled in a local steel smelter (For details see Schimpf, 2013)

For other hazardous gases, either the manufacturer or hazardous waste company that undertakes the collection and disposal of the overall stocks should be able to provide a solution.



Badly corroded pressure containers

Other materials – certain toxic elemental components of past pesticides, such as arsenic and mercury, can present a problem with the incineration process because, as chemical elements, they cannot be broken down. They would, therefore, be emitted in one of the incinerator's effluent streams and could present a hazard to man and the environment. Such emissions are strictly controlled and so the hazardous waste company needs to make itself aware of the levels of such materials in the waste to ensure the emission standards will not be exceeded. Where significant levels of such components are found, then alternative approved 'disposal' methods need to be used, such as recovery (for mercury) or hazardous waste landfill or deep mine storage (for arsenic). The major hazardous waste disposal companies are well-acquainted with such techniques.

OTHER TECHNOLOGY

Over the past 25 years a number of other technologies have been studied for the safe and practicable destruction of obsolete pesticide stocks. Disposal options were reviewed under the Africa Stockpiles Programme.

These have included plasma technology and chemical decomposition. None has come even close to surpassing the use of the current state-

of-the-art high temperature incinerators. Reasons include the great variety of pesticides found among the obsolete stocks, their physical states and the presence of packaging and formulation solvents and other ingredients, but above all, the high temperature incinerators already exist and have been demonstrated to do the job required. For further discussion see http://www.fao.org/fileadmin/templates/obsolete_pesticides/Guidelines/EMTK3web_nov_small.pdf (Annexes 4-6)

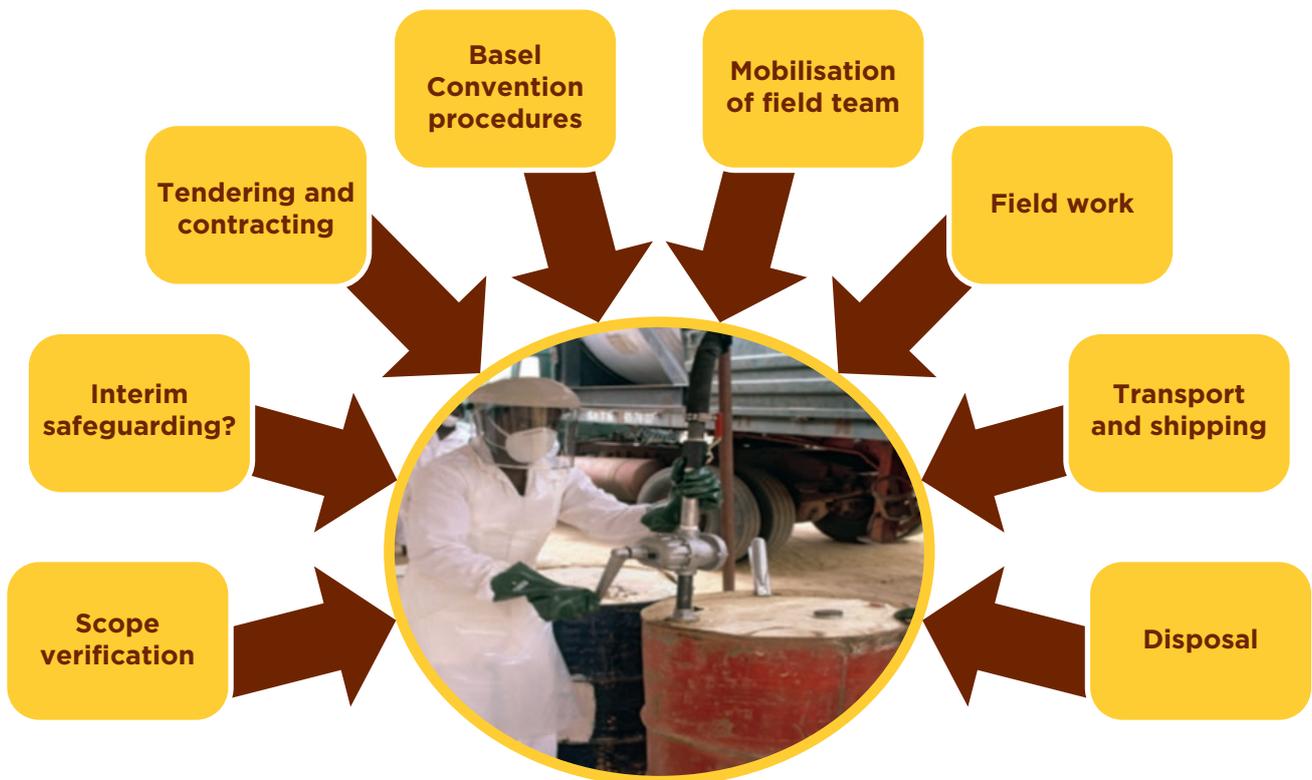
STEEL DRUMS

Most packaging is shipped with the waste and then incinerated – particularly paper, fibre and plastic packaging. However, steel drums are a special case. The steel is sometime considered to be a valuable local resource and so drums are often rinsed (with water or solvent) to decontaminate them, crushed and sent to a local steel smelter. This also saves shipment and incineration costs.



Crushed steel drums being recycled in a local smelter

4.4. Project implementation



Scope verification

Before tendering for the services of a hazardous waste collection and disposal contractor, reasonably precise details of the stocks, their condition and their locations are required. If the managing organisation has the necessary in-house expertise, then one of the in-house experts should visit the locations and undertake the detailed inventory and assessment. In the absence of in-house expertise, specialist independent consultants are available who can undertake this work⁵. Not only will details of the stocks be required but there should also be an estimation of any gross contamination associated with the stocks. This is generally an assessment of the volume of soil/sand visibly contaminated, as well as contaminated containers.

The forms (in various languages) required for inventory-taking can be found on the FAO website <http://psms.fao.org/psms/resources.htm>

A detailed photographic record should be made:

- To aid the identification of key products and their suppliers (essential for obtaining disposal funding contributions from suppliers),
- To facilitate a health, safety and environmental risk assessment
- To provide important information required by a hazardous waste contractor.

Poor photography may mean that an inventory, or part of it, has to be repeated. See Annex 1 for guidance on photographic needs.

The visits may also include route scouting, because large vehicles bearing loaded freight containers will need safe access to and from the sites.

Interim safeguarding

If a full collection and disposal project is not able to commence immediately, perhaps because sufficient funding for the full project has not yet been obtained, then an interim safeguarding initiative should be considered. This will apply especially when a particular stock forms a clear and present danger to a local community.

Interim safeguarding can vary in degree from simply securing the store in which a stock is held, through to repackaging the stock and transporting it to a secure location. It can also include the collection of unwanted and obsolete pesticide stocks held by the private sector. The safeguarding process usually involves a high potential risk of exposure and so professional expertise and equipment are required and all those assisting will require training and personal protective equipment.

The CropLife CleanFarms initiative has been applied successfully in a number of African countries since the mid-2000s and includes a major safeguarding component. The initiative evolved from a national campaign undertaken by CropLife Canada and ChemClear in Australia. Details of the various case histories can be found via the CropLife International web link: www.croplife.org/obsolete_stocks.

The basic principles of a safeguarding initiative might include:

- assemble a 'management team', which would normally comprise representation from the public and private sectors, together with expert and/or funding bodies such as FAO, CropLife International and experts from donor organisations
- The terms of reference of the various parties, including the roles and potential inputs, such as communications, storage facilities, assistance, expertise and funding, should be defined
- a stock awareness, amnesty (possession of obsolete chemicals is illegal in many countries) and collection campaign focused on the private sector (agrochemical dealers, farmers and other users)
- an inventory of public sector stocks
- assessment of the collected data
- selection, and if necessary upgrading, of one or more secure central stockholding points
- contracting an accredited hazardous waste management company with proven experience of working with obsolete pesticide stock disposal projects
- providing the necessary safeguarding training to selected key personnel from the local public, private and non-governmental sectors
- repackaging the stocks in UN-approved drums or other approved containers and safely transporting them to the selected collection centres, ready for eventual disposal
- securing and guarding the safeguarded stocks until their safe collection and disposal takes place.

This collaborative model of safeguarding obsolete pesticides effectively reduces environmental risk in the short term, while multilateral agencies, such as the FAO, and national governments, work to acquire funds for the subsequent shipping of the stocks to Europe and their safe disposal.



⁵ Organisations such as FAO, GIZ and CropLife International can provide details of independent consultants having suitable expertise.

Tendering and contracting

FAO and donor organisations, as well as CropLife International, are well-acquainted with the undertaking of competitive tenders so that they are done in a business-like manner and in a fair and unbiased way that will withstand independent scrutiny. The process steps include:

- precisely defining the scope of the work required. It is most important to get the work as completely described as possible, with full substantiating documentary and photographic evidence
- submitting the required work and tendering requirements to a number of international hazardous waste management companies that have an established track record for undertaking such work. Organisations such as FAO, GIZ and CropLife International are well-acquainted with the companies that are experienced with the undertaking of obsolete pesticide safeguarding, collection, transporting, shipping and disposal projects. It is preferred to have a single company that is able to undertake both the field work using its own, or a closely affiliated, experienced team as well as having its own hazardous waste treatment facilities. Some potential funding or project managing organisations, such as the embassies of OECD nations and multi-lateral agencies, may require an open public tender, for which any party may bid
- assessing tender submissions, firstly from the standpoints of technical compliance with the defined scope of work and evidence of competence. Those submissions that comply fully with these criteria are then assessed from the financial standpoints, in particular their bids. It would be normal to have a bid panel, comprising technically, financially and legally competent parties, with first-hand experience of previous similar projects.
- awarding of contracts and the drawing up and signing of agreements. Such agreements would normally have phased payments tied to agreed work completion points.

The finer details of tendering and contracting go beyond the scope of this guidance booklet.

Trans-frontier shipment procedures

The Trans-Frontier Shipment (TFS) procedures are a requirement of the *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal*. The Convention was introduced in 1989 in response to a public outcry following the discovery, in the 1980s, in Africa and other parts of the developing world of deposits of toxic wastes imported from abroad. It entered into force in 1992 and requires, *inter alia*, those nations involved with the movement of hazardous waste, and which are party to the Convention, to comply with a strict regulatory system, which is the cornerstone of the Convention.

Based on the concept of prior informed consent, it requires that, before an export may take place, the authorities of the State of export notify the authorities of the prospective States of import and transit, providing them with specified information

about the intended movement. The movement may only proceed if and when all States concerned have given their written consent. The *Basel Convention Secretariat* is available to help facilitate and support this cooperation when required.

Many nations have now ratified the *Convention* and the list can be found on the *Basel Convention* website (see section 7). In essence, any nation that is involved with international movement of obsolete pesticide stocks will need to have ratified the *Basel Convention* – this includes those nations via which a shipment of obsolete pesticide stocks will have to transit. Should a nation have not yet ratified the *Convention* then a project that requires transboundary movement cannot normally be considered.

All of the international hazardous waste management companies are well acquainted with the TFS procedures required by the *Basel Convention* because without being so they would be unable to undertake their international hazardous waste business. It must form part of their contractual undertaking, therefore, to ensure that the necessary TFS documents are completed properly before any shipments take place. The shipping lines are similarly well acquainted and will not accept such shipments without the necessary documentation being in order.

Mobilisation of the materials and field team

This is the step of getting the materials and field team out to the location where the work will be done. The field team will usually require visas and may also need special approvals if stocks are in sensitive areas. Good coordination is required to ensure the field team does not arrive ahead of the materials and their release from the customs/importation authorities. It needs good liaison with the shipping line and local authorities, and secure local storage for the materials is required. The materials will be determined by the work to be done and local circumstances and utilities/facilities available. A list of typical materials required by the field team is given in Annex 2.

For critical equipment there should be adequate back-up.

Field work

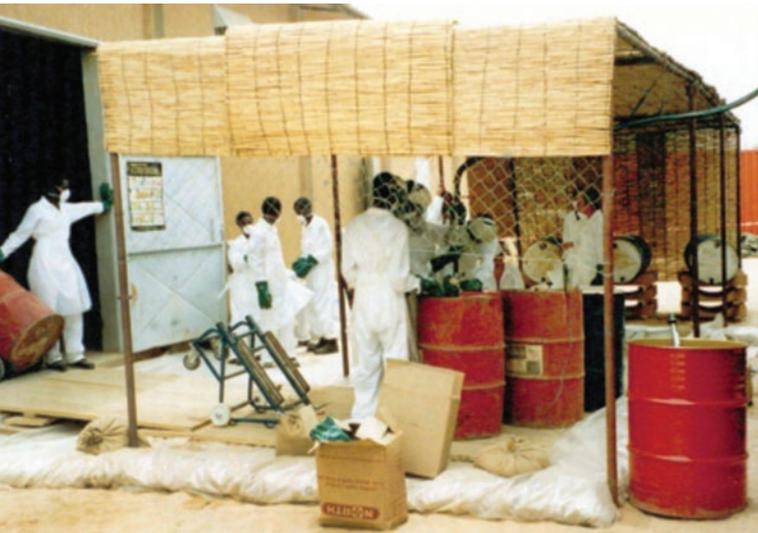
The first step in field work is to train all those local staff who will be involved. The training is normally undertaken by the hazardous waste management company overseeing the field work because not only does it have the expertise but it also has the safety and other equipment that will be used for the work. The training programme should include:

- an explanation of the work being undertaken
- an introduction to the pesticides believed to be present, their properties and hazards (toxicity, flammability, explosivity etc.)
- an explanation of risk and how to avoid exposure by its various potential routes
- where to find fuller information on the pesticides
- personal protective equipment – what is needed for which job/situation and how/when it should be used

4. Process steps

- standard operating procedures for specific tasks, such as the repacking of hazardous liquids and crushing of drums
- emergency response procedures in the event of personal contamination, signs of intoxication, spillage, fire etc., including how to contact nearby hospitals, the police, fire authorities etc.
- good general working practice, including personal hygiene (changing out of work clothes and washing hands before eating etc.) and avoiding heat stress
- explaining the chain of command and individual responsibilities.

The experienced hazardous waste management companies have well-established procedures. The photograph below shows a typical redrumming area. It has a bunded floor made of sandbags and an impermeable membrane so that any inadvertent spillage cannot leak into surrounding sand/soil. It also has a roof covering to give some protection from the direct sun.

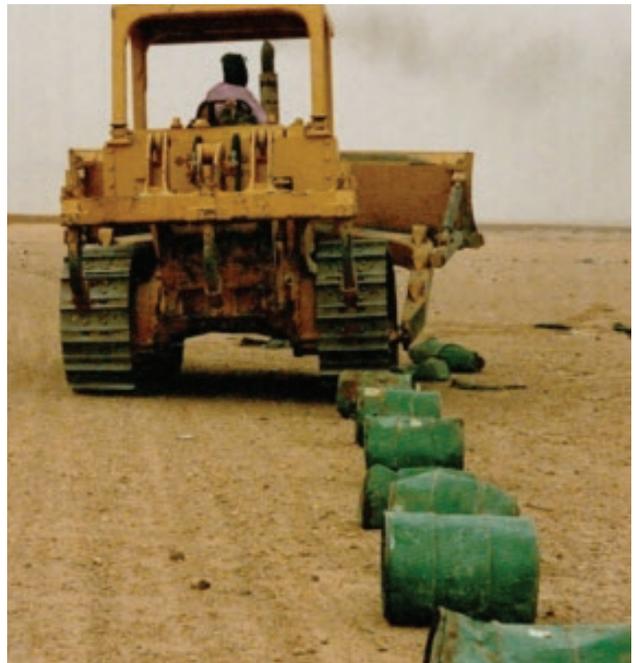


Redrumming of obsolete product



Drum-crushing in progress, using a commercial drum-crushing unit

The supervisors of field operations must not only have considerable experience of the work they are undertaking but they must be practical and inventive when required, as shown in one of the first projects to be undertaken where, in the absence of a drum crusher, a local bulldozer was used to crush the rinsed drums.



Crushing empty, rinsed drums

Transportation

The repacked and properly labelled obsolete pesticides and associated waste are most commonly transported from the site to the overseas hazardous waste incinerator in international shipping containers. A locally-fabricated steel floor-liner is sometimes used to capture possible leakage of liquids during transit, which is an unlikely event bearing in mind that new drums or overdrums are used. One project involving a large quantity of a single liquid pesticide product was able to use bulk liquid shipping tanks.



1 m³ bags of solid waste being loaded during a project in East Africa

Transportation normally involves movement of the waste both overland and by sea. Because of the hazardous nature of the materials being transported, care should be taken with the selection of local hauliers, including a safety check of their vehicles. The local national counterpart may sometimes be able to make available suitable vehicles for the movement of the waste to the port of departure.

The international shipping line is normally selected by the hazardous waste management company overseeing the project. In recent years it has become more difficult, and hence expensive, to find shipping lines that are willing to handle hazardous waste. Trans-shipment of the waste from one ship to another during the journey should be avoided whenever possible and the general aim should be to have the minimum number of ports of call. This minimises both the potential for accidents and the number of nations that have to be involved in the trans-frontier shipment (TFS) process.

The transportation of the waste should be an integral part of the overall emergency response procedure so that any emergencies, although unlikely under normal circumstances, can be dealt with promptly and correctly.

Disposal

HIGH TEMPERATURE INCINERATION

The normal disposal process for most obsolete pesticides will be high temperature incineration in a hazardous waste incineration facility that operates to normal OECD or UN emissions standards and is fully licensed for this purpose by the national authority. Over the past 25 years a small number of high temperature incineration facilities and operators, mostly in Europe, have demonstrated their competence in this type of work and are able to accept material from overseas.. Annex 3 give the contact details for a number of companies that offer hazardous waste services.



The sophisticated control room of a modern high temperature hazardous waste incinerator

On occasions a new high temperature incinerator operator may offer its services. The recommended practice would be to undertake an assessment, which must include a site visit, before accepting such services. Where credible emissions data are unavailable, an emissions monitoring trial may need to be undertaken, to verify compliance with OECD emissions standards. It would be normal practice for the trial to use obsolete pesticide stocks of known composition. If the stocks contain chlorinated pesticides (DDT, dieldrin, chlordane etc.) then they must be present in the trial because they can give rise to dioxin and furan formation, the levels of which are closely regulated.

The assessment of high temperature incineration facilities and operators requires a significant degree of expertise for undertaking an emissions monitoring trial, as well as specialist analytical facilities for verifying that the components in the emissions are not exceeding acceptable levels. Such expertise can be accessed via organisations such as FAO and GIZ.

MATERIALS NOT SUITABLE FOR INCINERATION

The hazardous waste management company overseeing the project must make itself fully acquainted with the composition of the waste. Much of this can be done by scrutiny of the inventory data, using reference sources such as Safety Data Sheets and the *Pesticide Manual*. The common elements being looked at are outlined in Section 3. The more problematic elements, including mercury and arsenic, subject to the concentrations present, may require special 'disposal' procedures.

DOCUMENTATION

Once disposal has been completed, the hazardous waste company entrusted with the disposal should acknowledge formally the safe destruction/disposal of the waste. This would normally occur at two levels, namely:

1. The TFS process requires the disposer of the waste to certify on the TFS form that the disposal/recovery of the described waste has been completed
2. The party for whom the waste is being destroyed should be given a 'certificate of safe disposal' by the hazardous waste management company. Where disposal has been undertaken in multiple batches or campaigns then a certificate for each should be issued. This certificate should specify the waste, describe how it was destroyed or otherwise disposed of, and might also provide the average levels of gaseous incinerator emissions during the period of disposal.

Following each project it is recommended to have a 'lessons-learned' session involving all of the main parties. These sessions almost always identify aspects where improvement is possible and hence should be incorporated into future projects. Such lessons should be included in the final project report.

Case history

A pictorial overview of a Public-Private Partnership project involving three West African governments, the Royal Netherlands Embassy, Dakar, and CropLife International is shown in the following Figure. The case involved the use of consultants for both scope verification and the monitoring of project implementation, and employed the services of the hazardous waste management companies SAVA GmbH and Tredi S.A.



Ambassade van het Koninkrijk der Nederlanden



Public – Private Partnership for the destruction of obsolete pesticides and POPs in West Africa

A public - private partnership between the governments of Cape Verde, Mauritania and Senegal, a Netherlands Embassy and CropLife International has achieved the destruction of 768 tonnes of obsolete pesticide stocks and contaminated wastes from the region, including 63 tonnes of POPs products (dieldrin and DDT).

The stocks, mainly insecticides, comprised a wide range of imported and locally formulated pesticides. Many had been donated as aid by international organisations for use against desert locusts and other strategic pests, but had never been used. All of the obsolete stocks had deteriorated with age and were no longer useable. Stocks in bulk storage tanks and those where the original containers had deteriorated presented a potential threat to communities close to the storage sites.

The project took 3 years to complete at a cost of Euro 2.4 million, or about Euro 3000 per tonne of waste. The main sponsor was the Royal Netherlands Embassy, Dakar, Senegal. CropLife International provided technical and management assistance and seven funding companies paid for the incineration of the products they originally manufactured. The national governments facilitated the work of the specialist disposal companies SAVA GmbH and Tredi S.A. employed to collect, remove and destroy the waste products. The project was independently monitored by NIRAS Consulting Engineers of Denmark.



A store at Rosso, Mauritania



Recovering dieldrin from an underground storage tank



A store at St Louis, Senegal



Collecting dieldrin from storage tanks in Senegal

After final packing of waste products to international standards, containers were shipped to Rotterdam and then by train to Germany.



High temperature incineration facility in Germany



Dieldrin stocks at Richard Toll, Senegal



Lessons-learned reports capture experience for future projects



Project reports record full details of all activities

Prepared by CropLife International. Photographs courtesy of NIRAS and SAVA.

5. Health, safety, environmental, security and communications considerations



When the stage of project implementation is reached, a more detailed consideration of health, safety and environmental (HSE) matters and security is required. The approach should be based on the risk assessment, first identifying the type and degree of hazards and then introducing controls designed to avoid or minimise exposure. In addition, in the event of an exposure, whether it be to man or the environment, an emergency response action plan is required. The issue of communications with local stakeholders must not be overlooked because the presence of a worker in protective clothing can cause undue concern if not managed properly.

Information

For each of the known products within a particular stock, a Safety Data Sheet (SDS) should be obtained from either the supplier/manufacture of the product or an appropriate alternative source. An SDS should ideally be specific for the formulation concerned because the hazards will relate specifically to the particular formulation. This includes properties such as the acute dermal toxicity and flammability, which can vary significantly with the formulation ingredients; water-based formulations will be non-flammable and usually have a lower dermal toxicity than organic solvent-based formulations. The SDS will also provide information such as the antidote that should be used in the event of an intoxication, and action to be taken in the event of a spill. If a particular pesticide is several decades old and the supplier/manufacture cannot be identified, or no longer exists, then generic SDSs can

readily be found via the Internet. Although they may not be specific to the actual formulation they should be selected to be as similar as possible and can then provide guidance related to hazard and action to be taken in the event of exposure.

The *Environmental Health Criteria* (EHC) series of WHO is an excellent source of information for many chemicals and a number of pesticides and is accessible from the WHO International Programme on Chemical Safety EHC website (see section 7).

Occupational health and safety

The key preventive action from the health and safety standpoints is to avoid exposure to the products. This is achieved by a combination of:

- well-designed operating procedures
- personal protective equipment
- pre-operational training
- constant supervision
- working procedure reviews.

The approach to occupational health and safety management should be presented in the submissions of hazardous waste management companies during the tendering stage. A general guide to the personal protective and related equipment is given in Annex 2. The services of a physician experienced in the

symptoms arising from exposure to the pesticides involved should be available to the work locations, together with any potentially necessary antidotes and therapeutic drugs.

Environmental protection

During the risk assessment, the potential opportunities for an accidental release should be identified. This could happen at any stage in the process from collection to destruction and suitable safeguards to avoid such releases must be taken. These include:

- well-designed operating procedures (bundled redrummy areas, spill containment protocols etc.)
- pre-operational training
- secure safeguarding
- good containment during movement to the final point of destruction (UN-approved drums, drip trays in shipping containers etc.)
- careful selection of hauliers and shipping lines
- careful selection of incinerator operators and facilities for compliance with emissions standards
- monitoring of emissions during destruction.

Emergency response

Should an emergency happen, rapid action is required and so a pre-prepared and tested emergency response system is required.

The basic elements of such a system include:

- a designated manager of the system
- designated responsibilities for those involved in the system
- an emergency response manual prepared specifically for the particular project, with clear procedures to be followed in the event of an emergency
- a readily-accessible source of product and emergency information (usually a set of MSDSs) on the pesticides listed in the inventory
- a list of specific signs and symptoms that could indicate intoxication
- a cascade list of key contacts, giving 24 hour contact details. This would include not only key project people but also a list of local emergency contacts, such as a doctor, hospital, fire service, police etc. (all would require a pre-briefing)
- a list of key contacts for the local community
- local availability of any emergency antidotes and therapeutic drugs
- a 'fail-safe' local emergency communications system
- someone designated for briefing the media and responding to enquiries.

The designated responsibilities will usually involve both the local counterparts and the project implementing party. The documentation may need to be in several languages to ensure comprehension by all involved.

Security

In recent years, security of field personnel has become an increasingly important consideration and needs to be discussed with the local authorities before field activities commence. The 'travel advice' from the country of origin of the field personnel should also be adhered to. A plan of action needs to be agreed, which could even include the provision of armed guards in certain circumstances. Some projects have had to be postponed as a result of poor local security. The security assessment should also consider the route the stocks need to follow when going to the port from where the stocks will be exported, which may include passing through other countries. This photo shows a guarded convoy transporting dieldrin stocks from Niger in the early 1990s.



The security of both equipment and obsolete pesticides themselves also needs to be considered and so suitable safeguards should be adopted. There have been cases of equipment being stolen and some parts of stocks have 'disappeared' when it became known that a collection and disposal project was about to take place.

Communications

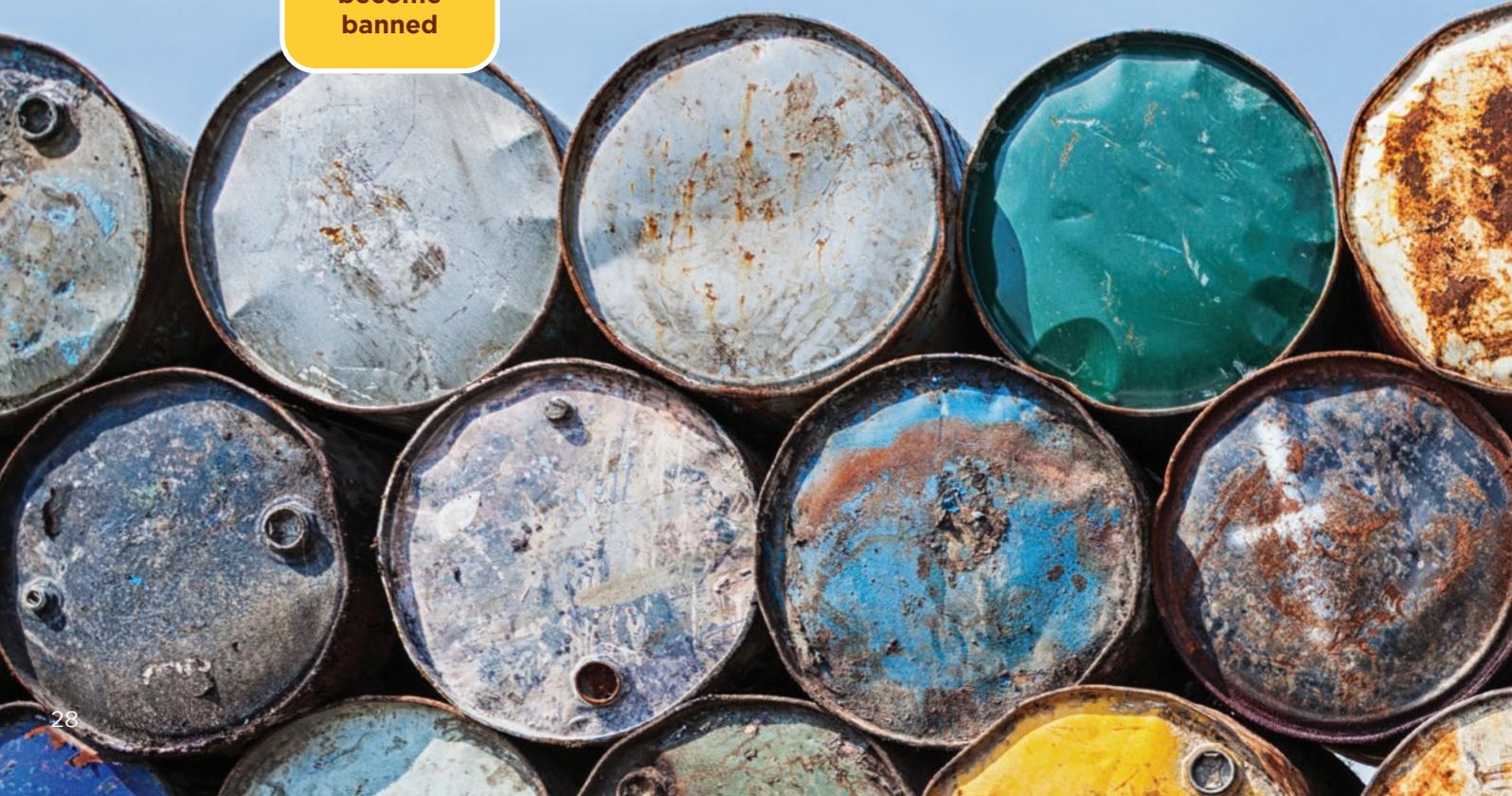
It is important to allay public concerns when arranging for the disposal of obsolete pesticide stocks and to be prepared to respond rapidly and accurately to questions from the general public and the media. It is recommended that a statement is prepared in advance, which summarises the essential details of the operation. This statement should be supported by a set of questions and answers that are designed to provide more and broader information that might be required at short notice.

Some circumstances may be particularly sensitive, for example a project being undertaken in the close vicinity of a school, and so merit additional communicational activity. This could include an open day, to which local communities are invited and where display boards show what is going to take place, and where questions can be answered. Such events would normally be organised jointly with the local authorities.

6. Causes and prevention measures

When the common causes of the accumulation of unwanted and obsolete pesticide stocks are analysed, it soon becomes apparent what common-sense prevention measures can be taken although some are rather more difficult than others.

Common causes of stocks becoming unwanted and/or obsolete



Pests do not appear – this is found typically with locust campaigns where the consequences of having insufficient crop protection products for an anticipated outbreak can be catastrophic for the agriculture of a nation or region. The attitude of ‘better to be safe than sorry’ is usually adopted for the good of the nation or region.

Donations – this is linked to the problem of anticipated pest outbreaks not occurring and nations and authorities not wanting to be faced with having insufficient pesticides to deal with a problem, which could have significantly adverse agricultural and political consequences. However, in addition, some donations in the past have been inappropriate for the particular pest problems being faced, due either to the pesticide type being wrong or its quality inadequate. Some donations have even been unsolicited, which places a further burden on the recipient nation.

Poor stock management – this is probably the main cause of stocks becoming obsolete. Over-ordering has been a common problem of the past, associated mainly with centrally-managed economies and state purchase. The basic principle of ‘first-in; first-out’ is often not practised and so stock remnants accumulate and deteriorate. Stores are often poorly designed, maintained and managed, and cases of damage to containers through rough-handling are commonplace. The official inventory records of stocks are often found to be out-of-date.

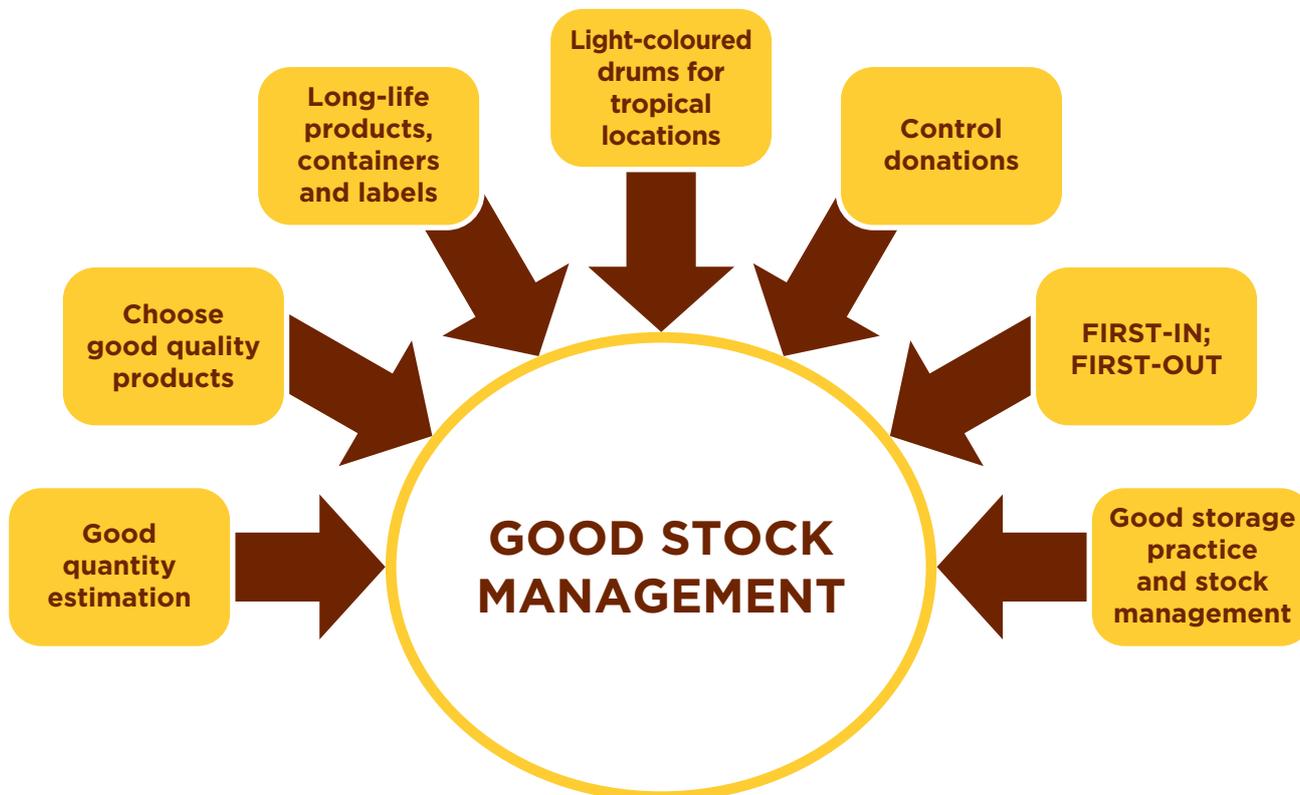
Poor product quality – this applies not only to the pesticide itself but also to the packaging. Both the pesticide and its packaging need to be fit-for-purpose, which may mean being able to withstand being kept in extreme climatic conditions, sometimes in the open. Many cases have been seen of paper and fibre sacks that have disintegrated totally, leaving the pesticide unable to be transported for use in the field and exposed to whoever has to enter the store. Drums have also been seen that have been severely damaged through bad handling, and sometimes have holes in them due to penetration by drum handling equipment.

Poor quality labelling – very many cases have been seen of poor labelling, most commonly from commodity suppliers and where products have been repacked locally. This makes product identification difficult or even impossible and so the products cannot be used. The poor quality of the labelling may relate to the material of manufacture not being able to withstand normal use due to abrasion, bleaching of the printing ink, becoming detached from containers or another weakness.

Product becoming banned – if a nation is already holding a stock that eventually becomes banned then the product immediately becomes obsolete unless a special use dispensation can be obtained, which is rarely the case. Well-known cases of banning being imposed when nations were still holding potentially still usable stocks include those of dieldrin and DDT.



How to avoid stocks becoming unwanted and obsolete



Good quantity estimation – the amount of new stocks of pesticides to be ordered/supplied is fundamental to good stock control and depends on many factors, including:

- what is the anticipated forthcoming need?
- how much stock of the needed pesticides is held already?
- has the current stock exceeded its shelf-life, or will it soon do so?
- can the quality of the current stock be re-validated?

Anticipating the forthcoming need is not always straightforward. Insufficient pesticides can lead to loss of crops and too much can lead to the surplus stocks eventually becoming obsolete. The consequences of having insufficient stock can result in significant adverse financial consequences for local agriculture, with potentially adverse political repercussions. It is human nature, therefore, to err on the side of safety and so it is not uncommon to see a degree of over-supply. A particularly difficult area is with desert locust campaigns and the unpredictability of when the pest will emerge and the need to have stock immediately available in the location when it does. Even with the availability of modern weather-predicting technology it is often not precise enough, particularly against the background of unexpected weather developments of recent years that have been attributed by many to climate change. The fail-safe approach of ordering sufficient for the most likely scenario can sometimes

result in much of the stock remaining unused, as happened in the Desert Locust Campaign of 2003-2005. The estimation of quantities needs to be based on the best information available and this can require the involvement of multiple expert parties in order to get the estimation as close to reality as possible.

Choose good quality products and packaging – pesticides should be purchased from reputable suppliers because quality and good product stewardship support are then guaranteed.

As a general rule:

- buy against strict specifications, such as those of the FAO and WHO
- make the supplier aware of the typical ambient storage temperatures and request products with an adequate shelf-life for the expected likely period of storage under these conditions
- ensure each container is marked with the batch number and date of production and that recently produced product is supplied
- ensure the supplier is made aware of the expected conditions of transport, storage and usage so that the packaging and labelling are designed to match. For example:
 - heavier duty steel drums might be required
 - plastic packaging may be unsuitable
 - extra-long-life labels may be required.

Note: Experience has shown that pesticides stored in direct sunlight in white, or light-coloured, drums can be up to 20° Celsius cooler than those stored in dark-coloured drums. This can reduce significantly the rate of any thermal decomposition that might otherwise occur, and so extend shelf-life.

Control donations – this is related to good quantity estimation. Both donors, aid agencies and the recipients should avoid:

- excessive donations
- unsuitable donations
- unrequested donations.

This requires a good dialogue between the donors, agencies and recipients, and the advice of impartial bodies such as FAO and WHO should be sought by the recipient nation or authority in cases of doubt. Novel options/conditions for supply should also be considered. One option being discussed is that ‘virtual stocks’ that are held by the supplier or manufacturer, which can be quickly moved to the areas they are required. This and other options will, of course, increase the tender costs.

Good storage practice and stock management – this is potentially the most important way of avoiding the accumulation of obsolete pesticides, and includes the issue of good quantity estimation covered above. It is something that requires recognition at the highest level in organisations holding pesticide stocks and should be a defined responsibility and accountability of a senior individual. Key requirements are:

- no overstocking
- maintain good stock records
- follow the principle of ‘First-in; first-out’
- protect stocks against sun and rain
- good stacking practice
- careful handling
- regular inspection
- trained operators.

It has become common practice in recent years to see a capacity-building ‘prevention’ element included in obsolete stock disposal projects, by for example GIZ, which features training in good storage practice and stock management. CropLife International has published guidelines on good warehousing.

Container management

In recent years this has become a key element of prevention because large numbers of contaminated containers can accumulate where pesticides are used and also, as a result of the necessary repacking, are a feature of every unwanted and obsolete pesticide disposal project.

The plant science industry has taken a lead to ensure the development, use and appropriate disposal or recycling of pesticide containers is managed sustainably. By 2014, CropLife International has helped establish 36 container management programmes around the world, mainly in Europe, North and Latin America, Australia and New Zealand. In addition, 24 pilot projects have been set up in Eastern Europe, Africa and Asia. In 2012 more than 70,000 tonnes of plastic were recovered and recycled into useful products such as drainage pipes, fence posts and road cones. In the case of rinsed and crushed steel drums, a local steel smelter will often be willing to take them and so save a valuable resource for the nation concerned.

More comprehensive information on container management, including case histories, is available from the CropLife International website via the link http://www.croplife.org/container_management. Also see Jones (2014).

7. Useful references and information sources

Africa Stockpiles Programme – *World Bank Implementation, Completion and Results Report ICR2682*
<http://documents.worldbank.org/curated/en/2013/06/18645044/ethiopia-mali-morocco-south-africa-tanzania-tunisia-first-africa-stockpile-program-project>

Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
www.basel.int/TheConvention/Overview/tabid/1271/Default.aspx

Container Management (various guidance documents from CropLife International)
www.croplife.org/brochures_and_fact_sheets

Dollimore L. and Schimpf W. (2013). *Obsolete pesticide stocks – the past 25 years, lessons learned and observations for the future*. *Outlooks on Pest Management*, December 2013, pages 251-256.

EU Directive on Industrial Emissions (Summary)
<http://ec.europa.eu/environment/air/pollutants/stationary/ied/legislation.htm>

FAO – AGP – *Pesticide Specifications and Quality Control Standards*
www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/jmps/en

FAO – useful forms for inventory-taking <http://psms.fao.org/psms/resources.htm>

FAO Pesticide Disposal Series 15: Environment Management Tool Kit for Obsolete Pesticides – Vol 3 (2011) ISSN 1020-4695 http://www.fao.org/fileadmin/templates/obsolete_pesticides/Guidelines/EMTK3web_nov_small.pdf

FAO International Code of Conduct on Pesticide Management (approved June 2013)
www.fao.org/fileadmin/templates/agphome/documents/Pests_Pesticides/Code/Code2013.pdf

FAO News Release 11 February 2014 – *FAO and EU to help Belarus reduce risks from dangerous pesticides*

FAO Pesticide Stock Management System <http://psms.fao.org/psms/about.htm>
To get access approval send your request to PSMS@fao.org

FAO website – *Prevention and Disposal of Obsolete Pesticides*
www.fao.org/agriculture/crops/obsolete-pesticides/prevention-and-disposal-of-obsolete-pesticides/en

GIZ – *Chemical Safety – GIZ Convention Project – Managing Chemicals Properly*
www.giz.de/expertise/downloads/Fachexpertise/giz2011-en-project-chemical-safety.pdf

GTZ-Holcim Public-Private Partnership – 2006 – *Guidelines on Co-processing Waste Materials in Cement Production*
www.coprochem.com/trainingkit/documents/diverse/guideline_coprochem_v06-06.pdf

International HCH and Pesticides Association (IHPA) www.iHPA.info

Jones, K.A. (2014) The recycling of empty pesticide containers: an industry example of responsible waste management *Outlooks on Pest Management* **25(2)**:183-186.

Karstensen K.H. et al, (2006) *Environmentally sound destruction of obsolete pesticides in developing countries using cement kilns* – Elsevier ScienceDirect, *Environmental science & policy* 9, 577-586

Montreal Protocol on Substances that Deplete the Ozone Layer
http://ozone.unep.org/new_site/en/montreal_protocol.php

Mozambique Environmentalists Defeat Incinerator Plan, 13 October 2000
www.ens-newswire.com/ens/oct2000/2000-10-13-12.asp

Pesticide Manual <http://bcpcdata.com/pesticide-manual.html>

Schimpf, W. 2013. *Alternative method for the chemical treatment of methyl bromide*. IHPA POPs Newsletter No 25, September, pages 21-23.

Stockholm Convention – National Implementation Plan submissions
www.pops.int/documents/implementation/nips/submissions/default.htm

Stockholm Convention on Persistent Organic Pollutants Home Page <http://chm.pops.int>

WHO International Programme on Chemical Safety *Environmental Health Criteria* Series
www.who.int/ipcs/publications/ehc/ehc_alphabetical/en

WHO Recommended Classification of Pesticides by Hazard
www.who.int/ipcs/publications/pesticides_hazard/en

WHO specifications for public health pesticides
www.who.int/whopes/quality/en

Related CropLife International Publications

- Guidelines for the safe and effective use of crop protection products
- Guidelines for personal protection when using crop protection products in hot climates
- Guidelines for the safe transport of crop protection products
- Guidelines for the safe formulation and packaging of crop protection products
- Guidelines for emergency measures in cases of crop protection product poisoning.

Also visit the CropLife International website for latest information and publications. www.croplife.org

Annex 1 – Guidance on photographic needs

This guidance is provided because the photography during inventories of unwanted and obsolete stocks is rarely done by professionals.

There are several key requirements, including:

Good photographic coverage – this needs to be sufficient to match the information and data entered onto the FAO inventory forms.

Image sharpness and clarity – important factors include:

- good lighting
- close proximity to the subject
- good focus
- good photographic resolution (the number of pixels in the image)
- freedom from movement ('camera shake').

Equipment requirements

PHOTOGRAPHIC

- Two compact digital cameras (one as backup) with an automatic function
 - Large LCD monitor (at least 2.5")
 - At least 5 megapixels resolution
 - At least 3x **optical** zoom (digital zoom is additional)
 - Good built-in flash capability
 - Image stabilisation
 - Suitable for low light situations (without flash)
 - Short shutter-delay time
 - Backlight compensation capability
- Two long-life **rechargeable** batteries per camera (plus mains and vehicle chargers) plus several conventional non-rechargeable camera batteries for use in an emergency.
- Two high capacity memory cards per camera
- Lens brushes/cloths
- Protective case that can be worn on a belt.

DATA BACK-UP EQUIPMENT

- Laptop computer with suitable digital photographic and data transfer software
- USB connection cable (for camera to laptop, for data transfer)
- USB high capacity memory sticks.

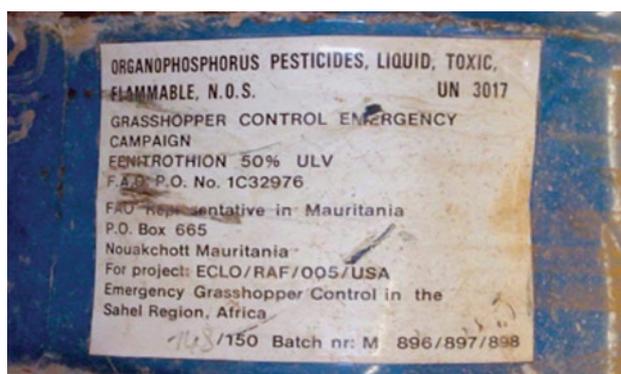
Photographic procedures

PREPARATION

- Select the member of the inventory team with the most photographic experience
- Practise with the camera (with instruction manual) prior to the inventory, with particular attention to working in both bright and poorly-lit conditions. Bright backlight is often a problem in stores where sunlight enters through windows, doorways and gaps in walls/roofs immediately behind the required image and so practise with the camera's backlight compensation capability (exposure compensation) or the images may be too dark to be of value
- Set the camera to give an image quality (resolution) of around 5 megapixels and verify that the time/date settings of the camera are correct.

PHOTOGRAPHY

- First, complete all external photos of the site and area layout, with panoramic shots from the four cardinal compass points (North, East, South and West). Include adjacent rivers/waterways, site gates, doors, walls/fences, roofs, staining of walls, drains, drainage gulleys, dwellings, schools and other potentially sensitive buildings etc.
- Next, take photographs of external obsolete stocks, empty drums/packaging, any associated equipment (such as storage tanks) and any visibly-contaminated soil
- Next, after putting on appropriate personal protective equipment, enter the store, open all doors/windows (where practicable) to allow the maximum of light and ventilation and take a panoramic photograph of the inside, showing the overall disposition of stocks, locations of doors/windows, type and condition of floor (concrete/soil etc.) and any special features such as damaged roofs and store security
- Stocks should be photographed systematically, in parallel with the inventory-taker noting down the stock and other details. Photos should be taken of common products as a group and then taken of important details of each product such as labels, container markings and container condition and leakage. The stock dispositions should be noted on the store plan for later correlation with the photographs



- Any photographs requiring flash should be taken as closely as safely possible, otherwise use optical zoom, with as much natural illumination as possible
- Photograph any areas and equipment that might assist work to be conducted at the site, including rail spurs, loading areas, forklift trucks, cranes, fire-fighting equipment, utilities (water, electricity etc.), office facilities and amenities
- All photographs should be referenced/marked on the site/store plans, showing the direction from which taken, camera file name (usually automatically allocated letters and numbers) and any file name assigned by you
- Photographs should be taken of any external situation that might impact upon the undertaking of the site clean-up. This could include narrow bridges and those with weight limitations, fords across rivers etc.



- To conserve the camera battery, switch it off when there are significant periods between photographs
- Finally, take a photograph of the inventory team, photographer and site personnel, and record their names.

DATA BACKUP

- During the inventory, regularly check that the photographs are satisfactory (by viewing in the camera's LCD monitor)
- At the end of each inventory session or site visit, the data should be copied from the camera memory to the hard drive of a laptop computer. At this stage the data should not be deleted from the camera memory
- At the end of the working day all of the photographic data on the laptop hard drive should be copied to a USB memory stick and the backup references and time/date should be recorded. Always view the images to confirm they have been copied successfully
- Backup memory sticks should be kept secure and separate from the laptop and cameras.
- If camera memories are large then the backed-up images may not need to be deleted until back at the base office
- When back at the base office the total set of photographs for the whole inventory should be copied to the hard drive of a desktop computer and a set of CD/DVD copies made, sufficient for all parties who require access to the data

- When images are resized (made smaller to typically 100-200 kilobytes) for Internet transmission, they should be given a modified file name and the original large images should be retained. Software for the bulk resizing and other adjustment of images is readily available on the Internet.

DIGITAL ENHANCEMENT

Once photographs have been taken, there remains the opportunity to improve clarity via digital enhancement using photographic software, in particular the brightness and contrast. Save the enhanced image using a new file name. **The original unmodified image should always be retained.**

PHOTOGRAPHIC RECORDING AND CATALOGUING

The FAO inventory data-forms contain sections for the recording of the file names of the related photos but the allowable space is limited. Multiple photos of, for example, a drum label or drum markings are often necessary for full data recording and so the multiple file names should be recorded on an annex that is attached to the form. The FAO PSMS administrator will ensure photographs are added to the FAO database.

The production of a photo catalogue for an inventory is a valuable tool because it can provide a virtual walk around a site or store. One of the simplest ways of cataloguing is with Microsoft Windows Explorer or equivalent, by setting up a folder with the overall inventory name/date and with subfolders containing the individual site names/numbers, into which the respective site/store photos are filed. Windows Explorer allows individual photo files to be viewed as Extra Large Icons (thumbnail images) so the screen appears as a photo album. It also has the built-in capability to run the photos as a full-screen Slide Show. A photo viewer can also be used to scroll through the photos, and zoom and rotate when necessary.

Safety

- The photographer must operate under the safety instruction of the inventory team leader
- **The fundamental approach should be for the photographer to avoid exposure of self and equipment to any potential hazard, whether it is flammability or toxicity**
 - The photographer should not touch anything contaminated within the store
 - Any handling of contaminated surfaces should be done by another member of the inventory team, wearing the appropriate personal protective equipment
- The photographer would normally need to wear suitable foot and head protection and a coverall (boiler suit). Surgical gloves, eye and respiratory protection may be required under certain circumstances
- Provided the above safety recommendations are followed, the camera is unlikely to suffer significant contamination and any dust can be removed by the careful use of a lens brush and clean damp lens tissue.

Annex 2 – Typical materials required for field work

Equipment

- solvent-resistant drum pumps, hoses, nozzles and hose clips (manual pumps are more dependable)
- earthing cables and rods (to prevent static electricity build-up during product transfer operations)
- drum crusher
- drum lifting and cutting equipment
- drum opening keys/spanners
- electrical transformers
- electrical generator, extension cables and lighting
- spades, shovels, scrapers, pickaxes, hammers, funnels, cleaning rags, buckets and brushes
- toolkit, padlocks, penetrating oil and aerosol marking paint
- fire extinguishers (suitable for chemical fires).

Packaging (UN-approved standard, where required)

- 200 litre tight-head drums (for liquids)
- 200 litre removable-head drums (for solids)
- overdrums/salvage drums (for the transportation of fragile/leaking/distorted 200 litre drums)
- 1m³ fibre bags (for the transportation of solid waste)
- heavy-duty polythene bags
- pallets
- container labels
- international shipping containers (for transporting the empty/filled drums/bags and equipment).

Miscellaneous

- drum rinsing solvent (although local diesel fuel may be adequate)
- spill-absorbing materials
- heavy-duty polythene sheeting and sandbags (for making a spill-containment area)
- detergent (for cleaning floors and wall surfaces)
- floor sealant (if floors are to be sealed on completion)
- surface-decontaminating chemicals, such as sodium carbonate or sodium hydroxide
- soap and detergent (for personal washing and protective equipment washing).

Personal protective equipment (general guide only – the specific items will be determined by the risk assessment)

- nitrile or neoprene gloves
- nitrile or PVC aprons
- rubber boots (steel sole and toe)
- coverall suits
- PVC one-piece chemical protection suits
- face shields, goggles and dust masks
- half-face respirators with organic vapour cartridges (with spare cartridges and valves)
- towels.

Emergency and medical equipment

- emergency shower
- eye-wash equipment and liquid
- comprehensive first aid kit
- antidotes and therapeutic drugs (if not available locally).

Data and communications equipment

- laptop computers and associated equipment
- photographic and associated equipment
- mobile telephone and perhaps radio communications equipment.

Locally-sourced equipment

- vehicles for carrying personnel, equipment and international shipping containers
- fork-lift truck
- digger/excavator
- fabrication of a drip tray for fitting inside the shipping containers.

Special equipment

This is determined by the scope of the work. For example, for a large number of cylinders of methyl bromide it could include a special unit for the safe emptying of the cylinders and denaturing of the captured gas.

Annex 3 – Some commercial companies with obsolete pesticide stocks disposal expertise⁶

Company name (base country)	Internet address	Services ⁷
AVG (Germany)	www.avg-hamburg.de/index.php?id=2&L=2&type=0	Incineration
Currenta (Germany)	www.currenta.com/waste-incineration.html	Incineration and logistics
Ekokem (Finland)	www.ekokem.fi/en/waste-services/waste-treatment/waste-incineration	Incineration
HIM (Germany)	www.him.de/services.php/Waste-Management	Incineration, field services and logistics
SAVA (Germany)	www.sava-online.com/index.php?id=18076&L=1	Incineration, field services and logistics
Séché Environnement (France)	www.seche-waste-treatment.com/our-solutions/destruction-of-your-waste-at-our-treatment-facilities	Incineration, field services and logistics
Veolia Environmental Services (UK)	www.veoliaenvironmentalservices.co.uk/Main/Services/For-business/Hazardous-waste/International-field-services/Capabilities	Incineration, field services and logistics

⁶ The listed companies have had a past association with one or more obsolete pesticide stock disposal projects. The list is not claimed to be comprehensive nor does the inclusion or exclusion of a company name infer endorsement or otherwise by CropLife International.

⁷ Other services may also be available. For full details, contact the company.

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CropLife International is the voice of the global plant science industry. It champions the role of agricultural innovations in crop protection and plant biotechnology in supporting and advancing sustainable agriculture; helping farmers feed a growing population while looking after the planet; and progressing rural communities. The world needs farmers, and farmers need plant science. CropLife International is proud to be at the heart of helping farmers grow.