



UNODC

United Nations Office on Drugs and Crime



Guidelines for the **Safe handling and disposal of chemicals used in the illicit manufacture of drugs**



Organization of
American States



Inter-American Drug Abuse
Control Commission

Guidelines for the

Safe handling and disposal
of chemicals used in
the illicit manufacture of drugs



UNITED NATIONS
New York, 2011

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ST/NAR/36/Rev.1

UNITED NATIONS PUBLICATION

Sales No. E.11.XI.14

ISBN 978-92-1-148266-9

eISBN 978-92-1-055160-1

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This publication has not been formally edited.

Publishing production: English, Publishing and Library Section, United Nations Office at Vienna.

Background and acknowledgements

The first United Nations Office on Drugs and Crime (UNODC) *Guidelines for the Safe Disposal of Chemicals used in the illicit manufacture of Drugs* (STNAR/36) was published in 2006 and was the culmination of an expert group meeting on “Environmentally safe methods for the destruction/disposal of chemicals”, organized in collaboration with the Multilateral Environmental Agreements Branch of the United Nations Industrial Development Organization (UNIDO), in Vienna, Austria, from 6 to 8 September 2005. The availability of the *Guidelines* in Spanish was facilitated by the Inter-American Drug Abuse Control Commission (CICAD), Organization of American States (OAS).

At the 33rd meeting of the Heads of Law Enforcement Agencies (HONLEA) Asia and Pacific, in Bali, Indonesia in 2010, Member States noted the significant increase in precursor chemicals discovered regionally and expressed concern about the difficulties encountered in storing and disposing of precursor chemicals in a safe and environmentally friendly manner. An Expert Group Meeting on “Safe and Environmentally-Responsible Disposal of Chemicals Used in the Illicit Manufacture of Drugs” was held in Bangkok, Thailand from 20 to 22 September 2010. The experts reviewed the existing UNODC guidelines with respect to its applicability to the emerging trends in regional drug manufacturing.

The present *Guidelines* reflect the discussions of the experts and the elaboration of practical methods for the safe handling and disposal of seized chemicals in situations where a waste management infrastructure may not be available.

The UNODC Laboratory and Scientific Section (UNODC/LSS, headed by Dr. Justice Tetley) wishes to express its gratitude to the following experts who participated in the expert group meeting in Bangkok, Thailand and contributed to the revision of the *Guidelines*:

Mr. Craig Mann, Team Leader, Specialist Response Amphetamine Type Stimulants, Australia Federal Police; **Dr. Chan Kee Bian**, Head of Narcotics Section, Department of Chemistry, Malaysia; **Dr. Nathan Green**, Forensic Chemist, Australia Federal Police; **Dr. Patrick Choi**, Principal Technical Advisor, NSW Department of Environment, Climate Change and Water, Australia; **Dr. Barbara Remberg**, Senior Technical Advisor, Precursors Control Section, International Narcotics Control Board, Austria; **Dr. Daniel Rothenfluh**, Assistant Director, Department of the Environment, Water, Heritage and the Arts, Australia; **Mr. Wong Hoy Yen**, Consultant/Pharmacist, Malaysia; **Dr. Hoang Manh Hung**, Senior Officer, Institute of Forensic Science, Viet Nam; **Mr. Paul Newell**, Senior Environmental Officer, Department of Environment and Conservation (WA), Australia; **Mr. Héctor Bernal Contreras**, Coordinador Grupo Internacional-Químico, Dirección Nacional de Estupefacientes, Colombia; **Mr. Peter Vallely**, Special Investigator Forensic Chemist, Australian Crime Commission, Australia; and **Ms. Marjorie Ungson Villanueva**, Chemist IV, Philippine Drug Enforcement Agency, Philippines.

Special thanks go to Ms. Pamela Smith (Consultant/Forensic Chemist, Ex United States Drug Enforcement Administration) who authored the background paper used for discussion at the above meeting and finalized the revised version of the *Guidelines* and to the UNODC Regional Centre for East Asia and the Pacific (headed by Mr. Gary Lewis) for providing the funds for the revision process.

The UNODC/LSS also expresses its gratitude to the following experts who contributed to the development and production of the original guidelines; Mr. Mark Colhoun, Dr. Rainer Dahlenburg, Ms. Mary E. Greene, Mr. Ziggy Malyniwsky, Mr. Pabalala Meshack Mthembu, Mr. Teodor Ognean, Ms. Lilia S. Osorio Bryson, Dr. Anil K. Saxena; Mr. Wayne K. Jeffery, Mr. Jorge L. Acevedo-Gierbolini and Dr. Howard Stead.

Note

Some of the methods for the handling and disposal of chemicals used in the illicit manufacture of drugs described in these guidelines may result in environmental degradation. Their inclusion in this manual is a matter of practicality, drawing attention to the fact that the chemicals are often encountered in very difficult circumstances, where, depending on the specific conditions, the disposal method presented may be the only alternative, and therefore the best available solution at a given point and time. Inclusion of methods in these guidelines should not be interpreted as an endorsement by the Laboratory and Scientific Section of the United Nations Office on Drugs and Crime, the United Nations or Inter-American Drug Abuse Control Commission, the General Secretariat of the Organization of American States, or the Organization of American States of their environmental safety, or a recommendation by any of them or by any of their respective personnel that existing environmental protection conventions, treaties, laws or regulations be ignored or violated.

Use of several of the methods included in these guidelines requires the presence of adequately trained personnel. The Laboratory and Scientific Section of the United Nations Office on Drugs and Crime, the United Nations and the Inter-American Drug Abuse Control Commission, the General Secretariat of the Organization of American States, the Organization of American States, and their respective personnel are not responsible for any damage to property, or injury to persons, resulting from following these guidelines.

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Introduction

The safe handling, storage and disposal of seized chemicals, and waste encountered at clandestine drug laboratory sites present unique problems to law enforcement and regulatory authorities.

Chemicals used by clandestine laboratory operators in the production of illicit drugs are usually diverted from the legitimate trade and may be encountered at any stage of the “licit” chain of distribution, or at the clandestine laboratory site. The location where the chemicals are actually seized, along with their characteristics, quantity and condition, will be determining factors as to how they will be handled. National drug control laws and regulations should provide for the speedy and efficient collection, processing and disposal of seized chemicals in a manner that minimizes or eliminates the potential problems resulting from long-term storage and handling, such as personal and public safety and the possibility of their diversion and subsequent reintroduction for use in the illicit manufacture of drugs. Disposal methods may include on-site neutralization of the chemicals, donation or sale to predetermined institutions that have a need for them, as permitted by local laws and regulations, or return to the “licit” trade chain of distribution. These *Guidelines* outline the different approaches to tackle these issues in different circumstances and situations.

The disposal of large quantities of seized drugs raises similar environmental concerns as that of seized chemicals. Provided that the drugs are not needed as evidence for prosecution, or that prosecution is complete, the approaches to disposal described in this document are therefore as applicable to drugs as they are to precursor chemicals. It should be noted, however, that to avoid offsetting the balance of legitimate supply and demand, the disposal of seized narcotic drugs and psychotropic substances by reprocessing/reuse (recycling) is regulated by the international drug conventions. Therefore, if the reprocessing of illicit drugs is considered, it must follow the provisions set out in the Conventions. Where illicit drugs are to be disposed of, guided by the need for the process to be as environmentally friendly as possible, the preferred option is incineration.

Background and use of the Guidelines

The disposal issue and related topics have been discussed at numerous meetings of the United Nations Commission on Narcotic Drugs over the past two decades. In 1989 and 1990, a United Nations Expert Group discussed the topic of pre-trial destruction of seized narcotic drugs, psychotropic substances and chemicals. This

manual takes into account some of the recommendations made by those Expert Group meetings and continues from there to outline methods and approaches for the disposal of different chemicals. It is meant to be a reference guide for use by those involved in the safe handling, transportation, storage and disposal of seized chemicals that could be used in the illicit manufacture of drugs. At the same time, the *Guidelines* provide a compilation of available methods for disposal of all the major chemicals used in the illicit manufacture of cocaine, heroin, amphetamine, methamphetamine, ecstasy-type substances (e.g. MDMA and MDA) and methaqualone/mecloqualone. The present *Guidelines* place emphasis on methods for disposal of large quantities of seized chemicals, usually under field conditions, and subsequently do not include the entire “laboratory methods” reported in the previous edition. It should be noted, however, that for the disposal of chemicals where methods have not been elaborated, these “laboratory methods” provide a good basis for designing disposal solutions.

The methods and approaches described in these guidelines may have to be tailored to specific situations/circumstances in individual countries. The present *Guidelines* therefore also provide brief outlines of the role of the chemical disposal specialist and of the suggested contents of a training course to assist in introducing, at the national level, if not already available, the appropriate expertise in the management of seized chemicals and other materials related to illicit drug laboratories.

In order to assist with the integration of chemical disposal, as part of a broader strategy of national waste management plans/strategies/systems, the present *Guidelines* also provide guidance for the identification of potential in-country resources. A summary of legal implications is also given for consideration in connection with disposal activities, and which should be addressed by the relevant national drug control laws

Finally, in addition to outlining the main types of chemical waste disposal and treatment, these *Guidelines* also provide a comprehensive compilation of specific disposal and treatment methods for individual chemicals. Some of the methods described have been tested in non-laboratory settings (including remote or jungle environments), while others have not. It is recognized that some specific disposal and treatment methods discussed in this document require further work.

Governments, industry and regional and international organizations should seek at all times to improve the response to disposal issues through the development and application of more practical, safe and cost-effective disposal technologies.

It is anticipated that Governments will wish to take the necessary steps to develop and implement safe practices for chemical disposal, based on the present *Guidelines*, and tailored to meet domestic circumstances. Whatever the specific circumstances, it will be important to introduce, or strengthen, specific plans/policies for the disposal of chemicals used in illicit drug manufacture within the national waste management infrastructures. In addition, improved responses to the need for chemical disposal

should also include the introduction or strengthening of mechanisms for sharing information at national and international levels, and a review of options as to how the necessary technical and financial resources can be made available.

Against this background, any guidelines in this highly complex field must be considered as work in progress, which can only be successfully pursued if available expertise worldwide is pooled strategically. Users of these *Guidelines* are therefore encouraged to share experiences with the use of disposal methods, and any other comments they may have on the present *Guidelines*, at the following address:

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1. Chemical waste disposal and treatment methods

To address the breadth of circumstances under which illicit drug manufacturing occurs worldwide, a range of disposal methods must be considered. These methods range from recycling to disposal at the site of seizure, for example, at a clandestine laboratory site. The disposal methods discussed below may require neutralization or other types of treatment prior to disposal. Several types of treatment methods are therefore also discussed. Considering the different circumstances (or scenarios) in which the disposal of chemicals may have to be accomplished worldwide, the available methods and approaches can be classified into three general groups:

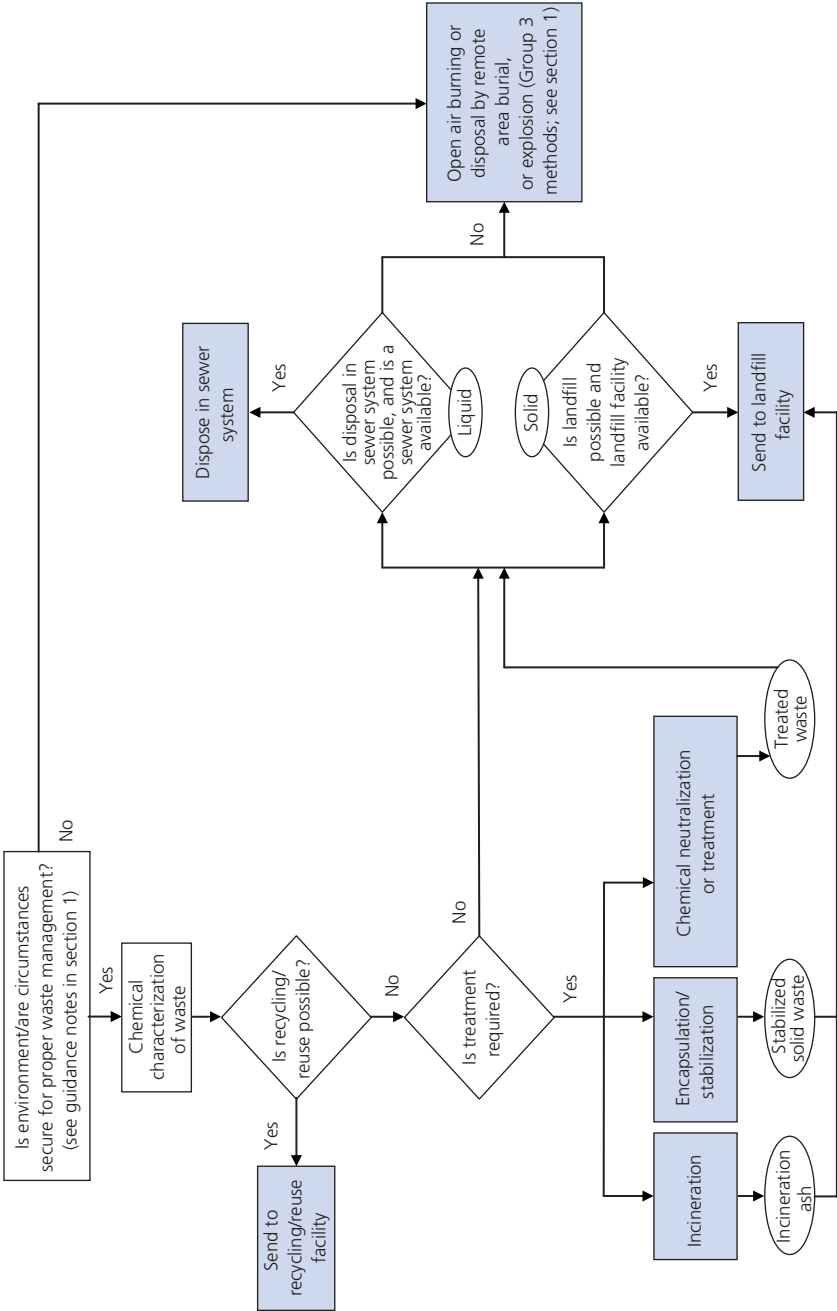
Group 1: These are the most desirable (i.e. most environmentally safe) methods and approaches. They typically require the availability of an environmental management infrastructure and/or closeness to urban centres. Some of these methods are:

- Recycling/reuse of the chemicals
- Fuel blending
- Incineration and disposal in engineered landfills of incineration ash
- Disposal in engineered landfills of stabilized chemical waste, or non-hazardous waste
- Disposal in sewers of neutralized, non-toxic chemicals

A government agency in need of chemical disposal may also contract the entire clean-up (e.g. process of chemical identification, safe handling, transportation, treatment and disposal), as an all-inclusive solution, to a specialized commercial firm, such as a chemical waste management company. This company may, or may not, use the same methods as those listed above, but, from the government agency's point of view, all decisions in this regard become the responsibility of the company.

Group 2: The second scenario assumes a secure environment, but absence of an environmental management infrastructure. Methods and approaches in this group may vary depending on the exact circumstances of the case. They may be similar to (or the same as) methods in Group 1, or they may be closer to those in Group 3 below. Typically, they are carried out under conditions of limited resources, and require the support/guidance of a scientist or of adequately trained law enforcement officers to help follow the guidelines given in this document.

Figure 1. Disposal decision tree



Group 3: The third scenario is a remote and unsafe location, requiring on-site solutions, such as the clandestine laboratories found in jungle areas of South America or parts of Asia. In this scenario, a balance is made between the health and safety of law enforcement personnel, environmental concerns and the primary enforcement goal of disruption of clandestine manufacture. The methods discussed here are used when the safety of the law enforcement personnel cannot be ensured for periods of time needed to employ other methods, or when transport of the chemicals to another location is not feasible. They include: open air burning, landfills, remote area burial, and explosion.

It is clear that the safest approach (Group 1) may only be applicable in urban environments, for example, to chemical shipments stopped at commercial ports. The least environmentally safe approach (Group 3) may be the only practical option in very remote mountainous or jungle environments.

The decision tree in figure 1 summarizes, and assists in identifying, options for the treatment and disposal of chemical waste under different circumstances and prevailing conditions.

1.1 Chemical waste disposal methods

Chemical waste management companies

The term “chemical waste management companies” refers to all-inclusive operations. The company responds to the location and manages all aspects of disposal and clean-up of the site. Thus, while the actual disposal methods may be the same as the ones described below (incineration, etc.), the entire process of packaging, storage, transport, treatment and final disposal is the responsibility of the company. This process is rapid, and generally safer. The costs may be very high. The operators of these enterprises must be constantly vetted to ensure diversion does not occur. These services are generally not available outside of an urban environment.

Recycling/reuse

Recycling/reuse refers to the reuse or return of unused, factory sealed and labelled containers.

Examples are:

- Contacting the supplier and attempt to return the order
- Donation to a school, university or hospital
- Sale to a legitimate industry
- Fuel blending for energy recovery

However these methods may not be feasible in remote areas due to transportation problems. Possible industry sources include:

agricultural	fertilizer plants	pharmaceutical	soap
boiler plants	glass	plastics	
brick works	metal foundry	pottery	
building/construction	munitions	printing	
cement plants	oil	pulp and paper	
cosmetic	paint	refrigeration	
dyes	perfume	rubber	

Care must be taken that diversion to the illicit market does not occur.

Open air burning

For the purposes of this document, open air burning refers to burning by uncontrolled flames, with the combustion particles being released directly into the atmosphere.

Open air burning is a disposal method that should only be employed in remote locations where other management approaches are impractical or impossible. It can be most safely done in a 200-litre metal drum. When this is not possible, open pits or trenches may be used (refer to page 13, *Safe construction of trenches and pits for burning or encapsulation*). Pits or trenches are open areas dug into the ground, down to areas of clay, if possible, so the liquids do not absorb into the soil. The liquids are then poured into the pit or trench and ignited from a safe distance by remote ignition. Caution should be taken to ensure that any solvents are completely burnt.

When disposal by burning in a pit or trench is considered, the selected site and the burning process should meet minimum requirements:

- At least 500 metres from human habitation, electrical lines, forested and food growing/producing/grazing areas
- Flat terrain
- Away from waterways
- Deep water table
- Hard surface

The following precautions must be followed:

- Restrict access to burning site
- Only essential personnel present

- Set up safety perimeter
- Locate all personnel up-wind
- Do not burn more than the contents of ten drums at a time
- If multiple pits are necessary, the pits must be separated by a minimum of 10 metres

Landfill

There are different types of landfills. Definitions and specifications vary depending on the type of waste allowed, and the safety measures in force, both from an environmental and occupational safety point of view. For the purposes of this document, two types of landfills are referred to:

Engineered landfill

This refers to an official site for landfill, which has appropriate protective lining, and is approved for the disposal of hazardous waste, as per applicable national regulations. Engineered landfills are also used for non-hazardous or municipal wastes, but have different requirements.

Remote area burial

If an engineered landfill is not available, remote area burial may be the only method available in remote locations. This refers to a pit or trench which is dug into the ground (prepared in the same way as under open air burning, see *Safe construction of trenches and pits for burning or encapsulation*, page 13). When used for remote area burial, the trench is refilled with dirt after the burial of chemicals is completed.

Disposal in the sewer system (Group 1 and 2)

Disposal in the sewer system should only be considered for small amounts of treated, neutralized and non-hazardous waste.

Evaporation

This method may only be used with small quantities (less than 4 litres) of volatile organic solvents, such as ether, acetone, etc. In addition, this method should only be used when other disposal options are not available, and under strictly controlled circumstances (i.e. where exposure to the fumes will be prevented, ignition sources are not present and environmental laws and regulations allow such a treatment/disposal method).

Explosion

This method should only be used to dispose of chemicals found at remote clandestine laboratories where the transport of the chemicals is not feasible and the safety of the law enforcement personnel is unsure. It entails putting all chemicals of similar chemical characteristics together followed by detonation at a safe distance with remote ignition, using as appropriate, detonation cord, military or industrial detonators. If the explosion method is used at all, it should only be used for flammable organic solvents, or mixtures of solids or dilute aqueous solutions with solvents of flammability ratings 2 or 3 (other liquids alone will be dispersed by this method, rather than being disposed of; use of solvents of flammability rating 4 is also not appropriate for this method).

Dumping at sea, in rivers or other streams of water

This method should never be used. It can cause major environmental damage and may have long-term impact to the aquatic ecosystem.

1.2 Chemical waste treatment methods

Chemical waste treatment is an intermediate step towards final disposal. It reduces the amount of waste and/or changes the properties of the chemicals, typically by making them less hazardous. However, all treatment methods require that further action be taken to dispose of a residue. For example, in the case of incineration, the remaining ash must also be disposed of appropriately.

Incineration

For the purposes of this document, incineration means burning by controlled flame in an enclosed area, with appropriate safeguards to facilitate complete combustion and prevent the release of toxic chemicals into the environment. Incineration produces ash that must be disposed of in an appropriate manner.

Chemical treatment

Some chemicals require pre-treatment before they can be safely disposed of by other types of disposal methods. A common chemical treatment method would be neutralization of acids and bases. Other chemical treatment methods include oxidization and conversion of the chemical to a less toxic form, e.g. acetyl chloride.

Encapsulation/stabilization

Encapsulation refers to the treatment of chemicals and chemical waste by converting the hazardous waste into an inert, physically stable mass (stabilization). This treated waste should have a very low leachability sufficient to allow for remote burial.

Inertization

This is a variant of encapsulation which is used to render controlled substances and precursors unusable.

2. Specific details for the practical disposal of chemicals

See section 4/annex I for specific methods recommended for the chemicals.

2.1 Burial pits

The pit should be no more than 2-3 m deep and approximately 2 m square (12 m³). If possible, the entire pit should be lined with a 30-cm layer of compacted clay or any other suitable low permeability material. If sufficient quantities of the impermeable material are not readily available, then only the bottom of the pit should be lined such that percolation of any liquids into the soil underneath is reduced to a minimum. The top portion of the pit should be slightly elevated and properly sloped to keep surface waters from entering the pit. Ideally the pit should be built by persons knowledgeable in construction so that it is constructed to prevent the sides from collapsing.

UNODC does not advocate the disposal of chemicals or wastes to non-engineered landfills nor to engineered landfills that are only authorized for non-hazardous or municipal wastes. This method of disposal may pose a long-term risk to human health and the environment, and should only be considered as a disposal option when chemicals have been appropriately neutralized or stabilized.

Safe construction of trenches and pits for burning or encapsulation

The excavation of trenches and/or pits can potentially pose a risk to the safety of workers and the environment if not constructed correctly or constructed in an inappropriate location. Excavation failures can occur very quickly and without warning, giving workers little time to escape.

To render an excavation safe for workers, the use of slopes (angled side walls), benching (the creation of wide horizontal steps down the excavation) or the use of shoring should be used. Where possible, trench or pit excavations above 1.5 m (5 feet) in depth should be inspected by a suitably qualified engineer. There are two

main factors which should be considered when undertaking the excavation of a trench or pit, these are as follows:

Site selection

- The location selected for the excavation should ideally be an area of flat firm ground providing sufficient surrounding area to accommodate a 1.5 m safety exclusion zone around the excavation, soil (excavated material), equipment and other workers.
- The stability or safety of an excavation will be determined by the soil type. Granular, soft, sandy or moist/wet soils will not be suitable for trenches or pits and may pose a risk of failure to workers within the excavation.

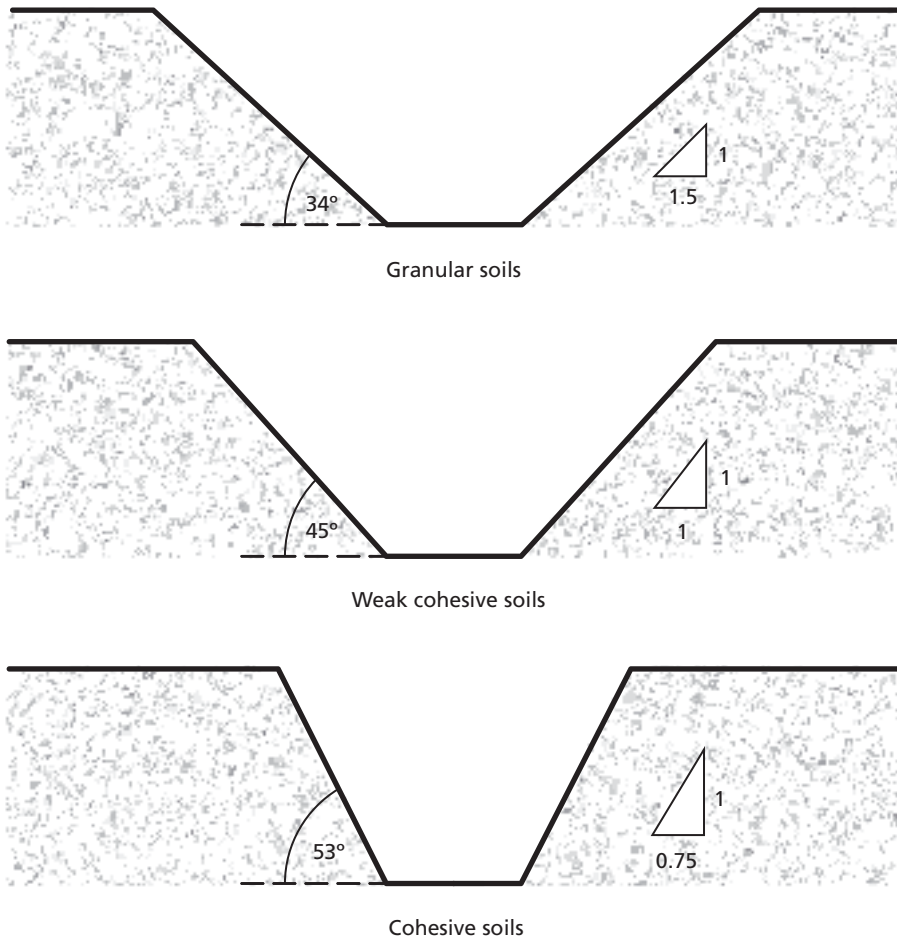
Environment

- Trenches or pits should not be excavated within 500 m of a water body including streams, rivers, dams or wells.
- When planning an excavation, it is recommended that where possible a test hole/pit be excavated to a depth of not less than 1.5m below the intended depth of the trench or pits to determine if groundwater is present.
- During any excavation, the appearance of moist or wet soil in the base or walls may indicate the presence of groundwater. If moist or wet soil is encountered, the location is not suitable for these disposal options and a new location will need to be identified or alternate disposal method employed.
- Diversion channels should be constructed to prevent surface water entering the excavation, and divert surface water away from the excavation area.

Safe excavation design

The use of slopes or steps in excavation is designed to prevent failure or collapse of the trench or pit by creating a more stable distribution of weight and force. The angle of the slope will vary depending on the soil type and stability, for example a granular or weak soil will require a slope angle of 34° while a more cohesive soil may require an angle of 45° and a firmer cohesive soil may only require an angle of 53°. The following illustration shows examples of angles used in different soil types.

It is recommended that for excavations of greater than 3 m in depth, the sides of the excavation should be stabilized with the use of wide horizontal steps. This prevents material from above falling down into the area below where workers may be located. For excavations greater than 3 m in depth it is recommended that a step width of not less than 1 m be used.

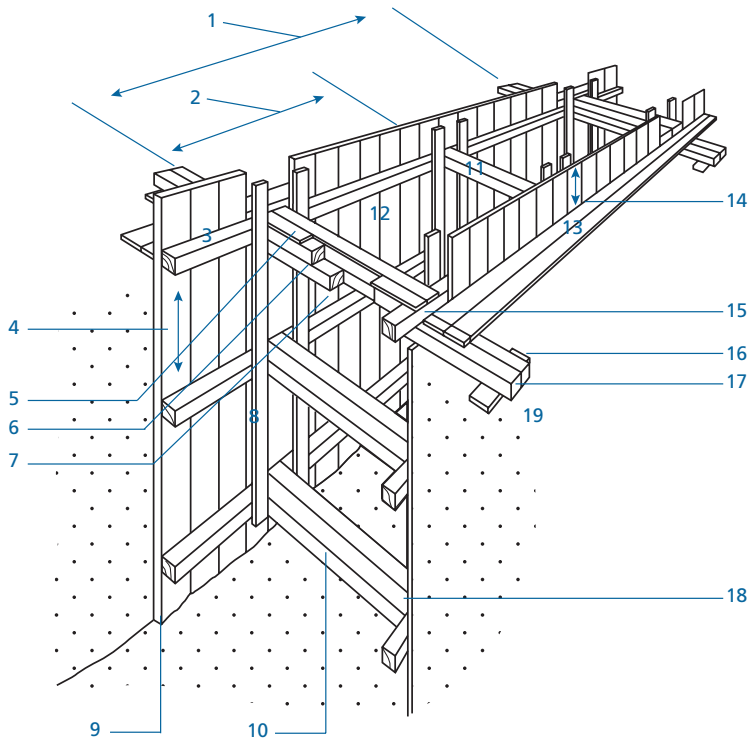
Figure 2. Safe excavation designs based on soil types

Source: Reproduced courtesy of the Commission for Occupational Safety and Health, Western Australia (www.worksafe.wa.gov.au)

For excavations of greater than 3 m in depth it is recommended that support systems such as shoring or shielding, such as shown below, be used in all excavations where workers are required to enter the trench or pit. Support systems need to be installed in a manner that protects workers from cave-ins, structural collapse or being struck by members of the support system. Different types of shoring or shielding are available including mechanical jacks and prefabricated trench shields, however in remote areas where this equipment may be unavailable, the use of timbering as a support system can also be used as shown in the following illustration. It is recommended that the depth of excavations be limited to between 2 m and 3 m in depth,

and not more than 2 m² (12 cubic metres). Where larger pits are required, it is recommended that multiple smaller pits be used in preference to single larger pits for safety reasons.

Figure 3. Support system diagram for excavations greater than 3 m in depth



1. Maximum distance between bearers, 3.5 m.
2. Maximum distance between toms, 1.8 m
3. Waling minimum size, 100 mm x 100 mm
4. Maximum spacing between walers, 0.5 m.
5. Cap.
6. Tom.
7. Bearer.
8. Lacing to support timber waling, minimum size 75 mm x 25 mm
9. Vertical sheeting driven securely into trench bottom.
10. Twin toms, minimum size 100 mm x 100 mm.
11. Central capped tom.
12. Vertical timber sheeting, minimum size, 235 mm x 38 mm.
13. Timber walkway with joints over bearers.
14. Minimum height.
15. Waling joints over bearers.
16. Pressure boards below bearers.
17. Bearers from which all sets are suspended, or on which top set of walings and struts are placed, minimum size 100 mm x 100 mm. Where bearers are used to provide access over trench, minimum access width is 450 mm requiring five bearers. Access should not occur at tom points. Guard rails must be provided to both sides of access.
18. Capping over toms and bearers, 100 mm x 25 mm.
19. Two bearers accompanied by two capped toms should be used to ensure full support of waling joints.

Source: Reproduced courtesy of the Commission for Occupational Safety and Health, Western Australia (www.worksafe.wa.gov.au).

Nationally recognized or legislated safety and evacuation procedures should be followed for each individual country, however where such procedures do not exist, the following basic principles should be followed. Safety and evacuation plans should be in place prior to the commencement of any excavation works. For excavations of greater than 3 m in depth where workers are located within the trench or pit, these should include rescue and recovery plans in the event of collapse or failure of the excavation. For excavations of greater than 1.5 m in depth, a safety supervisor should be appointed to observe and monitor the excavation and safety of workers. The following list includes suggested actions and equipment which should be in place when excavations are being carried out:

- Safety and evacuation plan should be in place.
- Daily inspection of the excavation to assess safety and stability.
- Direct supervision of excavation while workers are carrying out duties within the excavation.
- Barrier should be erected creating a 1.5 m wide safety zone around the edge of the excavation.
- Drainage should be in place to prevent surface water from entering the excavation.
- The atmosphere (air) within the excavation should be monitored to ensure that no “heavy gases” such as exhaust fumes from plant equipment or vehicles or methane accumulate within the excavation which may pose a risk to the safety of workers.
- Safety harnesses and rescue harnesses should be worn by workers in excavations of greater than 1.5 m in depth.
- Safety helmets and eye protection should be worn by workers carrying out any duties within the excavation.
- Excavated material (soil) should not be placed or stockpiled within 1 m of the edge of the excavation.
- Emergency excavation equipment should be on-site or available.
- Medical support should be on-site including resuscitation equipment.

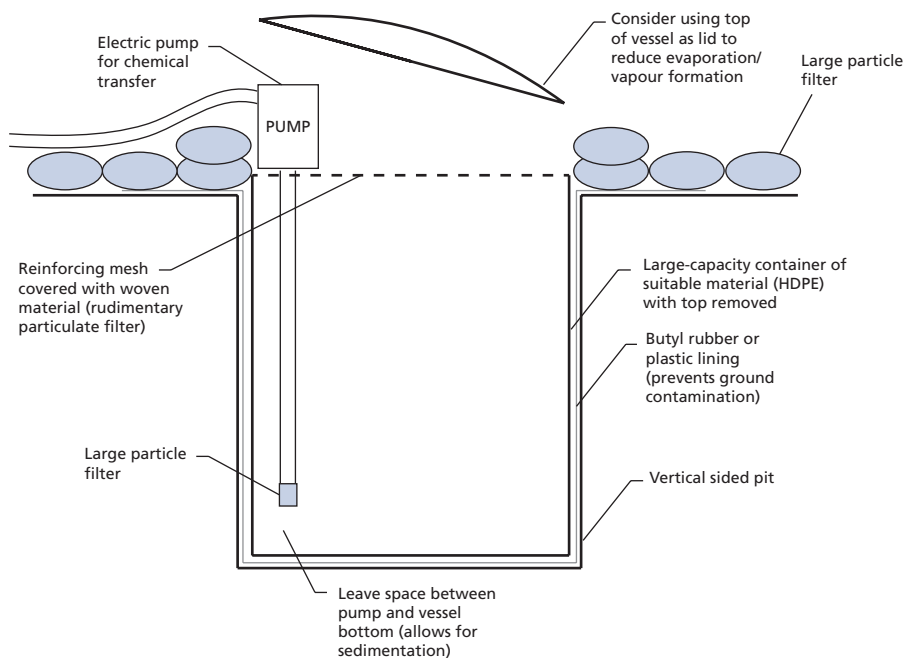
2.2 Open burning

Use a 200-litre barrel for burning or a pit of no more than 12 cubic metres. Keep all personnel upwind from fumes. No more than the contents of 10 drums should be burned at any one time—regardless of contents. If possible, a transfer pit (see figure 4) should be constructed to contain the bulk of the chemicals with a transfer line used to pump the chemical to the burning pit or drum. A burning device (see below for an example) is the recommended device to safely burn the material.

If a burner is not used, then the contents should be ignited by remote ignition. A simple method is to use a long bamboo pole with a cloth tied to the end. Ignite the cloth and use it to ignite the drum or pit.

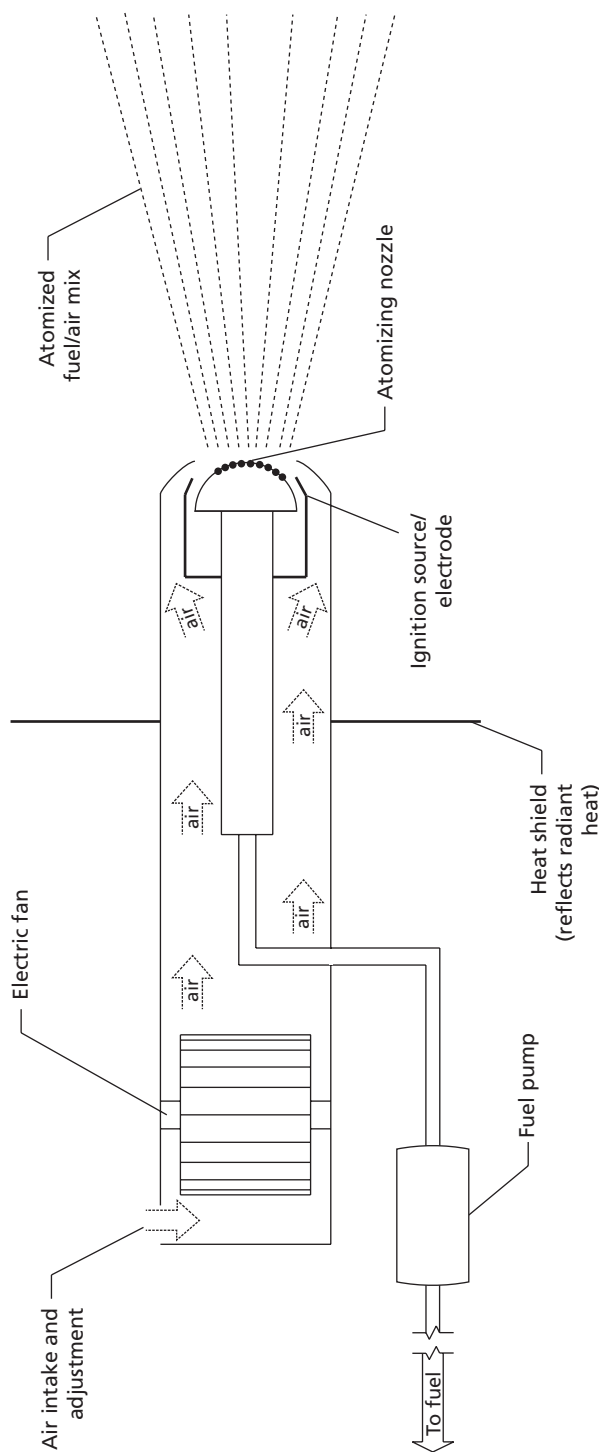
Note: Remote ignition is necessary because flammable solvents have a layer of vapour above the surface of the liquid. This is a very dangerous situation and one may become engulfed in flame if the material is ignited while standing nearby.

Figure 4. Transfer pit diagram



Source: Schematic drawn by Nathan Green, Forensic Chemist, Crime Scene Sciences, Australian Federal Police.

Figure 5. Fuel burner diagram



Source: Schematic drawn by Nathan Green, Forensic Chemist, Crime Scene Sciences, Australian Federal Police.

2.3 Neutralization

Procedures for neutralizing acids and bases are described in the following three sections. You should only perform neutralization of corrosives if you have been trained, you feel confident that you understand the process, you have the proper personal protective equipment, and are comfortable doing it.

General neutralization procedures

Perform neutralizations carefully, as vapours and heat may be generated. Wear personal protective equipment including apron, gloves and goggles. A face shield in combination with safety goggles is recommended. A face shield alone is not sufficient, safety goggles must be worn when using a face shield.

- Keep containers cool during process, such as placing a beaker in a bucket with slushy ice.
- Work slowly.
- Stir constantly.
- After neutralization is complete, dispose of down drain connected to a sewage system followed by 20 parts water to one part neutralized solution. If no sewer system is available—dispose of in a burial pit as described in section 2.1.
- See annex for specific strengths of acids and bases.
- Follow the specific neutralization procedures below for the acid or base you are trying to neutralize.

Acid neutralization

While stirring, add acids diluted 1:10 by volume with water to large amounts of an ice water solution (1:10) of base such as sodium carbonate, calcium hydroxide/oxide (lime), or sodium hydroxide for concentrated acids. Lime is the preferred base if available. Lime forms less water soluble salts which are more safely and easily disposed of.

When a pH of at least 5.5 to 9.0 is achieved, dispose of the solution down a drain connected to a sewage system (if available) followed by 20 parts water to one part neutralized solution. If no sewer system is available, dispose of in a burial pit as described in section 2.1.

Base neutralization

Add the base to a large vessel containing water (1:10). Slowly add a dilute solution of hydrochloric acid.

When a pH of at least 5.5 to 9.0 is achieved, dispose of the solution down a drain connected to a sewage system (if available) followed by 20 parts water to one part neutralized solution. If no sewer system is available, dispose of in a burial pit as described in section 2.1.

Neutralization of uncontaminated acids and bases

General comment: Always dilute acids at a ratio of approximately 1:10 by volume prior to neutralization. Always slowly add the acid to water (never the other way round). Stir constantly while adding the acid.

General comment: Always dilute base at a ratio of approximately 1:10 by volume prior to neutralization. To that end, slowly add the base to water (never the other way round). Stir constantly while adding the base.

- Neutralize in a barrel or a pit (if possible).
- If the water table is too high for a pit, create a ground level pit with sand bags and cover with a large butyl rubber sheet.
- Maximum recommended size for neutralization is 20 kilograms.
- Always stir during this process.
- Use a piece of wood or broomstick to stir.
- Even with dilution, effervescence is common.
- Steam may evolve.
- Container will get hot.
- Liquid may bubble.

Neutralization procedure—acids

- Slowly add diluted acid to a solution of the basic material selected.
- Dilute the solution further, approximately 1 to 10, with water.
- When possible always use lime to neutralize. When lime is not available, select a basic material, such as sodium bicarbonate, potassium bicarbonate, calcium bicarbonate, sodium hydroxide or potassium hydroxide.

- Always dilute base at a ratio of approximately 1:10 by volume prior to neutralization. To that end, slowly add the base to water (never the other way round).
- Always stir during this process—use a piece of wood or broomstick to stir.
- Never choose ammonia-based compounds. They should be avoided due to the possibility of incompatibility.
- Continue the process until a pH of between 6 and 8 is obtained.
- Neutralized material to be disposed of in drums or a burial pit or trench.

Neutralization procedure—bases

- Note: use sulphuric acid or hydrochloric acid but never nitric acid to neutralize the bases.
- Always dilute acids at a ratio of approximately 1:10 by volume prior to neutralization. Always slowly add the acid to water (never the other way round).
- Slowly add diluted acidic solution to a diluted solution of the base. Always dilute base at a ratio of approximately 1:10 by volume prior to neutralization. To that end, slowly add the base to water (never the other way round).
- Always stir during this process—use a piece of wood or broomstick to stir.
- Dilute the solution further, approximately 1 to 10, with water.
- Continue the process until a pH between 6 and 8 is obtained.
- Neutralized material to be disposed of in drums or a burial pit or trench.

It should be noted that often, especially at clandestine laboratory sites, both acids and bases are seized at the same time. Taking certain incompatibilities into consideration, those seized acids and bases may be used to neutralize each other, provided that they are not contaminated. Ammonia compounds are incompatible with nitric acid.

2.4 High temperature incineration using existing industrial plants

Industries which use high temperature technology, such as cement kilns, coal-fired thermal power stations or foundries, usually have furnaces that operate at temperatures well in excess of 850°C, have long combustion retention times and disperse exhaust gases via tall chimneys, often to high altitudes. Cement kilns are particularly

suited for waste disposal. Several features of cement kilns make them suitable for waste disposal. During burning the cement raw materials reach temperatures of 1,450°C, while the combustion gases reach temperatures up to 2,000°C. The gas residence time at these high temperatures is several seconds.

In these conditions, all organic waste components are effectively disintegrated. Some potentially dangerous or toxic combustion products become absorbed into the cement clinker product or are removed in the heat exchange equipment. Cement producers in many countries are eager to use alternative fuels. Waste should be introduced into the furnace as a reasonably small proportion of the total fuel feed. It is suggested that a sensible “rule of thumb” is no more than 5 percent of the fuel fed into the furnace at any one time is waste material. Cement kilns typically produce 1,500 to 8,000 metric tons of cement per day and therefore quite large quantities of material can be disposed of in a short period.

Flammable solvents, some solids, precursors, and controlled substances lend themselves to this disposal method. Some industries that may be suitable are:

- Petroleum industry
- Pulp industry
- Chemical industry
- Pharmaceutical industry
- Hospitals
- Universities
- Cement industry

2.5 Waste immobilization

Encapsulation

Encapsulation method 1

This involves immobilizing the waste in a solid block within a plastic or steel drum. Drums should be cleaned/rinsed prior to use and should not have previously contained explosive or hazardous materials. Fill the drum three-quarters full of the waste material and then fill with a cement mixture. For ease and speed of filling, the drum lids should be cut open and bent back. Irrespective of prior cleaning procedures, if the drums are of steel construction, the removal of the lids with either oxyacetylene cutting equipment or powered cutting disks is strongly discouraged as any residual organic vapours (e.g. fuels) may explode violently. Plastic drums should be used for encapsulation operations where possible. Care should be taken to avoid cuts to hands when filling.

Once the drums are filled with the waste, mix lime, cement and water in a 15:15:5 ratio by volume (extra water may be needed to liquefy the mixture for pouring).

Fill the drum to capacity with the cement mixture. Replace the lid and weld closed. Dispose of in an engineered landfill if available. If not available, bury the sealed drums in the ground (see section 2.1).

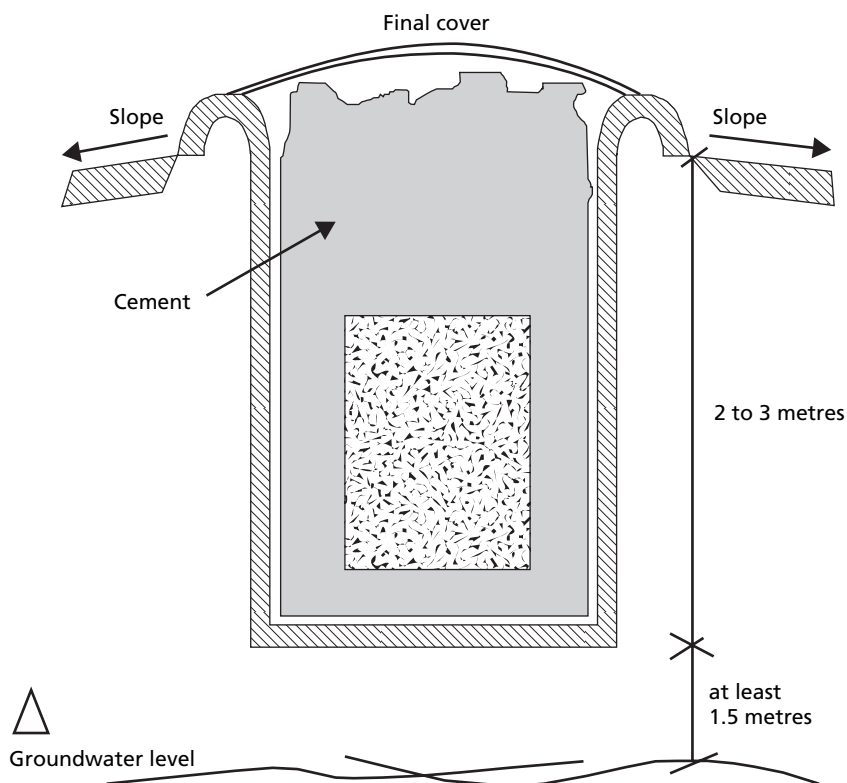
Lime and cement are corrosive substances. Personal protective equipment, e.g. gloves and protective clothing, must be used when handling these materials.

Encapsulation method 2

This involves immobilization of the waste in a pit. Dig the pit as described in section 2.1. Prepare a cement mixture in the ratio of: cement, lime, sand, water 1:1:4:5 by volume. Line the bottom with a layer of cement, fill with the waste and encase entire mass in more cement. Cover with soil and contour so rain water runs off away from the pit.

An example of a pit can be seen below.

Figure 6. Encapsulation pit diagram



Source: Adapted from L.F. Diaz and others, "Alternatives for the Treatment and Disposal of Healthcare Wastes in Developing Countries", Waste Management, vol. 25 (2005), pp.626-637.

Inertization

Inertization method 1

Remove the packaging materials, paper, cardboard and plastic, from the precursors or controlled substances. Tablets and capsules need to be removed from their blister packs. They are then ground (using a grinder or road roller). The ground powder is mixed with lime, cement, and water in a 65:15:15:5 ratio by volume. More water may be added as necessary to form a homogeneous paste. The paste is then placed in a drum or pit (see section 2.1).

Inertization method 2

Solids, semi-solids, and powders should be removed from their outer packaging but remain in their inner packaging and placed in clean plastic or steel drums, for treatment according to the encapsulation method above. Removing outer packaging dramatically reduces the volume for disposal by encapsulation.

The separation of materials should be as follows:

- Tablets and capsules in plastic/foil blisters should be removed from all outer packaging but not from blisters
- Tablets and capsules in bottles should be removed from outer packaging but not bottles
- Tablets and effervescent tablets in tubes should be removed from outer packaging but not from tubes
- Powders in bottles should be removed from outer packaging but not from bottles

2.6 Disposal of containers

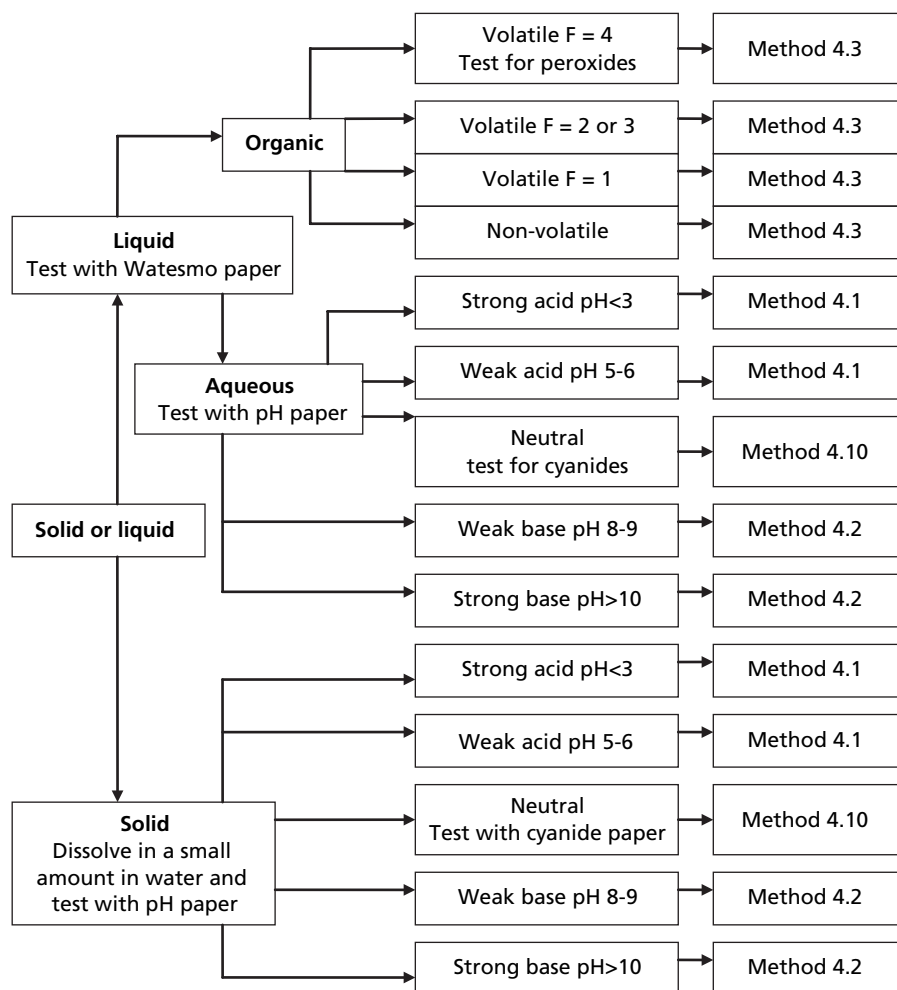
Care should be taken when disposing of containers that previously held chemicals. Traces of the original material may cause fire or explosion if handled improperly. In general, rinse the containers with water (verify first that the listed ingredient does not react with water). Using a road roller, crush and compress the containers. Once crushed, bury these items in a burial pit of their own.

2.7 Disposal of controlled substances and their precursors

Controlled substances and their precursors are best destroyed by high temperature incineration. When this option is not available, encapsulation or inertization are the best alternatives.

3. Safe disposal of unknown/unlabelled chemicals

In the instances where chemical containers are open, labels are missing, and/or the original manufacturer's seals are damaged, or where there are mixtures or chemical waste; testing is required to identify the chemicals. This is necessary to ensure the proper disposal methods are chosen. The scheme below summarizes the approach for identifying the type of treatment/disposal method appropriate for unknown/unlabelled chemicals, including mixtures. (For details on testing, see annex II.) The disposal methods provided are not comprehensive, but typically provide for the most desirable option for treatment and disposal. For health and safety considerations, please refer to section 4.

Figure 7. Disposal method selection flow chart for unknown/unlabelled chemicals*Notes*

1. This chart must be used by a forensic chemist or an adequately trained police officer/customs agent.
2. The operator should be aware that unknown/unlabelled chemicals might also be explosive. It is therefore recommended, as outlined in annex II, to use the smallest possible amount for preliminary testing.
3. Compounds labelled as reactive metals, or unlabelled chemicals, which appear to be stored under oil, must not be tested.
4. Similarly, compressed gases (cylinders) must not be sampled or tested. A trained specialist should be brought in to move them. (See method 4.20 below.)

4. Practical details for chemical neutralization and treatment

While it is always desirable to employ Group 1 disposal methods (see section 1), there may be situations where the required technologies/approaches are not available, or the disposal methods are not practicable for other reasons (e.g. lack of infrastructure or inability to transport the chemicals/wastes, etc.). In addition, many chemicals require some form of treatment (e.g. neutralization), before they can be disposed of as described in section 1.

This section provides a comprehensive compilation and practical details of specific methods for chemical neutralization and treatment, applicable to individual chemicals, or groups of chemicals. It should be noted that, in most cases, treated chemicals are eventually disposed of (usually the last step of any of the methods below) by one of the main types of disposal methods described in section 1 above.

Health and safety considerations

Standard health and safety procedures should be applied when performing the methods described in these guidelines. It is recognized, however, that this may not always be possible, and that different situations call for different safety procedures. (See annex VII for minimum health and safety procedures.) The precaution that must be taken before chemical neutralization and treatment proceeds include making every effort to ensure that:

(a) Trained personnel are present to conduct the treatment and oversee the disposal (see annex VIII for a suggested outline for a training course.);

(b) Proper safety equipment is available, for example: nitrile gloves; full face respirator; chemical resistant clothing.

In addition, the chemicals, glassware and other equipment needed for treatment in preparation for disposal should be available.

Neutralization of uncontaminated acids and bases

It should be noted that often, especially at clandestine laboratory sites, both acids and bases are seized at the same time. Taking certain incompatibilities into

consideration, those seized acids and bases may be used to neutralize each other, provided that they are not contaminated. While establishing a comprehensive list of neutralization “partners” is beyond the scope of these guidelines, it is recommended that tailored lists of compatible pairs of acids and bases be prepared, including the quantities required for neutralization, based on those chemicals most frequently seen at the national/provincial levels.

Unknown/unlabelled chemicals

In cases where chemical containers are open, labels are missing, and/or the original manufacturer’s seals are damaged, or in cases of mixtures or chemical waste, basic tests (see figure 7 and annex II) are required to identify the properties of the chemical in question and determine the most appropriate disposal method. Presumptive tests, which can be carried out at the scene (on-site), are helpful in this regard.

Disposal of containers

Care should be taken when disposing of containers that previously held chemicals. Frequently, the amounts of chemicals that remain in “emptied” containers are not negligible. Until such time as the identity or nature of unlabeled chemicals or mixtures has been established, they should be handled, transported or stored with maximum caution. In case of flammable chemicals, for example, small residues in the container may be enough to generate flammable vapours at or near the explosive limit of the chemical in question. From ether residues, explosive peroxides may form, and other chemical residues may cause violent reactions with other chemicals added to the container, if the two are incompatible.

Chemical residues should be removed by adding base or acid, or by rinsing the container with water, depending on the chemical previously held in the containers. The emptied and neutralized containers should be crushed, compressed and sent for material recovery or disposal, if possible.

In case of on-site treatment/disposal in a pit or trench, emptied containers should not be disposed of in the same trench that is used for the treatment or disposal of chemicals. In case of neutralization, the presence of waste containers may interfere with the reaction or may cause trench subsidence.

Specific disposal methods for a variety of chemicals are listed below.

4.1 Acids

- Inorganic acids (e.g. hydrochloric acid):
 - Neutralize as above.

- Specific acids—glacial acetic acid, acetic acid:
 - Neutralization see above.
 - Dilute the organic acid in an organic solvent (flammability rating 2 or 3) and burn. See above. See annex III for flammability ratings.
- Concentrated acids such as formic, hydrochloric, hydrobromic and lactic acids:
 - Neutralize as above.
- Oxidizing acids, such as nitric and perchloric acids:
 - Neutralize as above.
- Concentrated (57 per cent) hydriodic acid:
 - Neutralize as above.

4.2 Bases

- Caustic alkali (e.g. sodium hydroxide) and ammonia:
 - Neutralize as above.

4.3 Organic solvents (e.g. ethanol)

Peroxide-forming chemicals must be tested for the presence of peroxides, following procedures outlined in annex II. If positive, peroxides must be removed prior to disposal, as described in method 4.4, below.

- Solvents with flammability rating 2 or 3:
 - See annex III for flammability rating.
 - Burn in pit or trench, in an area 10 metres away from combustible material, or in a 200 litre drum (use remote ignition to ignite).
 - Fuel blending.
- Solvents with flammability rating 1 or 0:
 - Mix or dissolve in a solvent with a flammability rating of 2 or 3. Then burn in pit or trench in the same manner as described above.

4.4 Ethers

Liquids/solutions suspected to be ethers must be tested for the presence of peroxides, following procedures outlined in annex II. If the solution tests positive, peroxides must be removed prior to disposal.

- Dilute ether 1:3 with higher alcohol (e.g. isopropyl alcohol) or other available solvent of flammability rating 2 or 3 (see annex III for flammability ratings). Burn in a barrel or a trench using remote ignition.
- Removal of peroxides—If the solution tests positive for peroxides, the following steps must be followed to remove them:
 - Add 10 ml of 5 percent aqueous solution of ferrous sulphate or 6 grams of ferrous sulphate (hydrated) and 6 ml of concentrate sulphuric acid in 11 ml of water; or 3.5 grams of sodium iodide in 70 ml of glacial acetic acid to the solution.
 - Keep adding this solution until the ethyl ether does not test positive for peroxides.

If the solution appears to contain dried crystals on its interior surface or the liquid appears to contain slurry of crystals, no attempt should be made to remove the peroxides (extreme danger of explosion exists). The container should be carefully disposed of as dangerous, shock sensitive material by properly trained explosives handling personnel.

- Any quantity or sample contaminated with peroxides:
 - The transportation of any potentially explosive materials should be carried out with the use of an open vehicle where any explosive blast would be directed upwards. An open truck with strong metal sides, e.g. earth mover, tip-truck or scrap metal carrier design may serve for this purpose.
 - Transport (safely) to a pit in an open area.
 - Ignite with remote ignition.

4.5 Organic acid halides (e.g. acetyl chloride)

- To a large container, containing an excess of sodium bicarbonate (or sodium carbonate, or calcium carbonate), slowly add in the organic acid halide, and mix thoroughly:
 - Dilute with water until pH of approximately 6-8 is obtained, let stand 24 hours.

- Dispose of by burial in a trench.
- Always remember that organic halides may react violently with water.

4.6 Aldehydes (e.g. benzaldehyde) and organic halogen compounds (e.g. benzyl chloride)

Peroxide-forming chemicals must be tested for the presence of peroxides following procedures outlined in annex II. If positive, peroxides must be removed prior to disposal, as described in 4.4 above.

- Dissolve in an available flammable solvent (flammability rating 2 or 3) and burn in 200 litre drums, or an open pit.
- In an open pit filled with sodium bicarbonate, slowly add the chemical. Cover with scrap wood, and burn.

4.7 Aliphatic amines (e.g. methyl amine)

- In a large container, containing an excess of sodium bisulphate, add the amine and dilute with a large excess of water until a pH of 6-8 is obtained. Dispose of by burial in a trench.

4.8 Inorganic salts (e.g. aluminium chloride)

- Add the salt to a large excess of water.
- Add excess of soda ash, sodium (calcium) carbonate, and allow it to stand for 24 hours.
- Remove aqueous layer, check the pH and neutralize with acid or basic material, if necessary, to pH 6-8.
- The sludge may be disposed of in a burial pit.

4.9 Oxidizing agents (e.g. potassium permanganate, hydrogen peroxide, sodium dichromate)

- Add oxidizing agent to a large volume of a concentrated solution of sodium hypo-bisulphite (sodium metabisulphite) or a ferrous salt:

- Acidify with dilute sulphuric acid.
- When reaction is complete (i.e., when heat generation stops), neutralize the solution with soda ash or dilute hydrochloric acid.
- Dispose of in burial pit.
- Potassium permanganate in solid or aqueous solutions:
 - Dissolve 450 grams of potassium permanganate, in 8 litres of water.
 - Prepare a trench at least 16 metres away from flammable substances.
 - Place green leafy material in trench (do not use dry or combustible material).
 - Slowly pour potassium permanganate solution into trench as follows:
 - Small amount at a time: must change colour from purple to brown.
 - Heat may be generated: adjust pouring rate so it all turns brown.
 - Observe the reaction: you may have to add more green leafy material. Watch for the disappearance of the purple colour (the reaction is over).
 - Add water to trench. If purple in colour add more leafy material.
 - Refill the trench with dirt when finished.

In many cases, in remote areas, potassium permanganate is found dissolved in sulphuric acid. The above method may only be used if the sulphuric acid is dilute.

- Special procedures for calcium hydroxide, hydrogen peroxide and potassium permanganate:
 - Acidify to pH 2 with dilute sulphuric acid.
 - Add 50 per cent excess of aqueous sodium bisulphite.
 - Temperature will start to increase; if not, add more sodium bisulphite.
 - Adjust pH 6 to 8.
 - Dispose of by burial in a trench.
- Peroxides (e.g. hydrogen peroxide):
 - Mix or absorb the peroxide onto sand or vermiculite.
 - Wet with 10 per cent sodium hydroxide.
 - In a 200-litre drum or open pit, ignite with remote ignition.

4.10 Cyanides (e.g. sodium cyanide)

- Place in a large container (e.g. 200-litre drum) and make alkaline ($\text{pH} > 10$) with a sodium hydroxide solution:
 - Add an excess of ferrous sulphate solution.
 - After approximately 1-2 hours, dispose of by burial in a trench.
- Conversion to thiocyanate:
 - Add the cyanide to an alkaline solution ($\text{pH} > 9$) of sodium hydroxide and calcium hypochlorite.
 - Maintain an excess of sodium hydroxide and calcium hypochlorite.
 - Scoop the slurry into a large container and dilute with water.
 - Dispose of in a landfill or, in a remote area, by burial in a trench.
- Bleach method:

Do not use this procedure on more than 1.8 kg of cyanide at a time.

- Perform this procedure in a 200-litre drum.
- Add the cyanide to the drum.
- Dilute with water (11 litres per 450 grams of cyanide).
- Add a dilute caustic soda solution (diluted 1 in 10 with water) slowly with stirring.
- Test the pH and continue to add caustic soda solution until the pH is adjusted to 11.
- Refer to the table on amounts and select the volume of sodium hypochlorite solution needed.
- Add the required amount of sodium hypochlorite solution to the basic cyanide solution.
- Stir the solution and wait for fifteen minutes for the chemical reaction to occur.
- Bubbles of nitrogen gas can be observed.
- After the reaction stops generating gas bubbles, test for excess chlorine using chlorine test paper.
- If chlorine is not indicated, add another 4-litre portion of sodium hypochlorite solution, stir, wait and test.
- Once excess chlorine is present allow the solution to stand overnight.

It is essential that excess chlorine is indicated using the test paper before proceeding with the next step. If the test paper does not indicate excess chlorine, this indicates that the amount of sodium cyanide was incorrectly estimated. In that event, add an additional 4 litres of sodium hypochlorite solution with stirring, and allow the solution to stand overnight again. If excess chlorine is indicated proceed with the next step.

- After the above reaction has been completed, adjust the pH of the solution to 8-8.5 by the addition of dilute sulphuric acid (1 part acid to 10 parts water) with stirring. Now test with chlorine test paper again to be sure that there is excess chlorine. The solution may now be disposed of in an engineered landfill or, in a remote area, by burial in a trench.

<i>Sodium cyanide (kg)</i>	<i>15% Sodium hypochlorite (litres)</i>	<i>10% Sodium hypochlorite (litres)</i>
1	7.6	11.4
1.5	9.5	15.2
2	11.4	17.0
2.5	13.3	20.8
3	15.2	22.7
3.5	17.0	26.5
4	19.0	28.4

4.11 Hydrides (e.g. lithium aluminium hydride)

- Place the chemical in a trench or pit away from flammable material and burn with remote ignition. This method will result in a fire.

4.12 Organic amides (e.g. formamide)

- Dissolve or mix with flammable solvent (flammability rating 2 or 3—see annex III) and proceed as in 4.3.

4.13 Non-metallic compounds (e.g. phosphorous trichloride)

- Prepare 50/50 mixture of dry soda ash and slake lime:
 - Add non-metallic compound.

- Spray with water (Caution fire!).
- Neutralize by dilution with a large quantity of water.
- Dispose of in a burial pit.

4.14 Non-hazardous, solid chemicals

The following is a list of solid chemicals, which are not considered hazardous and are therefore suitable for disposal with regular waste in a burial pit.

- Organic chemicals:
 - Activated carbon
 - Sugars and sugar alcohols
 - Starch
 - Citric acid and its Na, K, Mg, Ca, NH_4 salts
 - Lactic acid and its Na, K, Mg, Ca, NH_4 salts
 - Urea
- Inorganic chemicals:
 - Silica
 - Sulphates: Na, K, Mg, Ca, Sr, NH_4
 - Phosphates: Na, K, Mg, Ca, Sr, NH_4
 - Carbonates: Na, K, Mg, Ca, Sr, NH_4
 - Oxides: B, Mg, Ca, Sr, Al, Si, Ti, Mn, Fe, Co, Cu
 - Chlorides: Ca, Na, K, Mg, NH_4
 - Borates: Na, K, Mg, Ca
- Tablet excipients

Urea can be donated for use as a fertilizer if packaging is intact and uncontaminated. Urea should not be used for neutralization of acids; it reacts with sodium hypochlorite to form nitrogen trichloride, an explosive.

4.15 Phosphorous (yellow and red)

Yellow phosphorus:

- In a 200-litre drum (typically, the original container), cover the powder with water.

- As the water evaporates (in the course of up to several days) the exposed phosphorus will ignite and burn.

Red phosphorus:

- Material should be placed in a thin layer in a suitable receptacle (e.g. a 200-litre drum halved lengthways).
- The receptacle should allow sufficient oxygen to be present for the burning of the material (with no other ignitable material present).
- Ignite using remote ignition from a safe distance (at least 10 metres).
- Ensure the material is completely destroyed before adding additional red phosphorous.

Caution: If a crust forms over burning red phosphorus, the formation of white phosphorus is a possibility. The agitation of "burnt" white phosphorus can cause re-ignition.

4.16 Alkali metals

- To a container of alcohol slowly add small amounts of the metal (approximately 1 gram):
 - Continue to add slowly each time the bubbling stops.
 - After all the metal has been added, add water to this solution in the same fashion.
 - If done too quickly fire will result.
 - The solution is then disposed of in a burial pit.

4.17 Other metals

- Encapsulation in a drum is the only possible method when in a remote area.

4.18 Aqueous solutions of water-miscible flammable organic solvents (e.g. solutions of less than 18 per cent acetone, ethanol, methanol and other water-soluble and water-miscible solvents)

- Most aqueous solutions can be disposed of in a burial pit.

- Pour the organic solvent on an absorbent material (e.g. sand), and let evaporate.

4.19 Iodine

- Add iodine to a solution of sodium thiosulphate (300 ml of 4 per cent) containing sodium carbonate (0.1 g).
- Stir until all of the iodine has dissolved (solution is colourless).
- Neutralize to a maximum pH of 8.5 with sodium carbonate (if pH higher than 9, iodine will re-dissolve).
- When reaction is complete, add sodium carbonate or dilute hydrochloric acid to neutralize the solution.
- Dispose of in a burial pit.

4.20 Gases and compressed/liquefied gases

- Gases and liquefied gases should not be moved; they should be kept in their original containers, and passed to a specialized disposal company.
- Gases may also be slowly vented to air by a specialist in a safe open area.
- Vent into a barrel of water—best used for HCl, HBr and methylamine:
 - Neutralize and dispose as above.

4.21 Radioactive material (e.g. thorium nitrate)

- Must be destroyed by proper radioactive disposal methods.

4.22 Thionyl chloride

- Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e.g. vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as sawdust. Do not flush with water.
- Neutralize by reacting with an excess mixture of sodium bicarbonate/calcium oxide in a tub. Mix sodium bicarbonate/calcium oxide together in a tub in a ratio of 3:1 by weight. Add thionyl chloride to this mixture slowly and carefully suited in level B safety equipment (see annex VI).

The total ratio of the three must be in the ratio of 3:1:1. Once neutralized—add 50 per cent hydrogen peroxide in an amount equivalent to 30 per cent of the starting amount of thionyl chloride. An example of the proper amounts would be: The maximum batch size is 100 kg of thionyl chloride. 300 kg of sodium bicarbonate, 100 kg of calcium oxide and 33 kg of 50 per cent hydrogen peroxide would be needed to oxidize the calcium sulphite to calcium sulphate. The calcium sulphate can be used by water treatment plants to treat the water.

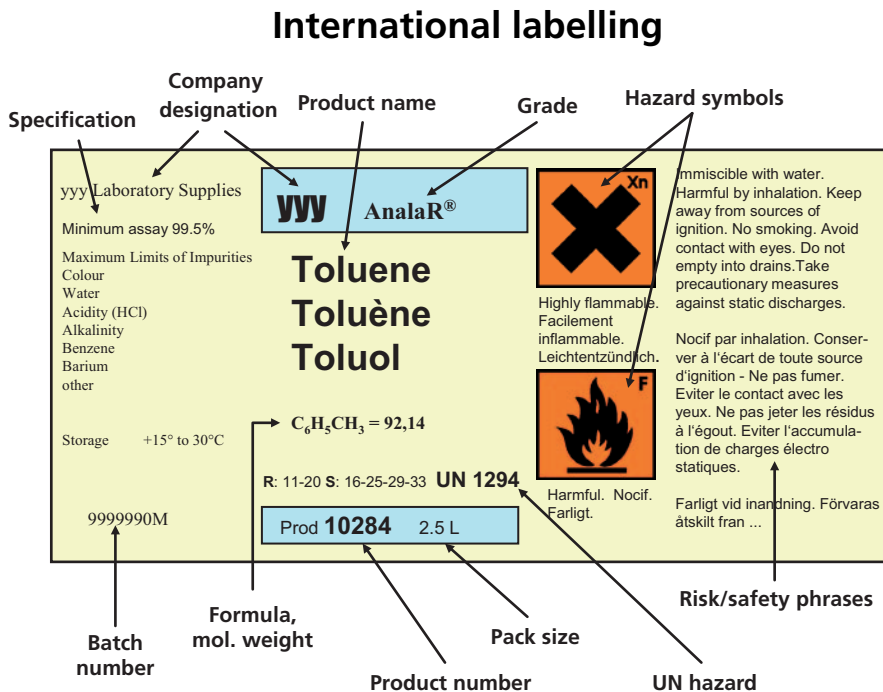
4.23 Sodium hypochlorite

- To the sodium hypochlorite solution add a large excess of a bisulphite or a ferrous salt and acidify with dilute sulphuric acid (diluted 1:10 with water).
- When the reduction is complete, add soda ash or dilute hydrochloric acid (diluted 1:10 with water) to neutralize the solution.
- Dispose of in the sewer system (if available) with a large excess of water; if not, remote burial or dispose of in an engineered landfill.

5. Safe handling and storage of chemicals

5.1 Safe handling of seized chemicals

1. When handling seized chemicals, always utilize proper safety equipment (see annex VI).
2. Never handle chemicals alone; always have a second person to assist.
3. Read all labels prior to handling or moving chemicals. Note that labels may not always reflect the actual contents either as a result of adulteration or through deliberate mislabelling.



4. Carry out field tests to identify unknown chemicals or determine their chemical characteristics prior to transportation or storage.
5. Handling and transportation of chemicals should only be done by qualified personnel, and in compliance with local laws and regulations.
6. When moving or transporting chemicals:
 - Package them in the original containers, wherever possible;
 - Separate containers to prevent breakage;
 - Segregate by chemical hazard groups;
 - Transport must follow dangerous goods legislation.
7. Chemicals should not be stored or handled more than is absolutely necessary.
8. Chemicals should never be stored in an area or building where personnel regularly work or eat, e.g. offices.
9. If chemicals must be stored for a long time; they should never be stored in plastic containers. Plastic is not chemically resistant for long-term storage.
10. When chemicals must be stored, store them by groups (e.g. acids, bases, volatiles, oxidizers, etc.).
11. Retain the minimum amount of chemicals required for evidentiary purposes (with appropriate labelling to maintain the chain of custody).
 - Never mix unknown chemicals.
12. Take special care when opening containers, because solvent vapours may have built up significant pressure inside:
 - Especially in warm climates;
 - Drum tops frequently bulge.
13. Use separate units/containers and tools for chemical neutralization and treatment of different chemicals to avoid incompatibility reactions from chemical residues present from an earlier treatment operation.
 - Clean tools and containers in between these activities to prevent cross contamination.

5.2 Safe storage of seized chemicals

When chemicals are seized they must be separated and stored as per chemical class characteristics. Develop a chemical segregation and storage plan.

The following procedures can be applied to clandestine laboratories in urban settings, or in remote areas. In an area away from the actual laboratory site, separate the chemicals as per class characteristics. The sampling and disposal of chemicals will then proceed accordingly.

If the chemicals must be stored for a period of time in a storage facility, the facility should employ the following practices:

- Storage of chemicals per class (i.e., avoid storing incompatible compounds together):
 - Flammables or combustibles (e.g. acetone, alcohols, kerosene, methyl ethyl ketone, petroleum ether, etc.)
 - Halogenated organic compounds (e.g. chloroform methylene chloride, etc.)
 - Ammonia
 - Oxidizing agents (e.g. potassium permanganate, sodium dichromate, sodium hypochlorite, etc.)
 - Alkalis (e.g. ammonium hydroxide, potassium hydroxide, sodium hydroxide, etc.)
 - Acids (e.g. hydrochloric acid, nitric acid, sulphuric acid, etc.)
 - Solids (All solids should be separated.)
 - Compressed gases
 - Laboratory chemical waste

When chemicals are inadvertently mixed, the results can be fire, explosion and/or the release of toxic gases. It is therefore important that chemicals from the different classes do not come into contact with one another (e.g. potassium permanganate must never come in contact with an organic compound as fire and explosions will result).

Use of segregation barriers to separate and secure chemicals:

- These barriers (e.g. containment berms) may be built with small sandbags that physically isolate different types of chemicals, contain spills and prevent them from spreading.

- Contaminated absorbent material can then be disposed of in a suitable manner.
- Regular safety inspections of the storage and handling area, including of the storage containers.
- Easy access to every container (for preventive inspection and timely response to leakages/spills).
- Must have the capacity to handle deteriorated containers and repackage leaking containers.
- Proper ventilation.
- Maintenance of a supply of absorbent material (e.g. sand or vermiculite) to be used as segregation barriers and for absorbing spills.

5.3 Handling of chemical spills

Chemical spills refer to the accidental release of chemicals or substances outside their intended containers, which may pose a risk to human health or the environment. Appropriate measures should be taken to ensure the risk to human health and impact on the environment is kept to a minimum by cleaning up the spilt chemical and remediating the site.

In case of chemical spills, where there are no applicable national regulations, the following practices should be employed.

Indoor spills

Assess the risks posed by the nature and quantities of chemical spilled and determine whether it is a minor or major spill.

Indoor minor spills

A minor spill involves the release of a type or quantity of a chemical which does not pose an immediate risk to health and does not involve chemical contamination to the body and is less than 2.5 litres:

- Secure the area;
- Inform the officer/chemist/laboratory technician in charge;
- Use personal safety equipment including protective chemical suit, gloves, boots and breathing protection;
- Notify all staff in the vicinity of the spill;

- Identify, if possible, what the chemical is (check the label on the container);
- Remove ignition sources and unplug nearby electrical equipment, alternately isolate power to room or building if safe to do so;
- Establish ventilation. Vent vapours to outside of building only (open windows or external doors);
- Use a chemical absorbent to absorb the chemical:
 - Confine and contain spill
 - Acid and base spills should be neutralized prior to cleanup
 - Cover with absorbent material
 - Sweep solid material into a plastic dust pan and place in a sealed container;
- Dispose of in an engineered landfill only if neutralized or stabilized and only if no other viable disposal method described in this guideline, such as complete incineration is available.

Indoor major spills

This involves the release of a type or quantity of a chemical that poses an immediate risk to human health or the environment or involves risk of uncontrolled fire or explosion. In such cases, the following action should be taken:

- Evacuate the immediate area and inform the Fire/HAZMAT officer in charge without delay, or if risk is sufficient or situation becomes dangerous, evacuation of building may be appropriate;
- Use personal safety equipment including protective chemical suit, gloves, boots and breathing protection. Selection of safety equipment should be based on the risk posed by the chemicals spilled. If chemical type is unknown, maximum level of personal protective equipment should be used, including but not limited to, full chemical resistant suit, boots and full face sealed breathing apparatus;
- Identify, if possible, what the chemical is (check the label and all records);
- If safe to do so, power to the area should be isolated, especially where risk of fire or explosion exists;
- Confine and contain spill, in same manner and using appropriate methods and absorbent materials as described for indoor minor spills;
- Keep the place/area well ventilated if the spilt chemical is a volatile and flammable substance;
- Dispose of in an engineered landfill only if neutralized or stabilized and only if no other viable disposal method described in this guideline, such as complete incineration is available.

Outdoor spills

When dealing with outdoor spills, regardless of volume or size the following actions should be taken:

- Evacuate the immediate area and immediately inform the officer in charge.
- Use personal safety equipment including protective chemical suit, gloves, boots and breathing protection. Selection of safety equipment should be based on the risk posed by the chemicals spilled. If chemical type is unknown, maximum level of personal protective equipment should be used, including but not limited to, full chemical resistant suit, boots and full face sealed breathing apparatus.
- Contain the spill and prevent the chemical from entering drains, wells, streams or other waterways.
- Drains may be blocked with material such as plastic and covered in soil or sand. The spill may also be contained by excavating a channel, ditch or dam made from the soil, sand (sand bag) or other available material to prevent and contain the flow of the substance.
- Using a spade or shovel, disperse the absorbent material across the surface area of the spill as evenly as possible, larger quantities of absorbent can be concentrated on deeper areas of the spill or around locations such as drains to further prevent chemicals from leaving the spill area.
- When the spill has been contained and the absorbents used, the saturated absorbent material should be placed into sealed drums for transport, treatment and disposal off site. Label the drum with full description of the spilt chemical and appropriate Dangerous Goods code.
- The area affected by the spilled chemical should be cleaned or excavated, such that no evidence of the spilled material is visible on the ground or soil where the spill occurred.
- Absorbent material (see page 47) and any soil or sand used to contain the spill, or which becomes contaminated by the spilt chemical, such as excavated soil, should be treated by neutralization or stabilization prior to disposal to an engineered landfill approved to receive hazardous wastes and this option should be adopted only if no other viable disposal method described in this guideline, such as complete or high temperature incineration is available.

The UNODC does not advocate the disposal of chemicals or wastes in non-engineered landfills nor in engineered landfills that are only authorized for non-hazardous or municipal wastes. This method of disposal may pose a long-term risk to human health and the environment, and should only be considered as a disposal option where chemicals have been appropriately neutralized or stabilized.

Chemical absorbents

There are many different absorbent materials available which are suitable for use as chemical absorbent materials. It is recommended that when handling or transporting chemicals, a chemical spill kit containing an absorbent material should be carried at all times. Most commercial spill kits will contain an absorbent manufactured from recycled paper or vermiculite or other inert substances. In remote locations such materials may not be available, in such cases the use of sand/soil, which is widely available is recommended. The following is a list of absorbent materials which may be suitable:

- Commercial recycled paper absorbent (low cost)
- Sand
- Diatomaceous earth (expensive and not widely available)
- Vermiculite (expensive)
- Zeolite

Always read the label and manufacturer's information about the safe application of the absorbent material.

Breathing protection should be worn when handling chemical absorbents, particularly vermiculite and zeolite which may contain alpha-silica. Chemical absorbents manufactured from cotton waste (cotton trash) should not be used to absorb spills involving sulphuric acid, as this absorbent material may spontaneously combust.

6. Potential in-country resources

This section is intended to provide guidance for the identification of potential in-country resources and capacity for chemical disposal. As an initial step, it is recommended that existing facilities and resources for disposal, or management of other types of wastes are reviewed and assessed as to their utility, or adaptability, for the disposal of the chemicals of concern. Ultimately, as part of a broader strategy, chemical disposal should be considered as an integral element of national environmental waste management regulations and plans.

The review of potential in-country resources for disposal involves the establishment of strategic partnerships with those industries/institutions that already have access to the required technologies. For example, if the need for an incinerator has been identified, where would one turn in order to try and find such equipment, with available capacity and appropriate specifications?

Companies, industries and other national institutions that may have chemical disposal equipment (e.g. incinerators), which may be of use to police and forensic agencies that need access to chemical disposal include:

- Chemical waste disposal companies
- Petroleum industry
- Pulp industry
- Chemical industry
- Pharmaceutical industry
- Hospitals
- Universities
- Cement industry

The review of potential in-country resources for disposal also involves the identification of potential innovative uses for the chemicals of concern.

For example, certain chemicals, in particular flammable solvents, may be disposed of in a cost-effective manner by fuel-blending (or co-incineration). This refers to the use of the waste solvents as fuel, for energy recovery, in the existing facilities of other industries, e.g. the cement industry.

Other options include the construction of specific facilities where chemicals might be transformed into other products. Colombia, for example, has invested in the industrial scale reaction of seized sulphuric acid with bauxite, which is abundantly available from Colombia's natural deposits, to produce aluminium sulphate for water treatment.

To ensure national inter-agency coordination, the above activities could be led by a national focal point. This focal point could be the designated authority for a national environmental waste management strategy, the designated competent authority under the international drug control conventions, or another agency that supports industrial development.

7. The role of the specialist

Planning and executing activities related to the disposal of chemicals is a complex task. In many circumstances no one individual will have all the required expertise and/or training. It is therefore advisable to have a trained team that can deal effectively with chemicals from seizures. Depending on the circumstances, these teams may consist of a mixture of the following expertise: chemistry, occupational health and safety specialists, firemen trained in the disposal of hazardous waste, waste management and bomb disposal experts, police, military, etc.

Preferably, such teams should be coordinated by a trained forensic chemist (with expertise in chemical management, including chemical identification, safe handling, storage, treatment and disposal), or someone with training in chemistry and chemical disposal/waste management.

Under many circumstances this may not be possible. A police officer/customs agent may be a suitable replacement, if he/she has had appropriate training in the area. Scenarios where specialist expertise would come into play are:

When seized chemicals and/or drugs need to be destroyed and no chemical waste management company is available and transport of the chemicals and drugs is not feasible.

The expert may give advice on:

- The separation of chemicals as to compatibility/hazards;
- Use of field testing equipment;
- Sampling procedures as necessary;
- Treatment/disposal methods that should be used;
- Supervising, coordinating and monitoring the disposal.

When chemicals and/or drugs are seized in a clandestine laboratory location. The expert may:

- Secure the clandestine laboratory site;

- Provide information on what drugs are being made;
- Provide information on hazards in the laboratory;
- Provide information on what exhibits to seize;
- Provide information on what exhibits need to be analyzed;
- Take samples as necessary.

In both scenarios, the specialist/expert will also advise on local chemical names, and the role/function of different chemicals in the illicit drug manufacturing process.

Sampling procedures will depend on the laws of the country. Therefore, where samples of seized chemicals need to be taken for analysis or for legal/court proceedings, standard protocols used by national law enforcement personnel should be followed.

8. Summary of legal implications

The discovery, seizure, transport, storage and disposal of chemicals encountered in the enforcement of national drug control laws present unique problems to law enforcement and regulatory authorities. Among the problems encountered are:

- The establishment of ownership;
- The lack of legal authority to seize and dispose of these chemicals;
- The handling of these substances in a manner that is consistent with protecting the health and safety of the personnel processing them;
- The disposal of substances in a manner that is consistent with current environmental concerns and legislation;
- The need to check the bona-fides of companies that are contracted for disposal or recycling of chemicals to ensure their legitimacy; and
- The need to monitor the fate of seized chemicals to avoid their return to illicit channels by documenting their chain of custody.

Outlined below are different issues to be considered in connection with disposal activities, which should be addressed by the relevant national drug control laws.

Large quantities of chemicals with multiple legitimate uses, which transit in international and national commerce, are required for the clandestine manufacture of illicit drugs. The individuals and organizations that operate clandestine laboratories divert these chemicals from the licit trade. The recommended methods of controls to prevent and/or uncover chemical diversion are found in the United Nations drug conventions. This document takes those recommendations to the next logical step: What actions should be taken when chemicals are encountered as a result of Member States implementing the recommendations of the United Nations drug conventions?

Chemicals used by clandestine laboratory operators in the production of illicit drugs are usually diverted from the legitimate trade and may be encountered at any stage of the “licit” chain of distribution, or at the clandestine laboratory site. The location where the chemicals are actually seized, along with their quantity and condition, will be the determinant factors as to how they will be handled or treated. National drug control laws and regulations should provide for the speedy and efficient collection, processing and disposal of seized chemicals in a manner that minimizes or eliminates the potential problems resulting from long-term storage and handling, such as

personal and public safety and the possibility of their diversion and subsequent reintroduction for use in the illicit manufacture of drugs. Methods may include on-site neutralization and disposal of the chemicals, donation or sale to predetermined institutions that have a need for them, as permitted by local laws and regulations, or return to the “licit” trade chain of distribution.

The following legal factors and other circumstances must be considered when determining how national drug laws will treat seized chemicals destined for the use in clandestine drug manufacturing:

- The national legitimate requirements for a particular chemical must be established in order to determine what type of control measures, if any, will be applied (e.g. quotas, permits, etc.).
- The national judicial and legal requirements must be established to determine how chemicals seized at clandestine laboratory sites and at border crossings, including stopped shipments will be classified (e.g. contraband, hazardous material, abandoned, etc.).
- The legal ownership, as well as the rights, if any, of the legal owners of chemicals seized at any point in the “licit” chain of distribution must be established to facilitate the processing of the seized chemicals through the judicial process.
- The national legal process to seize and dispose of chemicals destined for use in clandestine drug manufacturing must be established in order to allow for quick disposition (e.g. return to supplier, public sale, destruction, etc.) and to eliminate the need for long-term storage.

Overcoming legal obstacles

- Strict control of chemicals with multiple legitimate uses in a particular country may be difficult or impossible, whereas the opposite is true for chemicals with limited or no use. The method of control should be determined according to the chemical’s use.
- Classifying seized chemicals as contraband, hazardous waste, or abandoned products, depending on the circumstances surrounding the seizure, will grant authority to the legal system to finalize forfeiture and order the method of disposal.
- Legal owners of chemicals seized while in the “licit” chain of distribution may have certain rights under national laws. It is imperative that those rights be tempered to allow the courts to facilitate the processing of seized chemicals in a timely fashion.
- National laws must be amended to ensure that courts authorize the quick disposition of seized chemicals (pre-trial destruction) in order to prevent the possible disappearance of the chemicals and to protect public health and safety, and the environment.

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Glossary

This glossary defines the terms as they are used in the present document, and provides additional explanations where necessary.

ATS: Amphetamine type stimulants.

Burning: Refers to burning by uncontrolled flames, the combustion products being released directly into the atmosphere. Burning is typically an option in remote locations where more environmentally safe disposal methods are not practicable.

Chemical treatment: The chemical substance is treated in a way that renders the material non-recoverable.

Chemicals: The term as used in these guidelines refers to all chemicals used in the clandestine manufacture of ATS drugs (primarily, amphetamine, methamphetamine, MDA and MDMA). It also includes chemicals used to synthesize precursors and chemicals used to process opium/morphine to heroin.

Clean-up: Refers to the entire process of chemical identification, safe handling, transportation, treatment and disposal.

Controlled substance: Drug or chemical substance whose manufacture, possession, or use are controlled by law.

Corrosivity: A waste is corrosive if it dissolves metals and other materials, or burns or damages the skin or eyes on contact:

- Is aqueous with a pH of 2 or less or 12 or higher or a powder that when added to water produces the same pH values.
- It is a liquid and corrodes steel at a rate greater than 6.35 millimetres per year.
- Examples of corrosive wastes are:
 - Acids: hydrochloric acid, sulphuric acid, nitric acid, acetic acid
 - Bases: sodium hydroxides, ammonium hydroxide, aqueous ammonia

Destruction: The physical destruction of the chemical substance, e.g. for the purposes of energy recovery by incineration.

Disposal: The term refers to the act or process of treating chemicals, chemical waste, containers, and other materials associated with the illicit manufacture of drugs.

Encapsulation: The stabilization of hazardous chemicals in a matrix that prevents its release.

Fuel-blending: Refers to the use of flammable solvents (flammability rating 2 or 3) as fuel, for energy recovery (co-incineration) at commercial companies (e.g. cement industry, etc.) as a method of disposal.

Ignitability: A waste is ignitable if it is easily combustible for flammable, or, if ignited, burns so vigorously that it creates a hazard. These include:

- A liquid with a flashpoint equal to or less than 37.8 °C;
- A non-liquid, capable under standard temperature and pressure of causing fire by means of friction, absorption of moisture, or spontaneous chemical changes and which when ignited, burns so vigorously and persistently that it creates a hazard;
- An ignitable compressed gas as defined in the U.S. Department of Transportation (DOT) regulations;
- Examples of ignitable wastes are solvents such as acetone, ether alcohols, toluene, hexane, ethyl acetate.

Incineration: Burning by controlled flame in an enclosed area with appropriate safeguards to prevent the release of toxic chemicals into the environment. Incineration is considered a form of treatment and produces ash that must be properly disposed of.

Inertization: Inertization is a variant of encapsulation.

Landfill: Refers to the disposal on land of solid waste and solid waste residues (e.g. ash from incineration), by use of excavations—remote area burials.

Neutralization: Chemical reaction in which an acid and a base are mixed to form a “neutral” pH (generally 6-8) solution.

Open air burning: See “Burning”.

Pit: A pit is an open area dug into the ground, if possible down to areas of non-porous soil (e.g. clay), with a flat bottom and sloped sides. A pit may also be a natural depression. Pits are used in remote locations for open air burning, neutralization, or as a landfill (remote area burial), when more environmentally safe disposal options are not practicable.

Precursor: Any chemical, reagent, solvent, catalyst that is involved in the transformation of, or transformed into another compound, as in the course of a chemical reaction, and therefore precedes that compound in the synthetic pathway.

Radioactivity: Spontaneous emission of radiation, either directly from unstable atomic nuclei or as a consequence of a nuclear reaction. It also refers to the radiation, including alpha particles, nucleons, electrons, and gamma rays, emitted by a radioactive substance. Example of radioactive compound is thorium nitrate (α emitter).

Reactivity: A waste is reactive if it is unstable or undergoes rapid or violent chemical reactions, such as catching fire, exploding, or giving off fumes, when exposed to or mixed with water, air or other materials:

- Is unstable and readily undergoes violent change without detonating
- Reacts violently with water
- Generates toxic gases, vapours or fumes when mixed with water and does so in a quantity sufficient to present a danger to life or the environment
- Is a cyanide or sulphide bearing waste which, when exposed to pH condition between 2 and 12.5 can generate toxic gases, vapours or fumes
- Is capable of detonation, explosive reaction or explosive decomposition
- Examples of reactive wastes are:
 - Cyanide compounds
 - Organic peroxides
- Water reactive:
 - Sodium metals
 - Calcium hydride
 - Thionyl chloride
 - Ammonium and sodium sulphide

Recycling: Resale or turnover of the chemical substance into legitimate industry, where the form of the chemical remains unchanged and the chemical can be used for its original intended purpose. For the purpose of these guidelines, the terms recycling and reuse include the following options:

- Returning commercially labelled, factory-sealed containers to the original supplier or, through auction sales, to vetted legitimate chemical handlers
- Sale, auction or donation to public/academic institutions that may have a direct legitimate need for them (e.g. schools, universities, hospitals, etc.)
- Fuel-blending

Remote area burial: See “Pit”.

Remote ignition: The lighting of a fire from a safe distance.

Segregation: Refers to a concept of chemicals storage, where different classes of chemicals (i.e., acids, bases, etc.) are stored in separate containers, in widely separated locations to minimize the risk of chemical reaction.

Stabilization: See “Encapsulation”.

Treatment: Action to change the characteristics of a chemical or chemical waste to result in less hazard or reduced volume.

Trench: See “Pit”.

Annex I. Chemicals used in the illicit manufacture of drugs and their disposal methods

Name		Used in the manufacture of: 1 = cocaine 2 = heroin; 3 = amphetamine/ methamphetamine 4 = MDA/MDMA 5 = methaqualone	Disposal method	Type A = Acid B = Base G = Gas M = Metal O = Other P = Precursor R = Radioactive S = Solvent	CAS number
	Acetaldehyde	3	4.6	S	75-07-0
	Acetic acid	1,2,3,4	4.1	A	64-19-2
	Acetic anhydride	1,2,3,5	4.1	O	108-24-7
	Acetone	1,2,3,4	4.3	S	67-64-1
	Acetonitrile	3	4.3	S	75-05-8
	Acetophenone	3		O	98-86-2
	Acetylacetone	5	4.3	S	123-54-6
N-	Acetylanthranilic acid	5	4.1	A	89-52-1
	Acetylchloride	2	4.5	O	75-36-5
N-	Acetyephedrine	3	4.14	P	16413-75-5
N-	Acetylpseudoephedrine	3	4.14	P	84472-25-3
	Activated carbon	2	4.14	O	7440-44-0
	Allyl chloride	3		O	107-05-1
	Allylbenzene	3	4.3	S	300-57-2
	Aluminum (metal)	3,4	4.18	M	91728-14-2
	Aluminum powdered	3,4	4.18	M	7429-19-5
	Aluminum chloride	2,3,4	4.8	O	7784-13-6
	Aluminum chloride (anhydrous)	3,4	4.8	O	7784-13-6
	Ammonia (gas)	3,4	4.21	G	1336-21-6
	Ammonium acetate	3,4	4.14	O	8013-61-4
	Ammonium carbonate	3	4.2	B	506-87-6

Name		Used in the manufacture of: 1 = cocaine 2 = heroin; 3 = amphetamine/ methamphetamine 4 = MDA/MDMA 5 = methaqualone	Disposal method	Type A = Acid B = Base G = Gas M = Metal O = Other P = Precursor R = Radioactive S = Solvent	CAS number
	Ammonium chloride	2,3,4	4.14	O	1215-02-9
	Ammonium formate	3	4.2	O	540-69-2
	Ammonium hydroxide	1,2,3,4,5	4.2	B	1336-21-6
N-	Amylamine	3	4.7	O	110-58-2
	Anthranilic acid	5	4.1	A	118-92-3
	Baker's yeast	3,4	4.14	O	68876-77-7
	Benzaldehyde	3,4	4.6	O	100-52-7
	Benzene	1,3,4	4.3	S	71-43-2
	Benzoquinone	4		O	106-51-4
	Benzyl chloride	3	4.8	O	100-44-7
	Benzyl cyanide	3	4.1	O	140-29-4
	Bromobenzene**	3	4.3	S	108-86-1
N-	Bromosuccinimide	4		O	75-18-3
N-	Butanol	1	4.3	S	71-36-3
N-	Butylacetate	1	4.3	S	123-86-4
2	Butylacetate	1	4.3	S	105-46-4
N-	Butylamine	3	4.7	B	109-73-9
	Calcium bicarbonate	2	4.2	B	3983-19-5
	Calcium carbonate (limestone)	1	4.2	B	471-34-1
	Calcium hydroxide (Slake lime)	1,2,3	4.2	B	1305-62-0
	Calcium oxide (quick lime)	1,2	4.2	B	1305-78-8
	Carbon dioxide gas	3,4	4.21	G	124-38-9
	Catechol	4		O	120-80-9
	Cement	1		O	65997-15-1
	Charcoal	2,3,4	4.14	O	7440-44-0
O-	Chloroacetanilide	5	4.3	O	120-66-1
	Chloroacetone	3	4.3	S	78-95-5
O-	Chloroaniline	5	4.3	O	95-51-2
	Chloroephedrine	3	4.14	P	25394-33-6
	Chloroform	1,2,3,4,5	4.3	S	67-66-3

Name		Used in the manufacture of: 1 = cocaine 2 = heroin; 3 = amphetamine/ methamphetamine 4 = MDA/MDMA 5 = methaqualone	Disposal method	Type A = Acid B = Base G = Gas M = Metal O = Other P = Precursor R = Radioactive S = Solvent	CAS number
	Citrate buffer pH 6	3,4	4.14	O	
	Copper metal	3,4	4.18	M	7440-50-8
	Cresol	2		O	95-48-7
	Cupric chloride	4	4.14	O	7447-39-4
	Cuprous oxide	4	4.14	O	1317-39-1
	Diacetone alcohol	1	4.3	S	123-42-2
	Dibromomethane**	4	4.3	S	74-95-3
	Dichloromethane**		4.3	S	75-09-2
	Diethylamine	4	4.7	B	660-68-4
	Dimethylformamide	3,4	4.3	S	68-12-2
	Ephedrine	3	4.14	P	134-71-4
	Ethyl acetate	1,2,3	4.3	S	141-78-6
	Ethyl alcohol	1,2,3,4,5	4.3	S	64-17-5
	Ethyl ether*	1,2,3,4,5	4.4	S	60-29-7
	Ethylamine	4	4.7	B	506-58-1
N-	Ethylephedrine	3	4.14	P	7681-79-0
N-	Ethylpseudoephedrine	3	4.14	P	258827-65-5
	Ferric chloride	3	4.14	O	10025-77-1
	Formamide	3,4	4.12	S	75-12-7
	Formic acid	3,4	4.1	A	64-18-6
	Glacial acetic acid	2,3,4	4.1	A	64-19-2
	Glucose	3,4	4.14	O	14431-43-7
	Hexane	1,3	4.3	S	110-54-3
	Hydriodic acid	3	4.1	A	10034-85-2
	Hydrobromic acid	3,4	4.1	A	10035-10-6
	Hydrochloric acid	1,2,3,4,5	4.1	A	7647-01-0
	Hydrogen bromide gas	3,4	4.21	G	10035-10-6
	Hydrogen chloride gas	3,4	4.21	G	7647-01-0
	Hydrogen gas	3,4	4.21	G	1333-74-0
	Hydrogen peroxide	3	4.9	O	7722-84-1
	Hydroxylamine HCl	3		O	7803-49-8
	Hypophosphorous acid	3	4.1	A	6303-21-5

Name		Used in the manufacture of: 1 = cocaine 2 = heroin; 3 = amphetamine/ methamphetamine 4 = MDA/MDMA 5 = methaqualone	Disposal method	Type A = Acid B = Base G = Gas M = Metal O = Other P = Precursor R = Radioactive S = Solvent	CAS number
	Iodine	3	4.2	O	10544-22-6
	Iron filings	4	4.18	M	7439-89-6
	Isatoic (anhydride)	5	4.1	A	118-48-9
	Isopropyl alcohol	1,3,4	4.3	S	67-63-0
	Isosafrole	4	4.3	O	120-58-1
	Kerosene	1	4.3	S	8008-20-6
	Lead acetate	3	4.18	O	6080-56-4
	Lithium aluminum hydride	3,4	4.11	O	16853-85-3
	Lithium metal	3	4.17	M	74-04-7
	Magnesium bromide (anhydrous)	5	4.14	O	7789-48-2
	Magnesium metal	3	4.18	M	67-56-1
	Magnesium sulfate	3	4.8	O	10034-99-8
	Manganese dioxide	1	4.9	O	1313-35-7
	Manganese oxide	1	4.9	O	1317-35-7
	Mercuric bromide	4	4.18	O	7789-47-1
	Mercuric chloride	3,4	4.18	O	7487-94-7
	Mercuric nitrate	3,4	4.18	O	10045-94-0
	Mercury metal	3,4	4.18	M	9439-97-6
	Methyl alcohol	1,2,3,4,5	4.3	S	67-56-1
	Methyl ethyl ketone*	1,2	4.3	S	78-93-3
	Methylamine (40% solution in water)	3,4	4.2	B	74-89-5
	Methylamine gas	3,4	4.2	B	74-89-5
	Methylamine HCl	3,4	4.2	B	593-51-1
	Methylene bromide**	3		S	74-95-3
	Methylene chloride**	3	4.3	S	75-09-2
3,4-	Methylenedioxy- phenyl-2-propanone (PMK; 3,4-MDP-2-P)	4	4.3	P	4676-39-5
N-	Methylephedrine	3	4.14	P	552-79-4
	Methylformamide	3,4	4.12	S	123-39-7

Name		Used in the manufacture of: 1 = cocaine 2 = heroin; 3 = amphetamine/ methamphetamine 4 = MDA/MDMA 5 = methaqualone	Disposal method	Type A = Acid B = Base G = Gas M = Metal O = Other P = Precursor R = Radioactive S = Solvent	CAS number
	Methyl isobutyl ketone	1	4.3	S	108-10-1
N-	Methylpseudoephedrine	3	4.14	P	51018-28-1
	Nitric acid	3	4.1	A	7697-37-2
	Nitroethane	3,4	4.3	S	79-24-3
	Nitrotoluene	5	4.3	S	88-72-2
	Norephedrine	3	4.14	P	154-41-6
	Norpseudoephedrine (phenylpropanolamine)	3	4.14	P	36393-56-3
	Palladium chloride	3,4	4.18	O	7647-10-1
	Palladium black	3,4	4.18	O	7440-05-3
	Palladium on barium sulfate	3,4	4.18	O	7440-05-3
	Paraformaldehyde	3,4	4.6	O	30525-89-4
	Perchloric acid	3		A	7601-90-3
	Petroleum ether	1,3	4.4	S	8032-32-4
1-	Phenyl-2-chloro- propane	3	4.3	S	10304-81-1
1-	Phenyl-2-propanone (P-2-P; BMK)	3	4.3	P	103-79-7
	Phenylacetic acid	3	4.1	A	101-41-7
α-	Phenylacetoacetonitrile	3	4.3	O	4468-48-8
	Phosphoric acid	3	4.1	A	37267-86-0
	Phosphorous, red	3	4.16	O	7723-14-0
	Phosphorous, white	3	4.16	O	7723-14-0
	Phosphorous, yellow	3	4.16	O	7723-14-0
	Phosphorous trichlo- ride	5	4.13	O	7719-12-2
	Phthalic (anhydride)	5	4.1	A	85-44-9
	Piperidine	3	4.2	B	110-89-4
	Piperonal	4	4.3	O	120-57-0
	Piperonyl alcohol	4	4.3	O	495-76-1
	Platinum (IV) dioxide (Adam's-type catalyst)	3,4	4.18	O	1314-15-4

Name		Used in the manufacture of: 1 = cocaine 2 = heroin; 3 = amphetamine/ methamphetamine 4 = MDA/MDMA 5 = methaqualone	Disposal method	Type A = Acid B = Base G = Gas M = Metal O = Other P = Precursor R = Radioactive S = Solvent	CAS number
	Platinum metal	3,4	4.18	M	7440-05-3
	Potassium bicarbonate	2	4.2	B	298-14-6
	Potassium carbonate	1,2	4.2	B	584-08-7
	Potassium cyanide	3	4.1	O	151-50-8
	Potassium hydroxide (caustic potash)	1,2,3,4	4.2	B	56-23-5
	Potassium manganate	1	4.9	O	10294-64-1
	Potassium metal	3	4.17	M	7440-09-7
	Potassium permanganate	1	4.18	O	7722-64-7
	Pseudoephedrine	3	4.14	P	90-82-4
	Pyridine	2,3,5	4.2	B	110-86-1
	Pyruvic acid	3,4		A	113-24-6
	Raney nickel	3,4		O	7440-02-0
	Safrole	4	4.3	O	94-59-7
	Sodium acetate	3	4.2	B	127-09-3
	Sodium bicarbonate	1,2,3,4,5	4.2	B	144-55-8
	sodium bisulfite	3	4.2	B	7631-90-5
	Sodium borohydride	3,4	4.11	O	16940-66-2
	Sodium bromide	3,4		O	7647-15-6
	Sodium carbonate (soda ash)	1,2,4	4.2	B	497-19-8
	Sodium cyanide	3	4.10	O	143-33-9
	Sodium cyanoborohydride	3,4	4.11	O	25895-60-7
	Sodium hydroxide (caustic soda)	1,2,3,4	4.2	B	1310-73-2
	Sodium hypochlorite	1	4.24	O	7681-62-9
	Sodium metal	3	4.17	M	7440-23-5
	Sodium perborate	3,4		O	10042-94-1
	Sodium percarbonate	3,4		O	15630-89-4
	Sodium pyruvate	3,4		O	113-24-6
	Sodium sulphate	1,3	4.14	O	7757-82-6

Name		Used in the manufacture of: 1 = cocaine 2 = heroin; 3 = amphetamine/ methamphetamine 4 = MDA/MDMA 5 = methaqualone	Disposal method	Type A = Acid B = Base G = Gas M = Metal O = Other P = Precursor R = Radioactive S = Solvent	CAS number
	Styrene	3		O	600-42-5
	Sulfuric acid	1,2,3,4	4.1	A	7664-93-9
	Tartaric acid	2,3	4.1	A	526-83-0
	Tetrahydrofuran*	3,4	4.3	S	109-99-9
	Thiamine pyrophosphate	3,4	4.14	O	154-87-0
	Thionyl chloride	2,3	4.23	O	7719-09-7
	Thorium nitrate	3	4.22	R	13470-07-0
	Toluene	1,3,4,5	4.3	S	108-88-3
O-	Toluidine	5	4.3	O	95-53-4
	Urea	2	4.14	O	506-89-8
	Xylene	1	4.3	S	106-42-3
	Zinc metal	3,4	4.18	M	7440-66-6

*Peroxide forming chemicals (these chemicals must be checked for the presence of peroxides before disposal by burning).

**Halogenated organic solvents—may form toxic gases during burning.

Annex II. Chemical tests to be conducted on unknown or unlabelled solids and liquids

Typically, the identity of unknown/unlabelled chemicals should be confirmed by laboratory analysis. However, presumptive group tests, which can be carried out at the scene (on-site) are helpful in determining appropriate health and safety precautions, proper storage, and potential disposal methods if the waste must be disposed of at the site and cannot be moved. Testing is particularly important if chemicals are opened, labels are missing and/or the original manufacturer's seals are damaged, or in case of mixtures or clandestine laboratory waste. The following is an outline for field-testing to determine the nature and chemical and physical properties of unknown chemicals. It is not an outline for presumptive testing of substance identity. The first step of the field-testing procedure is to take note of the physical characteristics of the unknown chemical. The physical description should include the state of the material (solid, liquid), the colour, and the consistency (for solids) or viscosity (for liquids). For liquid materials, describe the clarity of the solution (transparent, translucent, or opaque). If an unknown material is a bi- or tri-layered liquid, describe each layer separately, giving an approximate percentage of the total for each layer. This may be helpful in determining the quality of the chemicals to be listed and disposed of.

Test papers

The easiest way to test for the chemical properties of unknown chemicals is through use of commercial test papers. Test papers available include:

- Watesmo paper: determines if solvent is aqueous or organic
- pH paper: determines strength of acid or base
- Peroxide paper: determines amount of peroxides present
- Cyanide paper: determines if cyanides are present
- Ammonium paper: determines the presence of ammonia and ammonium hydroxide
- Iodide test paper: determines the presence of iodine

- Mercury test paper: determines the presence of mercury and its salts
- Chlorine test paper: determines presence of chlorine

These test papers should be used following the suppliers' instructions.

Chemical tests

If test papers are not available, a number of basic tests may be carried out to characterize, and determine key properties of, unknown chemicals. The flow chart in section 3 on page 28 will then help to determine the most appropriate disposal method. After taking appropriate safety precautions (see "Safe handling of chemicals" on page 41) for handling the unknown chemical, including the use of personal protection devices, remove a small sample for use in the following tests, preferably in an open environment.

Water reactivity

Carefully add a few crystals of the unknown substance to 1 ml of water. Observe any changes, including heat evolution, gas evolution and flame generation. If any of these occur, the compound is classified as water reactive.

Because unknown/unlabelled chemicals might be explosive, the utmost care has to be taken when performing tests.

Water solubility

Add a few crystals (if a solid) or five drops (if a liquid) to 1 ml of water. Observe if the solid or the liquid dissolves in the water. If it is an insoluble liquid, note whether it is less or more dense than water (i.e. does it float or sink). Most non-halogenated organic liquids are less dense than water.

pH

If a liquid, test directly with pH paper and observe result. If a solid, place a few crystals of the material in 1 ml of water, test with pH paper, and observe the result.

Ignitability (flammability)

Place five drops of the liquid in a small glass beaker. Apply an ignition source, typically a butane lighter or propane torch, to the test sample for one-half second.

If the material supports its own combustion, it is a flammable liquid with a flash point of less than 60°C. If the sample does not ignite, apply the ignition source again for one second. If the material burns, it is combustible. Combustible materials have a flash point between 60°C and 93°C.

Presence of peroxides

Any of these tests below (A-C) may be used:

- A. Commercial test papers. They can be purchased from, for example:
 - EM Scientific cat no: 100111-1
 - Lab Safety supply cat no: 1162
 - Aldrich Chemical cat no: Z10-168-0
 - Follow instructions provided by the manufacturer.
- B. Commercial starch-iodide paper: Wet paper with 1 N hydrochloric acid, and then place a small portion of the unknown on the wetted paper. A change in colour of the paper to dark purple is a positive test for an oxidizer.
- C. Non-commercial tests (i.e. solutions are made up).

Iodide tests

- Add 1 ml of substance to be tested to a freshly prepared solution of 100 mg of sodium (potassium) iodide in 1 ml of glacial acetic acid. Yellow colour equals low concentration of peroxides; brown colour equals high concentrations of peroxides.
- Add 1-3 ml of the liquid to be tested to an equal volume of acetic acid, and add a few drops of 5 per cent potassium iodide solution and shake. The appearance of a yellow to a brown colour indicates the presence of peroxides.
- Add substance to be tested to 1 ml of a freshly prepared 10 per cent solution of potassium iodide in 10 ml of ethyl ether in a 25 ml glass-stoppered cylinder of colourless glass protected from light. A resulting yellow colour indicates the presence of 0.005 per cent peroxides.

Iodide/starch test

Add 0.5 ml of the solution to be tested to a mixture of 1 ml of 10 per cent potassium iodide solution and 0.5 ml of dilute hydrochloric acid to which a few drops of starch solution have been added just prior to the test. The appearance of a blue to blue-black colour within a minute indicates the presence of peroxides.

Other

Prepare a solution of 5 ml of 15 per cent ferrous ammonium sulphate, 0.5 ml of 1N sulphuric acid and 0.5 ml of 0.1N ammonium thiocyanate. Shake with an equal quantity of the solution to be tested. If peroxides are present, a red colour will develop.

Presence of sulphide

The test for inorganic sulphides is carried out only when the pH of an aqueous solution of the unknown is greater than 10. Add a few drops of concentrated hydrochloric acid to a sample of the unknown while holding a piece of commercial lead acetate paper, wetted with distilled water, over the sample.

Development of a brown-black colour on the paper indicates generation of hydrogen sulphide.

In view of the toxicity of the hydrogen sulphide formed during this test, only a small sample should be tested, and appropriate ventilation should be used.

Presence of cyanide

A. Commercial test papers. They can be purchased from, for example:

- Macheery-Nagel ca# 90604
- mn-net.com cat# 91318
 - Follow instructions provided by the manufacturer.

B. This test for inorganic cyanides is carried out only when the pH of an aqueous solution of the unknown is greater than 10. Prior to testing for cyanides, the following stock solutions should be prepared:

- 10 per cent aqueous sodium hydroxide (solution A)
- 10 per cent aqueous ferrous sulphate (solution B)
- 5 per cent ferric chloride (solution C).

Mix 2 ml of the sample with 1 ml of distilled water and 1 ml each of solutions A, B, and C. Add enough concentrated sulphuric acid to make the solution acidic.

Development of a blue colour (Prussian blue, from ferric ferrocyanide) indicates the presence of cyanide.

In view of the toxicity of the hydrogen cyanide formed during this test, only a small sample should be tested, and appropriate ventilation should be used.

Presence of halogen

Heat a piece of copper wire until red in a flame. Cool the wire in distilled or deionized water, and then dip the wire into the unknown. Again heat the wire in the flame.

The presence of halogen is indicated by a green colour around the wire.

Chemical test to determine the presence of specific acids

Prepare three separate solutions of the acid to be tested by adding 1-2 drops of the acid to 1 ml of deionized water. Perform the following tests:

- A. *Silver nitrate test*: Add 1-2 drops of 5 per cent silver nitrate reagent* to the solution and observe the precipitate, if any. If a precipitate is observed add 1-2 drops of concentrated ammonium hydroxide and observe if the precipitate dissolves.
- B. *Barium nitrate test*: Add 1-2 drops of 5 per cent barium nitrate reagent* and observe the precipitate, if any.
- C. *Basic barium nitrate test*: Add 1-2 drops of 50 per cent NaOH, and make sure pH is basic.

Acid	Silver nitrate	Silver nitrate+NH ₄ OH	Barium nitrate	Basic barium nitrate
HBr	Pale yellow precipitate	Dissolves	No precipitate	No precipitate
HI	Yellow precipitate	White precipitate	No precipitate	No precipitate
HCl	White precipitate	Dissolves	No precipitate	No precipitate
H ₂ SO ₄	No precipitate	No precipitate	White precipitate	White precipitate
HNO ₃	No precipitate	No precipitate	No precipitate	No precipitate
H ₃ PO ₄	No precipitate	No precipitate	No precipitate	White precipitate
H ₃ PO ₂	Black precipitate	No precipitate	No precipitate	No precipitate

*All reagents should be prepared according to established procedures.

Presence of mercury

- A. Commercial test papers. They can be purchased from, for example:
 - Bgiusa.com catalogue # Hg01
 - Gardco.com cat# TR-2022
 - Follow instructions provided by the manufacturer.

B. Prepare the following solutions:

- Potassium iodide 1 gm in 10 ml water. Add material to test tube:
 - Add reagent and note the colour
 - Then heat and note the change in colour
- Potassium chromate 19.4 gm dissolved in 1 litre water. Add material to test tube:
 - Add reagent and note the colour
 - Then heat and note colour.

<i>Mercury ion</i>	<i>Potassium iodide</i>	<i>Potassium iodide heated solution</i>	<i>Potassium chromate</i>	<i>Potassium chromate heated solution</i>
Hg+	Green precipitate. Turns black with excess reagent.	Red	Brown precipitate	Red
Hg++	Orange to red- brown precipitate. Colourless with excess reagent.	No change	n/a	n/a

n/a—not applicable

Annex III. Health, flammability, reactivity and hazard ratings

A variety of health, flammability, reactivity and hazard ratings exist, including those established by the United Nations, known as the *Globally Harmonized System of Classification and Labelling of Chemicals*. Different countries, and different government agencies, may, historically, have chosen to adopt different approaches in establishing the ratings used. The ratings below are commonly used in North and South America in connection with the hazards associated with chemicals, including those chemicals frequently encountered in clandestine drug manufacture.

A. Health (H) ratings

- 4 A few breaths of the gas or vapour could cause death. The gas, vapour or liquid could be fatal on penetrating the protective clothing. Must use specific protective clothing.
- 3 Material extremely hazardous to health, but area may be entered with extreme care. Full protective clothing must be used. No skin surface should be exposed.
- 2 Material hazardous to health, but area may be entered freely with self-contained breathing apparatus (SCBA).
- 1 Material only slightly hazardous to health. It may be desirable to wear SCBA.
- 0 No hazard.



Very toxic



Toxic



Harmful

B. Flammability (F) ratings

- 4 Very flammable gases, very volatile flammable liquids, and materials that, in the form of dusts or mists, readily form explosive mixtures when dispersed in the air. Flash point below 23 °C.
- 3 Liquids, which can be ignited under almost all normal temperature conditions; any material that ignites spontaneously at normal temperatures in air. Flash point below 38 °C.
- 2 Liquids, which must be heated before ignition can occur; solids which give off flammable vapours. Flash point >38 °C but <93 °C.
- 1 Material, which must be preheated before ignition can occur. Flash point > 93 °C.
- 0 Materials that will not burn.



Extremely flammable



Highly flammable

A liquid which has a flash point of less than 140 °F (60 °C) is considered ignitable. This category includes almost all organic solvents.

C. Reactivity (R) ratings

- 4 Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperature and pressures.
- 3 Materials which in themselves are capable of detonation or of explosive decomposition or of explosive reaction, but which require a strong initiating source. Includes materials which are sensitive to thermal or mechanical shock at elevated temperatures and pressures or which react explosively with water without requiring heat.

- 2 Materials, which are normally unstable and readily undergo violent chemical change but do not detonate. Includes materials which react violently or which may form potential explosive mixtures with water.
- 1 Materials, which are normally stable but may become unstable at elevated temperatures and pressures: may react with water with some release of energy but not violently.
- 0 Materials, which are normally stable even under fire exposed conditions and which are not reactive with water.



Explosive

D. Hazard rating (Sax)

The Sax Hazard Rating is a combined rating of toxicity and hazard. Ratings are assigned on the basis of low (1), medium (2), or high (3) toxic, fire, explosive, or reactivity hazard.

- 3 Indicates a lethal dose (LD50) below 400 mg/kg or a lethal concentration (LC50) below 100 ppm or the material is explosive, spontaneously flammable or highly reactive.
- 2 Indicates an LD50 of 400-4,000 mg/kg or an LC50 of 100-500 ppm or the material is highly flammable or reactive.
- 1 Indicates an LD50 of greater than 4,000 mg/kg or an LC50 of greater than 4,000 ppm, or that the material is combustible.

Hazard (H), flammability (F) and reactivity (R) table

<i>Name</i>		<i>H</i>	<i>F</i>	<i>R</i>	<i>Hazard rating (Sax)</i>
	Acetaldehyde	2	4	2	3
	Acetic acid	2	2	1	3

	<i>Name</i>	<i>H</i>	<i>F</i>	<i>R</i>	<i>Hazard rating (Sax)</i>
	Acetic anhydride	2	2	1	2
	Acetone	1	3	0	3
	Acetonitrile	3	3	3	3
	Acetophenone	1	2	0	
	Acetyl chloride	3	3	2	3
	Acetylacetone	2	3	0	
N-	Acetylanthranilic acid	1	1	1	
	Activated carbon	0	0	1	
	Allyl chloride	3	3	1	
	Aluminum (metal)	0	1	1	3
	Aluminum chloride	3	0	2	3
	Aluminum powdered)	0	1	1	3
	Ammonia (gas)	3	1	0	
	Ammonium acetate	1	1	1	
	Ammonium carbonate	1	0	0	3
	Ammonium chloride	1	1	1	
	Ammonium formate				2
	Ammonium hydroxide	2	1		3
N-	Amylamine	3	3	0	
	Anhydrous aluminum chloride	3	0	2	
	Anthranilic acid	2	1	0	3 (1)
	Benzaldehyde	2	2	0	3
	Benzene	2	3	0	3
	Benzoquinone	1	2	1	
	Benzyl chloride	2	2	1	3
	Benzyl cyanide	3	1	1	
	Bromobenzene	2	2	0	
N-	Butanol	1	3	0	3
N-	Butylacetate	1	3	0	3
2	Butylacetate	1	3	0	3
N-	Butylamine	3	4	0	6
	Calcium bicarbonate			2	
	Calcium carbonate (limestone)	1	0	0	2
	Calcium hydroxide (slake lime)	2	0	0	2
	Calcium oxide (quick lime)	1	0	1	3
	Carbon dioxide gas		0		
	Catechol	3	1	0	

<i>Name</i>		<i>H</i>	<i>F</i>	<i>R</i>	<i>Hazard rating (Sax)</i>
o-	Chloroacetanilide	1	0	0	
o-	Chloroaniline	2	1	1	
	Chloroform	3	1	0	3
	Copper metal	2	0	0	
	Cresol	3	2	0	
	Diacetone alcohol	1	2	0	2
	Dibromomethane	3	0	3	3
	Diethylamine	3	3	0	3
	Dimethylformamide	1	2	0	3
	Ephedrine	1		0	
	Ethyl acetate	1	3	0	3
	Ethyl alcohol	0	3	0	3
	Ethyl ether*	2	4	1	3
	Ethylamine	3	4	0	3
	Ferric chloride	1	0	1	
	Formamide	3	1	0	3
	Formic acid	3	2	0	
	Glacial acetic acid	3	2	2	3
	Hexane	1	3	0	3
	Hydriodic acid	3		1	
	Hydrobromic acid	3		1	3
	Hydrochloric acid	3	0	0	3
	Hydrogen bromide gas	3	0	1	
	Hydrogen chloride gas	3	0	1	
	Hydrogen gas	0	4	0	
	Hydrogen peroxide	3	0	1	
	Hydroxylamine HCl	2	0	3	
	Hypophosphorous acid	2		0	3
	Iodine	4	0	0	3
	Isatoic anhydride	1	0	0	
	Isopropyl alcohol	1	3	0	3
	Isosafrole				3
	Kerosene	1	2	0	3
	Lithium aluminum hydride	3	1	2	3
	Lithium metal	3	2	2	
	Magnesium bromide (anhydrous)	1	0	0	

	<i>Name</i>	<i>H</i>	<i>F</i>	<i>R</i>	<i>Hazard rating (Sax)</i>
	Magnesium metal	2	4	3	3
	Mercuric bromide	3	0	1	3
	Mercuric chloride	3	0	1	3
	Mercuric nitrate	3	0	1	3
	Mercury metal	3			3
	Methyl alcohol	1	3	0	3
	Methyl ethyl ketone*	1	3	0	3
	Methyl isobutyl ketone	2	3	0	
	Methylamine (40% solution in water)	3	4	3	3
	Methylamine gas	3	4	0	
	Methylene bromide	2	3	0	
	Methylene chloride	2	3	0	
	Nitric acid	2	0	1	3
	Nitroethane	2	3	1	3
o-	Nitrotoluene	2	1	4	
	Palladium black	1	0	1	
	Palladium on barium sulfate	1	0	1	
	Paraformaldehyde	3	1	0	
	Perchloric acid	3	0	3	3
	Petroleum ether	1	4	0	3
1-	Phenyl-2-propanone (P-2-P; BMK)	1	1	1	
	Phenylacetic acid	2	1	1	2
	Phosphoric acid	3	0	3	3
	Phosphorous trichloride	3	0	2	
	Phosphorous, red	0	1	1	3
	Phosphorous, white	3	3	1	3
	Phosphorous, yellow	3	3	1	3
	Phthalic anhydride	2	1	2	
	Piperidine	2	3	3	3
	Piperonal	1	1	1	
	Platinum (IV) dioxide (Adam's-type catalyst)	1	0	0	
	Platinum metal	1	0	0	
	Potassium bicarbonate	1	0	0	1
	Potassium carbonate	3	0	0	3
	Potassium cyanide	3	0	0	3

<i>Name</i>		<i>H</i>	<i>F</i>	<i>R</i>	<i>Hazard rating (Sax)</i>
	Potassium hydroxide (caustic potash)	3	0	0	3
	Potassium metal	3	1	2	3
	Potassium permanganate	0	0	1	3
	Pseudoephedrine				3
	Pyridine	2	3	0	3
	Rainey nickel	1	0	1	
	Safrole	2	1	1	
	Sodium acetate	1	1	1	
	Sodium bicarbonate	1		0	1
	Sodium borohydride	2	2	2	3
	Sodium carbonate (soda ash)	2		0	3
	Sodium cyanide	2	0	0	3
	Sodium cyanoborohydride	2	2	2	3
	Sodium hydroxide (caustic soda)	3	0	1	3
	Sodium hypochlorite	2			
	Sodium metal	3	1	2	3
	Sodium sulphate	1	n/a	1	2
	Styrene	2	3	2	
	Sulfuric acid	3	0	1	3
	Tartaric acid	2	1	0	2
	Tetrahydrofuran*	2	3	1	3
	Thionyl chloride	4	0	1	3
	Toluene	2	3	0	3
o-	Toluidine	3	2	0	3
	Urea	0	n/a	1	3
	Xylene	2	3	0	3

*Peroxide forming chemicals (these chemicals must be checked for the presence of peroxides before disposal by burning).

Annex IV. Physical properties

	<i>Name</i>	<i>Molecular weight (gm)</i>	<i>Density (gm/cm³)</i>
	Acetaldehyde	44.05	0.788
	Acetic acid	60.05	1.049
	Acetic anhydride	102.09	1.082
	Acetone	58.08	0.791
	Acetonitrile	41.05	0.786
	Acetophenone	120.15	1.028
	Acetyl chloride	78.5	1.104
	Acetylacetone	100.1	0.975
N-	Acetylanthranilic acid	179.2	
N-	Acetyephedrine	207.268	
N-	Acetylpseudoephedrine	207.268	
	Allyl chloride	76.52	0.94
	Allylbenzene	118.18	0.89
	Aluminum (metal)	26.98	2.7
	Aluminum chloride	133.34	2.48
	Aluminum powdered	26.98	2.7
	Ammonia (gas)	17.03	0.73
	Ammonium acetate	77.08	1.17
	Ammonium carbonate	96.09	1.5
	Ammonium chloride	53.49	1.53
	Ammonium formate	63.06	1.27
	Ammonium hydroxide	35.04	0.91
N-	Amylamine	87.16	0.75
	Anhydrous aluminum chloride	133.34	2.48
	Anthranilic acid	137.1	1.4
	Benzaldehyde	106.12	1.044
	Benzene	78.11	0.874
	Benzoquinone	108.1	1.318
	Benzyl chloride	126.58	1.1

	<i>Name</i>	<i>Molecular weight (gm)</i>	<i>Density (gm/cm³)</i>
	Benzyl cyanide	117.15	1.015
	Bromobenzene	157.02	1.491
N-	Bromosuccinimide	177.98	2.098
N-	Butanol	74.12	0.81
N-	Butylacetate	116.16	0.88
2	Butylacetate	116.16	0.87
N-	Butylamine	73.14	0.741
	Calcium bicarbonate	163.96	
	Calcium carbonate (limestone)	100.09	2.71
	Calcium hydroxide (slake lime)	74.1	2.211
	Calcium oxide (quick lime)	56.077	3.35
	Carbon dioxide gas	44.01	0.77
	Catechol	110.1	1.344
o-	Chloro acetanilide	169.6	
	Chloroacetone	92.52	1.15
o-	Chloroaniline	127.57	1.21
	Chloroephedrine	184	
	Chloroform	119.38	1.492
	Copper metal	63.55	8.94
	Cresol	108.14	1.05
	Cupric chloride	134.45	3.386
	Cuprous oxide	143.09	6
	Diacetone alcohol	116.16	0.938
	Dibromomethane	173.83	2.497
	Diethylamine	73.14	0.707
	Dimethylformamide	73.1	0.944
	Ephedrine	165.24	
	Ethyl acetate	88.11	0.902
	Ethyl alcohol	46.07	0.794
	Ethyl ether*	74.12	0.706
	Ethylamine	45.08	2.1
N-	Ethylephedrine	193.285	
N-	Ethylpseudoephedrine	193.285	
	Ferric chloride	162.2	2.898
	Formamide	45.04	1.133
	Formic acid	43.03	1.22

<i>Name</i>		<i>Molecular weight (gm)</i>	<i>Density (gm/cm³)</i>
	Glacial acetic acid	60.05	1.049
	Glucose	180.16	1.54
	Hexane	86.18	0.659
	Hydriodic acid	127.91	1.701
	Hydrobromic acid	80.92	1.49
	Hydrochloric acid	36.46	1.2
	Hydrogen bromide gas	80.91	3.307
	Hydrogen chloride gas	36.46	1.477
	Hydrogen gas	1.01	0.07
	Hydrogen peroxide 3%	34.02	1
	Hydrogen peroxide 50%	34.02	1.18
	Hydroxylamine HCl	69.49	
	Hypophosphorous acid	66	1.274
	Iodine	253.81	4.933
	Iron filings	55.85	7.874
	Isatoic anhydride	163.1	
	Isopropyl alcohol	60.1	0.785
	Isosafrole	162.19	1.12
	Lead acetate	325.29	3.25
	Lithium aluminum hydride	37.95	0.917
	Lithium metal	6.94	0.534
	Magnesium bromide w(anhydrous)	184.1	3.72
	Magnesium metal	24.31	1.738
	Magnesium sulfate	120.37	2.66
	Manganese dioxide	86.94	5.026
	Manganese oxide	70.94	5.37
	Mercuric bromide	360.41	6.03
	Mercuric chloride	271.5	5.43
	Mercuric nitrate	324.7	4.3
	Mercury metal	200.59	13.534
	Methyl alcohol	32.04	0.791
	Methyl ethyl ketone*	72.11	0.81
	Methyl isobutyl ketone	100.2	0.802
	Methylamine (40% solution in water)	31.06	0.902
	Methylamine gas	31.06	0.902

	Name	Molecular weight (gm)	Density (gm/cm ³)
	Methylamine HCl	67.5	
	Methylene bromide	173.83	2.477
	Methylene chloride	84.93	1.325
3,4-	Methylenedioxy-phenyl-2-propanone (PMK; 3,4-MDP-2-P)	178.185	
N-	Methylephedrine	179	
	Methylformamide	59.067	1.003
N-	Methylpseudoephedrine	179	
	Nitric acid	63.01	1.4
	Nitroethane	75.07	1.045
o-	Nitrotoluene	137.1	1.163
	Norephedrine	151.206	
	Norpseudoephedrine (phenylpropanolamine)	151.206	
	Paladium chloride	177.31	4
	Palladium black	106.4	
	Paraformaldehyde		0.88
	Perchloric acid	100.46	1.67
	Petroleum ether		0.64
1-	Phenyl-2-chloropropane	154.637	
1-	Phenyl-2-propanone (P-2-P; BMK)	134.18	1.006
	Phenylacetic acid	136.15	1.08
α-	Phenylacetoacetonitrile	159.18	
	Phosphoric acid	98	1.7
	Phosphorous trichloride	137.3	1.574
	Phosphorous, red	30.97	2.2
	Phosphorous, white	30.97	1.823
	Phosphorous, yellow	30.97	
	Phthalic anhydride	148.1	1.53
	Piperidine	85.15	0.86
	Piperonal	150.13	1.337
	Piperonyl alcohol	152.15	1.329
	Platinum (IV) dioxide (Adam's-type catalyst)	227.09	10.2
	Platinum metal	195.09	21.45
	Potassium bicarbonate	100.11	2.17
	Potassium carbonate	138.2	2.29
	Potassium cyanide	65.12	1.52

	<i>Name</i>	<i>Molecular weight (gm)</i>	<i>Density (gm/cm³)</i>
	Potassium hydroxide (Caustic potash)	56.11	2.044
	Potassium manganate	197.13	2.78
	Potassium metal	39.098	0.862
	Potassium permanganate	158.03	2.7
	Pseudoephedrine	165.24	
	Pyridine	79.1	0.978
	Pyruvic acid	88.06	1.25
	Raney nickel	58.69	
	Safrole	162.19	1.095
	Sodium acetate	82.03	1.528
	Sodium bicarbonate	84.01	2.173
	sodium bisulfite	104.06	1.48
	Sodium borohydride	37.83	1.074
	Sodium bromide	102.894	3.21
	Sodium carbonate (soda ash)	105.99	2.54
	Sodium cyanide	49.01	1.595
	Sodium cyanoborohydride	62.84	1.2
	Sodium hydroxide (caustic soda)	40	2.13
	Sodium hypochlorite	74.44	1.11
	Sodium metal	22.99	0.968
	Sodium perborate	99.815	
	Sodium percarbonate	157.01	
	Sodium pyruvate	110	
	Sodium sulphate	142.04	2.664
	Styrene	104.15	0.909
	Sulfuric acid	98.08	1.84
	Tartaric acid	150.09	1.79
	Tetrahydrofuran*	72.11	0.889
	Thiamine pyrophosphate	425.314	
	Thionyl chloride	118.97	1.638
	Toluene	92.14	0.8669
o-	Toluidine	107.2	1
	Urea	60.06	1.32
	Xylene	318.5	1.5
	Zinc metal	65.38	7.14

Annex V. Properties of commonly encountered acids and bases

<i>Acids/bases</i>	<i>Percentage by weight</i>	<i>Density</i>	<i>Normality</i>
Acetic acid 96%	96	1.06	17
Acetic acid 99-100%	99-100	1.06	18
Acetic anhydride	90	1.07	
Ammonia	29	1.04	14.8
Formic acid	98-100	1.22	26
Hydriodic acid	47	1.53	5.51
Hydriodic acid	57	1.7	7.57
Hydrobromic acid	48	1.5	8.9
Hydrochloric acid	25	1.12	8
Hydrochloric acid	32	1.16	10
Hydrochloric acid	36	1.18	12
Hydrochloric acid—fuming	38	1.19	12.5
Hydrofluoric acid	49	1.16	28.9
Hypophosphorous acid	50	1.35	
Nitric acid	25	1.15	5
Nitric acid	65	1.4	14
Nitric acid—fuming	~86	1.5	20
Phosphoric acid	25	1.15	9
Phosphoric acid	85	1.7	14.7
Phosphorous acid	~99	1.65	
Potassium hydroxide	45	1.46	11.7
Sodium hydroxide	50	1.53	19.1
Sulphuric acid concentrated	95.97	1.84	36

Annex VI. Equipment and materials required for disposal activities

The following is a list of suggested equipment and materials for the disposal of chemicals on-site, i.e. where chemicals are seized:

- Barricade tape
- Threshold level gas detector
- Non-sparking tools, including hammer, pliers, wrench, crescent screw-drivers, scoop
- No smoking signs
- Fire extinguishers (3) types: carbon dioxide, halon, dry chemical
- Fire blanket
- First aid kit
- Eye wash
- Explosion proof fluorescent light
- Spill absorbent
- Spare caps: rubber, cork, etc.
- Army knife
- Safety line
- Explosion proof flashlight
- Pipettes 10 ml
- Test tubes
- Personal protective equipment (PPE)

Types of personal protective equipment include:

- Coveralls or fatigues rated as chemical and flame-resistant: e.g. saranex, nomex, chemklos, or cellulosic
- Chemical splash impact goggles, e.g. encon 160

- Chemical resistant gloves, e.g. neoprene, nitrile, pvc/nitrile
- Protective footwear: chemical resistant safety shoes or chemical boots
- Respiratory protection appropriate for the hazard, e.g. chemical cartridge canister gas masks or self-contained breathing apparatus (SCBA)
 - Dust masks do not provide any chemical inhalation protection
 - Respiratory protection is required even when working outdoors
 - The proper cartridge to use is a combination type that protects against acid gas, organic vapours and methylamine
- Hard hat with face shield

<i>Level</i>	<i>Equipment</i>
Level A Highest level of protection for extremely toxic conditions	Self-contained breathing apparatus (SCBA), fully encapsulated chemical resistant suit, chemical resistant gloves, chemical resistant boots, hard hat, two-way radio communication
Level B Provides the highest level of respiratory protection, but the environment is not considered acutely toxic to skin contact or by gas or vapour skin absorption	Self-contained breathing apparatus (SCBA), chemical resistant clothing, chemical resistant gloves, chemical resistant boots, hard hat, two-way radio communication
Level C This level is used after all of the chemical hazards have been identified. The criterion for wearing respiratory protection is present and the environment is not considered to be toxic via skin contact.	Full face piece air purifying canister/cartridge equipped respirator, chemical resistant clothing, chemical resistant gloves, chemical resistant boots, hard hat, two-way radio communication
Level D Lowest level of protection This level is used when the atmosphere contains no known hazards, no chemical splashes or contact with hazardous chemicals	Coveralls, face mask, hard hat, safety boots, safety glasses

Annex VII. Minimum health and safety procedures, including personal protective equipment

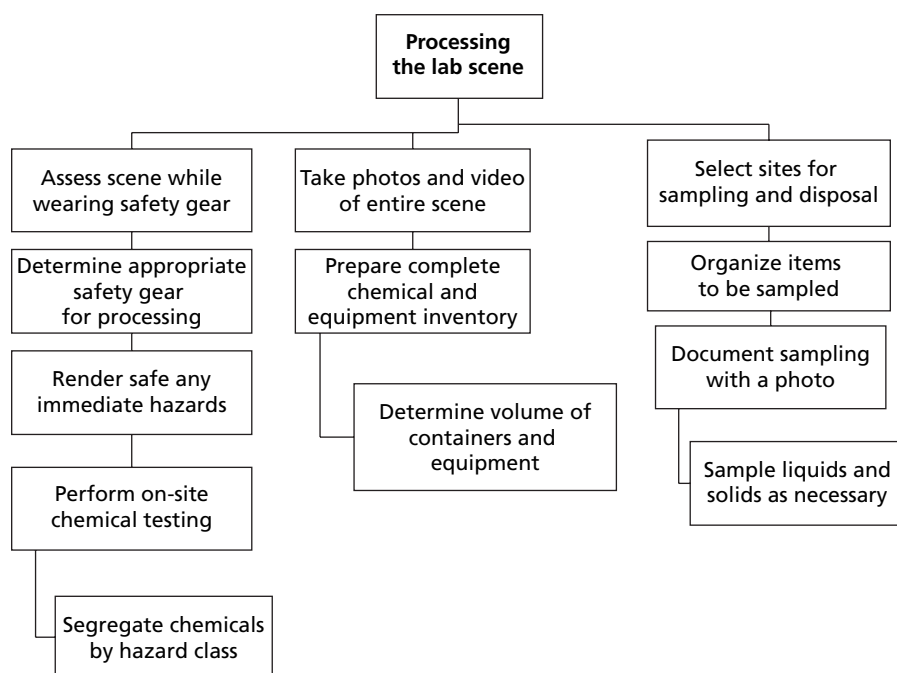
Safety is the responsibility of everyone involved—individuals and management alike. Each individual must know what hazards are present. Personnel must maintain constant vigilance for unsafe and potentially hazardous conditions. This annex discusses the minimum health and safety procedures that should be applied when chemicals are handled for disposal. It also summarizes the safety equipment recommended for processing and disposal of clandestine laboratory chemicals. It is recognized that different situations may call for different safety procedures.

Basic rules are:

- Beware of booby traps
- Do not smoke
- Do not turn electric lights on or off
- Shut off heat sources and gas cylinders
- Allow water to continue running through condensers
- Do not smell or taste anything
- Remove the principals from the immediate area
- Arrange for attendance of a chemist and identification officer
- Wear protective clothing
- Locate a fire extinguisher, if possible

Annex VIII. General guidelines for on-site operation

Figure 1. Processing the lab scene flow chart



Scene evaluation/overview

- Using safety gear, visually survey entire scene
- Determine what safety level is appropriate
- Render safe any immediate hazards
- Do photo and video overview
- Place case identifier in each view

- Pay special attention to torn or covered labels and addresses
- Photo all pertinent serial numbers

Note: If no assessment has been done, follow all appropriate assessment protocols before proceeding.

Sampling

- Select area to perform sampling
- Tarp and prepare area as necessary
- Select and tarp an area for hazardous waste disposal
- Prepare a chemical, glassware and equipment inventory
 - Note brands and lot numbers of chemicals
 - Note serial numbers and model numbers of all equipment
 - Note number and kind of containers—empty or not
- Establish in your mind what process(es) are being utilized
- Note what essential items are missing, if any
- Note how location was used
- Organize items to be sampled
- If printing items, lift prints before sampling
- Prepare sampling inventory
 - Record location found
 - Record colour
 - Record number of layers of all liquids
 - Determine and record pH of solutions
 - Determine volume of containers
 - Record height and diameter measurements
 - Measure the heights of each layer in multi-layered samples
 - Weigh items as necessary utilizing a portable scale
- Sample liquid containers with disposable pipettes or drum pumps
- When sampling liquids always take a portion from the top, middle, and bottom of the container to achieve a representative sample
 - Use a 20 or 40 ml glass vial, such as an I-chem or a Wheaton, with a teflon-lined cap for the samples

- This vial needs to be rated to contain corrosive or volatile liquids without leaking
 - Over-pack in a Nalgene wide-mouth bottle
- Photo sampling with exhibit and case information
 - Include a size reference
 - Sample vial in photo with original container
- Segregate chemicals by hazard types
 - Acids
 - Bases
 - Flammables
 - Oxidizers
- On-site testing
 - Draeger tubes
 - pH paper
 - Field test kits
 - Test papers
- Field instruments
 - IR
 - IMS
 - Raman
 - X-ray

Opening containers

Containers must be opened with care. It is best to open them in an isolated area, especially if flammable liquids are involved. Due to the extreme heat experienced in most regions, sample at night if possible to minimize heat expansion problems. However, it is essential to have adequate lighting for this process. If drums or carboys need to be opened, use a drum key or spanner for opening.

General working times

Based on climate conditions, working times need to be adjusted for maximum comfort. To minimize heat stress, work shifts should be scheduled during cooler hours. If lighting can be arranged, working at night may be the most practical.

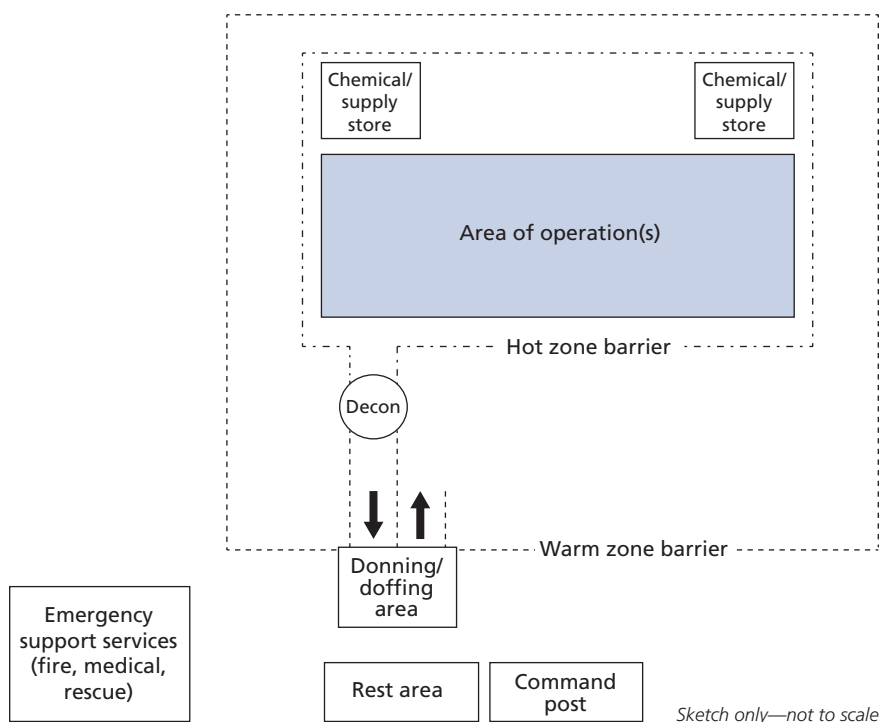
Transport considerations

If it is necessary to transport chemicals to another location for disposal, the following items should be considered:

- Use an enclosed truck when possible
 - Proper ventilation of the enclosed area is necessary to prevent flammable gas build-up which could cause an explosion
- No personnel should travel in the enclosed area
- Chemical containers that are damaged or compromised in any way must be repacked or “over-packed” before transporting.
- If a flat-bed truck must be used, the load must be adequately tied and strapped to prevent the load from shifting

Disposal site selection

- *Security:* Given the inherent value of the chemicals and drugs being destroyed, the need for a secure location is quite important. Have security present either once the chemicals are present, or when disposal equipment arrives (whichever happens first), and security must remain in place until the completion of the operation.
- *Location:* The location of the proposed area with respect to local infrastructure is an important consideration. The site will need to be far enough away from a town centre that civilians are not potentially affected by the operation, and to maintain security. However extreme distance from urban centres can create logistical problems for housing, feeding and maintaining staff, as well as obtaining replacement parts for failed equipment if required.
- *Size:* The size of the proposed site is an important consideration, to ensure that activities can be comfortably conducted in a safe manner. Conversely, too big an area can result in potential security concerns, with no additional operational benefit. It is important to have a site that is large enough to incorporate international standard HAZMAT elements, such as the hot/warm/cold zone system.
- *Fitness for purpose:* The proposed site should, wherever possible, reflect the intended operational requirements. Sites that are excessively hilly have heavy vegetation cover, or excessive ground water may present a less-than-ideal platform for a destruction operation.
- *Long-term environmental impact:* The future use of the site should be a factor taken into consideration, where it is known. Sites which are intended for use as civilian housing, sites of wells or water sources, or which may be used in the production/growing of food should generally not be considered as suitable.

Figure 2. Typical disposal work zone schematic

Source: Schematic drawn by Nathan Green, Forensic Chemist, Crime Scene Scientist, Australian Federal Police.

Suggested content of training course

It is widely recognized that the disposal of seized chemicals used in the illicit manufacture of drugs is a highly technical and complex task, requiring the presence preferably of a trained forensic chemist (with expertise in chemical disposal), or a law enforcement officer trained in chemical disposal.

The following is a suggested outline of the contents of a training course for individuals involved in the seizure, handling and disposal of chemicals. It is guided by the need for disposal procedures that aim at promoting personnel and public safety, while attempting to minimize environmental damage.

Suggested outline

1. Introduction and context (including relevant regulatory, law enforcement, health, environmental and industrial aspects)

2. Frequently encountered chemicals
3. Properties and hazards of individual chemicals
4. Clandestine laboratory sites (jungle laboratories vs. laboratories in urban settings)
5. Hazard assessment of the area, possible booby traps
6. Specific chemical dangers with the manufacture of specific drugs
7. Safety procedures used in seizing chemicals and chemical drug laboratories
8. Safety equipment used in seizing and processing seized chemicals
9. Evidence collection and sampling
10. Safe handling and storage of hazardous chemicals
11. Transportation of dangerous goods
12. Decontamination procedures
13. Testing and chemical neutralization/treatment of chemicals (practical exercises):
 - (a) Acids
 - (b) Bases
 - (c) Solvents
 - (d) Specific chemicals
 - (i) Organic solvents with flammability rating of 4 (e.g. ethyl ether)
 - (ii) Potassium permanganate
 - (iii) Acetic anhydride
 - (iv) Cyanides
 - (v) Thionyl chloride
14. Different types of disposal methods
15. Potential in-country resources
16. The role of the specialist
17. Legal issues

For cost-effectiveness, courses of this type should be organized as train-the-trainers courses. Individuals participating in a training course should be required to serve on a clandestine laboratory team for a minimum period of three years post training.

It is critical that, in addition to formalized training, a mentoring programme be established. This type of “training” ensures the ongoing training and increase of knowledge of the local personnel. This minimizes the need for continued international assistance.

Model scenarios

Model scenario 1

Seizure of 85 200-litre drums labelled safrole at a port in a large city

Prepared by Mr. Wayne Jeffery and Mr. Jorge Acevedo-Gierbolini

1. The seizure was legally justified pursuant to local laws.
2. The 85 drums were moved to a secure chemical storage facility in compliance with the local shipment of dangerous goods guidelines.
3. The facility is bonded as a chemical storage facility.
4. Forensic chemists were called to sample the containers and verify their contents.
5. The contents were identified as safrole.
6. The company that shipped the contents was contacted to inquire as to the possibility of returning the chemicals, but a negative reply was received.
7. In accordance with local laws and regulations, a court order authorizing disposal was obtained.
8. Options for disposal:
 - A. In this case, a local cement plant was contacted and arrangements were made to fuel blend the chemical.
 - B. If that had not been possible, other options for disposal would have included:
 - Contacting local manufacturing companies to try and recycle the chemical; or
 - Contracting a local waste disposal company for disposal.

Model scenario 2

The seizure of 140 15-litre plastic containers labelled acetic anhydride in a remote insecure border location

Prepared by Mr. Wayne Jeffery and Mr. Jorge Acevedo-Gierbolini

1. The seizure was legally justified pursuant to local laws.
2. The 140 plastic containers were moved to a secure area at the border.
3. Customs officers trained in chemicals testing, identified the chemical as possibly being acetic anhydride.
4. Samples were taken and sent to the customs laboratory for confirmatory analysis.
5. The contents were identified as acetic anhydride.
6. The company that shipped the contents was contacted to inquire as to the possibility of returning the chemicals, but a negative reply was received.
7. In accordance with local laws and regulations, a court order authorizing disposal was obtained.
8. Options for disposal:
 - A. In this case, no waste hauler was available for transportation, nor was there a local waste disposal company (i.e., an all-inclusive option, including transportation). Therefore, the following method:
 - Arrangements were made to bring an organic solvent (flammability rating 2 or 3, e.g. acetone) into the area.
 - The acetic anhydride was dissolved in the organic solvent, and burnt at the remote site.
 - B. If a waste hauler had been available for transportation, another option for disposal would have been to:
 - Contact local chemicals companies, or local manufacturing companies, to try and recycle the chemical.
 - Blend with an organic solvent (flammability rating 2 or 3). Turn over to an industry (such as a cement plant) for fuel blending.

Model scenario 3

Seizure of an MDMA laboratory, including large quantities of chemicals, compressed gases, unfinished reaction mixtures and organic solvent waste

Prepared by Dr. Rainer Dahlenburg, Bundeskriminalamt, Germany

1. The laboratory and the surrounding area was secured by the Crime Scene Unit.
2. Forensic chemists were called to verify the contents of the different vessels and drums.
3. Operating laboratory equipment was disabled and made safe, e.g. the reaction vessel was degassed with nitrogen by a specialist (from gas producing company).
4. Samples were taken and sent to the forensic laboratory for confirmatory analysis.
5. Contents of the plastic containers were identified as mixtures of acetone and methanol containing MDMA and impurities of the synthesis.
6. In accordance with local laws and regulations, a court order authorizing seizure and disposal was obtained.
7. Options for disposal:
 - A. In this case, the following arrangements were made:
 - A local manufacturing company was contacted for recycling of the original chemicals;
 - A specialized, local waste disposal company was contracted for the controlled disposal of the equipment, the waste, and liquids containing MDMA.
 - Another company, specialized in dealing with compressed gases, was contracted for transportation of the gas cylinders.
 - B. If option A had not been possible, and neither a waste hauler nor a local waste disposal company (i.e. an all-inclusive option, including transportation) had been available, the following method could have been utilized:
 - Arrange for an organic solvent (flammability rating 2 or 3, e.g. acetone) to be brought into the area.
 - Dissolve the waste and reaction mixture in the organic solvent, and burn at a distant site.
 - Move the gas cylinders to a secure place outside the laboratory, and vent to air in controlled manner.

Overview of the laboratory



Drums with acetone
and methanol

Wastewater tank



Around 30 gas cylinders in different colours and without original labelling, seven drums with acetone (200 litres), six drums with methanol (200 litres) and 12 plastic (150 litres) containers with waste (organic solvents) were found.



The autoclave (pressure vessel) in the background had a capacity of 240 litres. At the time of the seizure the vessel was under pressure (3 bar), heated (80 °C), connected with two gas cylinders (hydrogen, methylamine), and filled with a reaction mixture of MDMA (base), methanol and 3,4-MDP-2-P.

Model scenario 4

1,000 kg of thionyl chloride was discovered in a remote location

Prepared by Pamela Smith, ex-United States Drug Enforcement Administration, United States.

1. The seizure was legally justified pursuant to local laws.
2. The 40 (25 kg) plastic containers were moved to a secure area at the border.
3. Customs officers trained in chemical testing, identified the chemical as possibly being thionyl chloride.
4. Samples were taken and sent to the customs laboratory for confirmatory analysis.
5. The contents were identified as thionyl chloride.
6. The company that shipped the contents was contacted to inquire as to the possibility of returning the chemicals, but a negative reply was received.
7. In accordance with local laws and regulations, a court order authorizing disposal was obtained.
8. Options for disposal:
 - Neutralize by reacting with an excess mixture of sodium bicarbonate/calcium oxide in a tub. For 1,000 kg of thionyl chloride, the following chemicals were needed:
 - Sodium bicarbonate—3,000 kg
 - Calcium oxide—1,000 kg
 - 50 per cent hydrogen peroxide
 - This process was done in 10 batches

Per batch:

300 kg of sodium bicarbonate and 100 kg of calcium oxide were mixed in a tub. To this mixture 100 kg of thionyl chloride was slowly added and stirred. All operators wore level B safety equipment. Once neutralized, 33 kg of 50 per cent hydrogen peroxide was added to oxidize the calcium sulphite to calcium sulphate.
 - Once treated this calcium sulphate was transferred to a water treatment plant and used to treat water.
 - Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e.g. vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush with water.

Model scenario 5

Cocaine processing (“jungle”) laboratories

Prepared by Héctor Hernando Bernal Contreras, National Narcotics Directorate, Colombia and Isaac Urrutia Bermúdez, Technical Investigations Unit, Attorney-General’s Office

Classification of laboratories producing coca derivatives

There is no established definition or technical criterion classifying facilities where coca alkaloids are extracted or refined. Therefore, the following classification is submitted for the purpose of establishing interdiction and dismantling methodologies, based on intermediate and end products. Consideration for the health and physical safety of personnel involved, and which results in the least possible harm to the environment, is paramount.

A. Coca paste laboratories

Technically speaking these are not laboratories, but rudimentary, non-industrial facilities set up by coca leaf producers for the sole purpose of extracting basic cocaine paste. These facilities are usually comprised of a “picadero” or chopping area, where the coca leaves are shredded, and an extraction area composed of a series of platforms to support barrels in which the alkaloid extraction is completed.

The chemicals frequently encountered at these locations are gasoline or other combustibles (motor fuel oil, kerosene or petroleum), alkaline bases (generally white or grey cement, lime, and sodium or potassium carbonate or hydroxide), sulphuric acid, and ammonia.

Generally, these substances are not found in their original containers and should always be handled with care

B. Cocaine hydrochloride production complexes

These are complex facilities with specialized operating procedures, which house large quantities of chemicals and equipment needed for the cocaine processing.

(a) Crystallization laboratory

This is the area where the processing of coca paste into cocaine base and its subsequent conversion into cocaine hydrochloride (HCl) are carried out. It is the largest

structure within the complex. Most of the equipment used in an actual industrial plant will be found in this area.

Pressure filtration equipment. Designed to extract coloured impurities using activated carbon, this equipment usually has air compressors. These appliances must be disconnected by the enforcement personnel, along with the pipes connecting them to the filtering equipment.

Heating systems. The most common are bains-marie and reflux heaters. The primary heat source, which in most cases will be locally made boilers and located outside the crystallization laboratory, must also be disconnected.

Hydraulic compression systems. As with the heating system, these are non-industrial-type, locally-made appliances, to which hydraulic systems have been specially fitted.

Chemicals. These are primarily needed for the conversion of coca paste to cocaine base then to cocaine HCl, to dry solvents as part of a recycling process, and as combustible for the hydraulic compression, vacuum filtration or heating systems.

The substances frequently found are acids (e.g. sulphuric and hydrochloric acids), salts (e.g. potassium permanganate, calcium chloride, sodium sulphate), solvents (e.g. ethyl ether, chloroform, acetone, methyl isobutyl ketone (MIBK), methyl ethyl ketone (MEK), methanol, isopropanol, ethyl acetate, butyl acetate) and other combustibles.

(b) *Drying zone*

This area may have microwave ovens, or wooden structures fitted with light bulbs, commonly known as incubators. It is important to disconnect such equipment from the power supply before disposal. Specially designed machines that measure out drugs into one-kilo blocks are often found in this area.

(c) *Solvent recycling zone*

This area may have locally made distillation appliances that use water heated in boilers. Separation of the solvent mixtures is carried out by means of differences in boiling points.

The distillation apparatus must be off and disconnected when dismantling a production complex.

(d) *Chemical storage zone*

This is the area in a production complex that poses the greatest risk. If the presence of explosives is suspected, chemical containers must not be moved. Specialized

personnel should conduct an evaluation to decide how to dispose of the substances, especially if conditions do not allow for on-site neutralization or transportation.

Chemicals needed for drug production are usually stored near the laboratory (crystallization area) and are usually hidden, to prevent easy detection. The chemicals may be stored underground.

Dismantling and disposal methods are determined by local methodology.



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United Nations publication
Printed in Austria

Sales No. E.11.XI.14
ST/NAR/36/Rev.1



V.11-83777—September 2011—300

USD 26
ISBN 978-92-1-148266-9



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