GUIDELINES FOR THE
SAFE HANDLING AND DISPOSAL OF CHEMICALS USED IN THE ILLICIT MANUFACTURE OF DRUGS
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In cooperation with the

Supply Reduction and Control Section
Inter-American Drug Abuse Control Commission
Washington

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Disclaimer

Some of the methods for the 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 chemicals are often encountered in very difficult circumstances, where, depending on specific case 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 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 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.

This publication has not been formally edited.
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Finally, the role of CICAD/OAS in supporting the development and distribution of those guidelines is acknowledged. UNODC and CICAD/OAS have agreed to work closely to ensure the widest dissemination of the guidelines, and the widest application of the recommended procedures addressing environmental and occupational safety issues. Specifically, CICAD/OAS has made available the Spanish translation of the guidelines, considering the importance of safe handling and disposal in connection with the illicit processing of cocaine in the Andean countries. CICAD/OAS will also develop, as part of...
their chemical support programme, and along the lines of the outline presented in Annex VII, a training course for individuals involved in the seizure, handling and disposal of chemicals. It is anticipated that this comprehensive approach taken in the Andean region, and any lessons learnt, will also be applicable for and used in other regions.

Preparation of these guidelines was coordinated by staff of the Laboratory and Scientific Section, UNODC. The core team, which comprised Barbara Remberg, Sana Sarrouh, and Howard Stead, is grateful to all colleagues who contributed to 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 the 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 demand and supply, the disposal of seized narcotic drugs and psychotropic substances by reprocessing/reuse (recycling) is regulated by the international drug conventions. Therefore, if 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 GUIDELINES

The disposal issue, and related topics, has been discussed at numerous meetings of the United Nations (UN) Commission of Narcotic Drugs over the past 15 years. In 1989 and 1990, a United Nations Expert Group discussed the topic of pre-trial destruction of seized narcotic drugs, psychotropic substances, and chemicals [1, 2].

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 manual provides 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.

The methods and approaches described in this manual will 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 (Section 7, page 47), and of the suggested contents of a training course (Annex VII), 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 manual also provides guidance for the identification of potential in-country resources (Section 6, page 46). 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 (Section 8, page 48).

Finally, in addition to outlining the main types of chemical waste disposal and treatment (page 7), this manual also provides a comprehensive compilation of specific disposal and treatment methods for individual chemicals (page 28 to 37). The starting point for this compilation is the well-established laboratory-scale methods used by legitimate commercial/academic laboratories. Some of the methods described have been tested in non-laboratory settings (including remote, or jungle environments), while others have not. For some chemicals or under certain circumstances, therefore, laboratory-scale methods are the only treatment and disposal methods currently available.

It is recognized that some specific disposal and treatment methods discussed in this document require further work, including research into the feasibility of up-scaling those methods. 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 this manual are therefore encouraged to share experiences with the use of disposal methods outside formal laboratory settings, and any other comments they may have on the present manual, at the following address:

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HOW TO USE THE GUIDELINES

Section 1: MAIN TYPES OF CHEMICAL WASTE DISPOSAL AND TREATMENT
Provides a brief description of the main types of disposal and treatment methods, their advantages and disadvantages, and a classification of the different methods into three groups, in order of preference according to their environmental safety. Options for disposal and treatment under different circumstances and prevailing conditions are summarized in a decision tree.

Section 2: SPECIFIC METHODS FOR CHEMICALS USED IN THE ILLICIT MANUFACTURE OF DRUGS
Provides, in tabular form, specific treatment and disposal methods, and health, flammability, reactivity and hazard ratings, for individual chemicals. Tables should be used in conjunction with Section 4, which outlines practical details of how to neutralize and/or treat the different groups of chemicals (acids, bases, organic solvents, metals, compressed gases, and other chemicals) encountered.

Section 3: SAFE DISPOSAL OF UNKNOWN/UNLABELLED CHEMICALS
Provides a flow chart for testing and characterizing unknown/unlabelled chemicals and mixtures to determine the most appropriate method for managing the chemicals.

Section 4: PRACTICAL DETAILS FOR CHEMICAL NEUTRALIZATION AND TREATMENT
Provides a comprehensive compilation of specific methods for chemical neutralization and treatment of individual chemicals, or groups of chemicals. For individual chemicals/groups, methods are listed in order of preference. The final step of most methods listed in this Section 4 is cross-referenced back to one of the main types of chemical waste disposal and treatment described in Section 1.

Section 5: SAFE HANDLING AND STORAGE OF CHEMICALS
Provides guidelines for safe handling and storage of seized chemicals, including sampling for court proceedings.

Section 6: POTENTIAL IN-COUNTRY RESOURCES
Provides guidance for the identification of potential in-country resources and capacity for disposal, considering also the need to review existing facilities for disposal of other types of waste, and to identify innovative uses for the chemicals of concern. These include recycling, transformation and recovery, for example, blended as a fuel.

Section 7: THE ROLE OF THE SPECIALIST
Provides a brief outline of the role of the chemical disposal specialist, and of the requirements for national coordination of a multi-disciplinary disposal team.

Section 8: SUMMARY OF LEGAL IMPLICATIONS
Summarizes legal implications, which should be considered in connection with disposal activities and be addressed by the relevant drug control laws.

A GLOSSARY provides definitions, for the purposes of these guidelines, of terms related to chemical disposal and waste management.

A set of MODEL SCENARIOS (Annex VIII) illustrates, for particular circumstances, the approaches that may be taken for disposal.
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. ¹

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 key 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 review of options as to how the necessary technical and financial resources can be made available.

¹ These issues are key elements of the recommendations of the expert group meeting on “Environmentally safe methods for the destruction/disposal of chemicals”, held in Vienna, Austria, 6-8 September 2005.
PART I
1. **MAIN TYPES OF CHEMICAL WASTE DISPOSAL AND TREATMENT**

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 availability of an environmental management infrastructure and/or closeness to urban centres. Some of these methods are:

- (a) recycling/reuse of the chemicals;
- (b) incineration and disposal in landfills of incineration ash;^2^  
- (c) disposal in landfills of stabilized chemical waste, or non-hazardous waste; and  
- (d) disposal in sewers of neutralized, non-toxic chemicals.

A government agency in need of chemical disposal may also contract the entire cleanup (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 best 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 adequate training of law enforcement officers to help follow the guidelines given in this document.

**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:

- (a) open air burning;
- (b) landfills (remote area burial); and  
- (c) 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

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^2^ Strictly speaking, incineration is not a disposal method but considered a form of treatment, which produces ash that must be disposed of. Adequate disposal of ash may not be possible in remote areas.
safe approach (Group 3) may be the only practical option in very remote mountainous or jungle environments.

The decision tree below summarizes, and assists in identifying, options for the treatment and disposal of chemical waste under different circumstances and prevailing conditions:
Is disposal in sewer system possible, and sewer system available?

Chemical characterization of waste

Send to recycling/reuse facility

Is recycling/reuse possible?

Yes

No

Is treatment required?

Yes

No

Dispose in sewer system

Is disposal in sewer system possible, and sewer system available?

Liquid

Solid

Is landfill possible and landfill facility available?

Yes

Send to landfill facility

No

Open air burning, or disposal by remote area burial, or explosion (Group 3 methods; see Section 1)

Incineration

Encapsulation/Stabilization

Chemical neutralization or treatment (see Section 4: Methods 1-22)

Incineration ash

Stabilized solid waste

Treated waste

Is environment/are circumstances secure for proper waste management? (See guidance notes in Section 1)

Yes

No

Yes

No

Incineration

Encapsulation/Stabilization

Chemical neutralization or treatment (see Section 4: Methods 1-22)

Incineration ash

Stabilized solid waste

Treated waste

Is recycling/reuse possible?

Yes

No

Is treatment required?
The following is a brief description of the main types of disposal methods, their advantages and disadvantages, and their assignment to one of the three groups outlined above.

1.1. CHEMICAL WASTE DISPOSAL METHODS

1.1.1. CHEMICAL WASTE MANAGEMENT COMPANIES (Group 1)

For the purposes of this document, the term ‘chemical waste management companies’ refers to all-inclusive options, i.e., these companies, once called in to the location where the chemicals are encountered, will take care of all necessary steps from the safe handling, transport and storage, if required, to the treatment and disposal of the chemicals. 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.

**Advantages**
- Quick;
- Someone else does the work;
- Safe;
- Meets requirements of local laws and regulation.

**Disadvantages**
- Expensive;
- Not available everywhere.

Care must be taken that the companies operate legitimately and can be trusted to take chemicals that have a market value for illicit drug production (i.e., that they do not cooperate in any way to the release of chemicals to the illicit market).

1.1.2. RECYCLING/REUSE (Group 1)

For the purposes of this document, especially when seized chemicals are returned to the private sector, recycling requires the chemicals to be unused and not contaminated (i.e., this refers to chemicals in their commercially labelled, factory-sealed and unopened containers). In the case of contaminated chemicals, other treatment and disposal options must be considered.

Recycling may take several different forms:
- Returning chemicals that are found in 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.); and
- Recovery/transformation into products for which there is a legitimate use, including use of flammable liquids for fuel-blending for energy recovery.

If recycling is considered, applicable laws and regulations concerning the transportation of hazardous materials should be adhered to.

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3 Although returning the goods to the supplier is one of the options to be considered, some suppliers will not accept return of seized chemicals because: (1) they have received already full payment for the goods; (2) they are not the legal owners of the goods (the condition of the sale was Freight-On-Board (FOB)); and (3) contamination of the chemicals may be an issue.
Advantages
(a) Minimal environmental damage;
(b) Minimal cost;
(c) Chemicals get reused.

Disadvantages
(a) Transportation, safety and security considerations make this method infeasible for seizures in remote locations.
(b) The legitimacy and ability of companies to prevent diversion of the recycled chemicals must be established.

Chemicals used in clandestine laboratories may be recycled to the following types of facilities, sometimes at minimal or no cost:

(a) Industrial plants:
   -- oil industry
   -- paint industry
   -- pharmaceutical industry
   -- agricultural
   -- cosmetic
   -- printing
   -- fertilizer plants
   -- perfume
   -- building
   -- cement plants

(b) Chemical Laboratories:
   -- universities and schools
   -- private
   -- government
   -- industrial

(c) Hospitals, prison organizations, or other, where some chemicals are used for disinfection (e.g., dilute hydrochloric acid).

As with chemical waste management companies, care must be taken that the receiving institutions and companies operate legitimately and can ensure that the chemicals will not be returned to the illicit drug market.

1.1.3. OPEN AIR BURNING (Group 3)

For the purposes of this document, open air burning refers to burning by uncontrolled flames, with the combustion products 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, preferably, be done in the large metal containers (e.g., 45/55-gallon drums) that are typically found in remote clandestine laboratories or, as a last resort, in open pits or trenches.

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 with a detonating cord (“det cord”). 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, such as:

- **Remoteness:** select site sufficiently far away (i.e., about 500m) from areas of human activity, electrical main, and from forest areas;
- **Environment:** select site on flat land, without close-by water streams and with a deep water table; the burning site (pit) should preferably be surrounded by a hard surface (i.e., no bare soil) for ease of handling of waste containers;
- **Security/isolation:** restrict access to and remove non-essential personnel from burning site and beyond external safety perimeter; and
- **Health and safety:** minimum health and safety procedures (page 43 and Annex VI) should be followed; whenever possible, all personnel should be located upwind from the burning site.

The size of pits/trenches will be determined by the amount of chemicals to be disposed of. Where large quantities of chemicals (i.e., the contents of more than ten 45/55-gallon drums) are to be burnt, the digging of several smaller pits, separated by at least 10 metres, or a series of burning operations (over several days) is preferred to one large operation. This will ensure that the process can remain under control.

The use of home-made, portable medical burners may be an adequate alternative when the open air burning method is utilized [3].

**Advantages**

(a) Inexpensive;  
(b) Can be done in remote areas.

**Disadvantages**

(a) Hazards to the law enforcement personnel or others involved in the activity;  
(b) Potential release of toxic chemicals to the atmosphere and residue may leach into groundwater or other water bodies;  
(c) Need trained people on site to ensure that the procedure is carried out correctly and safely.

### 1.1.4. LANDFILL (Group 1, 2 and 3)

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:**
  
  (Group 1 and 2)
  
  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:**
  
  (Group 3)
  
  This method may be the only method available in remote locations. To the extent possible, it should only be considered for disposal of non-toxic solid chemicals. It refers to a pit or trench, which is dug
into the ground (prepared in the same way as under open air burning, above). When used for remote area burial, the trench is refilled (if possible) with dirt after burial of chemicals is completed.

Advantages
(a) Ease of disposal;
(b) Inexpensive;
(c) In remote area burial, no transportation of chemicals is required.

Disadvantages
(a) Landfill may not be readily available;
(b) Transportation is required to an engineered landfill;
(c) Environmental impact in remote area burial.

1.1.5. EXPLOSION (Group 3)
This method entails putting all chemicals of similar chemical characteristics together and igniting at a safe distance with a slow-burn fuse. As noted under the open air burning method, this approach 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.

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 disperse by this method, rather than being disposed of; use of solvents of flammability rating 4 is also not appropriate for this method)

Advantages
(a) Quick;
(b) Minimal cost.

Disadvantages
(a) Potential for the solvents to not combust completely and contaminate an area;
(b) Hazards to the law enforcement personnel at the site.

1.1.6. 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.

Advantages
(a) Disposal of water-soluble products that do not violate local regulations.

Disadvantages
(a) Environmental concerns;
(b) In most cases water-miscible flammable liquids cannot be disposed of.
1.1.7. EVAPORATION (Group 3)
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).

1.1.8. DUMPING AT SEA, IN RIVERS OR OTHER STREAMS OF WATER
This method should never be used, due to its major environmental impact.

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, it is the incineration ash that must be disposed of, if possible.

1.2.1. INCINERATION
For the purposes of this document, incineration means burning by controlled flame in an enclosed area, with appropriate safe-guides to prevent the release of toxic chemicals into the environment. Incineration produces ash that must be disposed of in appropriate landfill sites.

Most organic compounds can be burnt in properly designed and operated incinerators. For many types of hazardous chemicals, notwithstanding set-up and maintenance costs, incineration may be considered the treatment method of choice.

Advantages
(a) Emissions of toxic substances are limited;
(b) Release of contaminants as a consequence of malfunction can be corrected relatively quickly;
(c) Incinerators can handle many types of chemicals;
(d) It promises to give the generator the best assurance of long-term safety from liability;
(e) The volume of chemicals requiring disposal in landfill is greatly reduced.

Disadvantages
(a) Cost to set up and maintain can be prohibitive;
(b) Emissions to the atmosphere must be controlled to prevent releases of toxic substances;
(c) Ash must be disposed of in an appropriate landfill site;
(d) Difficult to establish an incinerator because of local opposition.

1.2.2. 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.

Part II (Section 4) provides specific methods for chemical treatment for specific substances and groups of chemicals.
Advantages
(a) Cost effective, especially if one seized chemical can be used to neutralize another;
(b) Can be done in remote areas;
(c) Commonly used treatment method.

Disadvantages
(a) Need trained people;
(b) Not all chemicals can be neutralized;
(c) May not have necessary chemicals at remote locations.

1.2.3. 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 and sufficient strength to allow for landfilling.

Advantages
(a) Enables landfill disposal of chemicals that could otherwise not be considered for disposal at such sites;
(b) Inexpensive.

Disadvantages
(a) Not all chemicals can be treated by this method;
(b) Transport of the stabilized waste to a landfill facility is needed.

1.2.4. BIOLOGICAL TREATMENT
Biological treatment refers to the treatment of chemicals and chemical waste by microorganisms. It may be an attractive future option, but at the time of writing, no biological treatment methods for the chemicals of concern are available.

Advantages
(a) Significant cost-effectiveness for possible future considerations.

Disadvantages
(a) Not developed at this time for most chemicals.
2. SPECIFIC METHODS FOR CHEMICALS USED IN THE ILLICIT MANUFACTURE OF DRUGS

This section discusses more specifically treatment and disposal methods for individual chemicals used in the illicit manufacture of drugs. Focus is on the chemicals most commonly used in the illicit manufacture of cocaine, heroin, amphetamine, methamphetamine, ecstasy-type substances (e.g., MDMA, MDA), and methaqualone. 4

Chemicals are classified into six groups/tables (acids, bases, organic solvents, metals, gases, and other chemicals), and listed, within each table, in alphabetical order.

Tables 1 to 6 below are intended for use where commercially labelled, factory-sealed (unopened) chemicals are involved. For unlabelled/unknown chemicals, mixtures, and chemical waste, basic tests to determine the nature and the chemical and physical properties (e.g., water reactivity, flammability, etc.) of the substances must be performed. (See Annex II.) Based on the results of those tests, the flow chart provided on page 23 helps to identify a treatment and disposal method.

The reader should be aware that local or slang names (e.g., ‘thinners’) are not indicative of a chemical name. They may refer to different chemicals in different countries or regions, and are therefore not included in Tables 1 to 6, below. **Chemicals that are only identified by their local or slang names should therefore be treated as unknown chemicals, and never be disposed of simply based on their alleged identity.**

**Treatment methods**

Tables 1 to 6 below cross reference two types of treatment and disposal methods (1) General and (2) Aldrich methods [7]. Details of the individual methods (cross-referenced by number or letter) are discussed later in this document. (See Section 4, below.)

1. **General methods**

Some of the methods in this sub-section have been used for large-scale treatment and disposal of wastes from illegal drug laboratories in remote areas (i.e., under practical conditions relevant for the purpose of these guidelines), while others have not. If a large seizure must be disposed of and the method has not been used for a large quantity seizure, it is advisable to perform the treatment and/or disposal in a series of small batches.

General methods are described on pages 28 to 37.

2. **Aldrich methods**

These methods are commonly used for laboratory-scale waste disposal. A disadvantage is that the required scientific glassware and equipment would most likely not be available in remote jungle locations. In addition, the Aldrich methods may require the presence of an environmental management infrastructure has not been established. Aldrich treatment and disposal methods are described on pages 38 to 39.

**Explanatory notes to Tables**

Tables 1 to 6 list General and Aldrich methods, and health (H), flammability (F), reactivity (R), and hazard ratings (Sax [4]) for individual chemicals. (See Annex III for definitions of the different rating levels.)

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4 Information on which chemicals are used for which drug may be found in Annex I.
Tables 1 to 6 do not list comprehensively organic and inorganic salts. See Method 15 for the disposal of non-toxic salts.

Similarly, tablet excipients, binders, dyes and cutting agents are also not listed as individual items. Most of them can also be disposed of using Method 15, i.e., a landfill.

In compiling Tables 1 to 6, the following lists have been considered:
- List of the Inter-American Drug Abuse Control Commission (CICAD) \(^5\); and
- European Community Voluntary Monitoring List of Non-controlled Chemicals. \(^6\)
Chemicals from those lists are included even where specific disposal methods could not be identified. As relevant information is identified, it will be included.

Chemicals in Table I and II of the 1988 Convention are highlighted.

<table>
<thead>
<tr>
<th>Table 1: ACIDS</th>
<th>ACID</th>
<th>General Method</th>
<th>Aldrich Method [?]</th>
<th>H</th>
<th>F</th>
<th>R</th>
<th>Hazard Rating (Sax [4])</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic acid</td>
<td>1.2.a</td>
<td>B</td>
<td></td>
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<td>2</td>
<td>1</td>
<td>3</td>
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<td>N-Acetylanthranilic acid</td>
<td>3</td>
<td>A</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Anthranilic acid</td>
<td>3</td>
<td>A</td>
<td>1 1 1 3 (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Formic acid</td>
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<td>A</td>
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<td>A</td>
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</tr>
<tr>
<td>Glacial acetic acid</td>
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<td>3 2 2 3</td>
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<td></td>
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<td>Hydriodic acid</td>
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<td></td>
</tr>
<tr>
<td>Hydrobromic acid</td>
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<td>N</td>
<td>3 1 3</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Hydrochloric acid</td>
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<td>N</td>
<td>3 0 0 3</td>
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<td></td>
<td></td>
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</tr>
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<td>Hydrofluoric acid</td>
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</tr>
<tr>
<td>Hypophosphorous acid</td>
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<td>Nitric acid</td>
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<td>Nitrobenzoic acid</td>
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</tr>
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<td>Phenylacetic acid</td>
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<td>A</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Phosphoric acid</td>
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<td></td>
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<tr>
<td>Picric acid</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Sulphuric acid</td>
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</tr>
<tr>
<td>Tartaric acid</td>
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<td>A</td>
<td>2 1 0 2</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** A Blank Cell in the table indicates there is no information available.

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\(^5\) In response to an Economic and Social Council resolution, the INCB established a limited international special surveillance list of non-scheduled substances at its November 1998 session. The list together with the recommendations for action is being transmitted to all competent authorities identified by Governments. In order to ensure the effectiveness of such a list, which will be amended from time to time when circumstances require, the list has not been published by the Board.

\(^6\) The EC’s Voluntary Monitoring List of Non-controlled Chemicals is also kept under review and discussed in every Drugs/Precursors Committee Meeting, where amendments can be made. Similar to the limited international surveillance list, the EC list has not been published. It is transmitted to European Union Member States.
### Table 2: BASES

<table>
<thead>
<tr>
<th>BASE</th>
<th>General Method</th>
<th>Aldrich Method [7]</th>
<th>H</th>
<th>F</th>
<th>R</th>
<th>Hazard Rating (Sax [4])</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonium carbonate</td>
<td>2.1, 2.2, NB1</td>
<td></td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3?</td>
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<tr>
<td>Ammonium hydroxide</td>
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<td>N</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Butylamine</td>
<td>2.2, NB1</td>
<td>D</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Calcium bicarbonate</td>
<td>2.2, NB1</td>
<td></td>
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<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Calcium carbonate (Lime stone)</td>
<td>2.2, NB1</td>
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<td>0</td>
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<tr>
<td>Calcium hydroxide (Slake lime)</td>
<td>2.2, NB1</td>
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<td>0</td>
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<tr>
<td>Calcium oxide (Quick lime)</td>
<td>15 O</td>
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<td>0</td>
<td>1</td>
<td>3</td>
<td></td>
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<tr>
<td>Diethylamine</td>
<td>2.2, NB1</td>
<td>D</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Ethylamine</td>
<td>2.2, NB1</td>
<td>D</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Methylamine (40% solution in water)</td>
<td>2.2, NB1</td>
<td>A</td>
<td>3</td>
<td>4</td>
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<tr>
<td>Piperidine</td>
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</tr>
<tr>
<td>Potassium bicarbonate</td>
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<tr>
<td>Potassium carbonate</td>
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<td>0</td>
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<tr>
<td>Potassium hydroxide (Caustic potash)</td>
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<td>0</td>
<td>3</td>
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<tr>
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<tr>
<td>Sodium bicarbonate</td>
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<td>1</td>
<td></td>
</tr>
<tr>
<td>Sodium carbonate (Soda ash)</td>
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<td>0</td>
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<tr>
<td>Sodium hydroxide (Caustic soda)</td>
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<td>0</td>
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<td>3</td>
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<tr>
<td>Triethylamine</td>
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<td>4</td>
<td>3</td>
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**NOTE:** A Blank Cell in the table indicates there is no information available.

### Table 3: ORGANIC SOLVENTS

<table>
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<th>SOLVENT</th>
<th>General Method</th>
<th>Aldrich Method [7]</th>
<th>H</th>
<th>F</th>
<th>R</th>
<th>Hazard Rating (Sax [4])</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>3 D</td>
<td>1</td>
<td>3</td>
<td>0</td>
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</tr>
<tr>
<td>Acetonitrile</td>
<td>3 D</td>
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<td>3</td>
<td>3</td>
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<td></td>
</tr>
<tr>
<td>Acetaldehyde*</td>
<td>6 D</td>
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<td>4</td>
<td>2</td>
<td>3</td>
<td></td>
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<tr>
<td>Allobenzene</td>
<td>3 D</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Benzene</td>
<td>3 D</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Bromobenzene **</td>
<td>3 C</td>
<td>2</td>
<td>2</td>
<td>0</td>
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<td></td>
</tr>
<tr>
<td>N-Butylacetate</td>
<td>3 D</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2-Butylacetate</td>
<td>3 D</td>
<td>1</td>
<td>3</td>
<td>0</td>
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<td>N-Butanol</td>
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<td>Carbon disulphide</td>
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<td>3 B</td>
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<td>Cyclohexane</td>
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<td>Cyclohexanone</td>
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<td>Diacetone alcohol</td>
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<td>Dibrometherane **</td>
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### Table 3: ORGANIC SOLVENTS

<table>
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<th>SOLVENT</th>
<th>General Method</th>
<th>Aldrich Method [7]</th>
<th>H</th>
<th>F</th>
<th>R</th>
<th>Hazard Rating (Sax [4])</th>
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</thead>
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<td>4</td>
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<td>Isopropyl alcohol</td>
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<td>Methylene dichloride (Dichloromethane)**</td>
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<td>Methylethyl ketone (2-butanone)</td>
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<td>D</td>
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<td>(\alpha)-Nitrotoluene</td>
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<td>1-Phenyl-2-propanone</td>
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</tbody>
</table>

* Peroxide forming (these chemicals must be checked for the presence of peroxides before they can be disposed of by burning)

** Chlorinated (halogenated) organic solvents (may form toxic gases during burning)

**NOTE:** A Blank Cell in the table indicates there is no information available.

### Table 4: METALS

<table>
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<tr>
<th>METAL</th>
<th>General Method</th>
<th>Aldrich Method [7]</th>
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<th>F</th>
<th>R</th>
<th>Hazard Rating (Sax [4])</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminium</td>
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<td>3</td>
</tr>
<tr>
<td>Arsenic</td>
<td>17</td>
<td>P</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Beryllium</td>
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Table 4: METALS

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<th>H</th>
<th>F</th>
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Table 5: GASES AND COMPRESSED/LIQUEFIED GASES

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Table 6: OTHER CHEMICALS

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</tbody>
</table>

* In this method, acetic anhydride is converted to calcium acetate using calcium hydroxide and calcium carbonate.

## Urea should not be subject to open burning, because it forms ammonia and nitric acid, as well as potentially, cyanuric acid.

n/a Not applicable

**NOTE:** A Blank Cell in the table indicates there is no information available.
3. **SAFE DISPOSAL OF UNKNOWN/UNLABELLED CHEMICALS**

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.

---

**Solid or Liquid**

- **Organic**
  - Liquid
    - Test with Watesmo Paper
      - Aqueous
        - Test with pH Paper
          - Strong Acid pH<3
            - Method 1.2, NA1
          - Weak Acid pH 5-6
            - Method 1.1
          - Neutral
            - Test for Cyanides
              - Method 15
          - Weak Base pH 8-9
            - Method 2.1
          - Strong Base pH>10
            - Method 2.1
          - Volatile F = 4
            - Test for Peroxides
            - Method 3
          - Volatile F = 2 or 3
            - Method 3
          - Volatile F = 1
            - Method 3
          - Non Volatile
            - Method 3.2
  
- **Liquid**
  - Test with Watesmo Paper
    - Organic
      - Liquid
        - Aqueous
          - Test with pH Paper
            - Strong Acid pH<3
              - Method 1.2, NA1
            - Weak Acid pH 5-6
              - Method 1.1
            - Neutral
              - Test for Cyanides
                - Method 15
            - Weak Base pH 8-9
              - Method 2.1
            - Strong Base pH>10
              - Method 2.1
            - Volatile F = 4
              - Test for Peroxides
              - Method 3
            - Volatile F = 2 or 3
              - Method 3
            - Volatile F = 1
              - Method 3
            - Non Volatile
              - Method 3.2
  
---

**Solid**

- Dissolve in a small amount in water and test with pH Paper
  - Organic
    - Liquid
      - Aqueous
        - Test with pH Paper
          - Strong Acid pH<3
            - Method 1.2, NA1
          - Weak Acid pH 5-6
            - Method 1.1
          - Neutral
            - Test for Cyanides
              - Method 15
          - Weak Base pH 8-9
            - Method 2.1
          - Strong Base pH>10
            - Method 2.1
          - Volatile F = 4
            - Test for Peroxides
            - Method 3
          - Volatile F = 2 or 3
            - Method 3
          - Volatile F = 1
            - Method 3
          - Non Volatile
            - Method 3.2
  
---

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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 22 below.)
4. **PRACTICAL DETAILS FOR CHEMICAL NEUTRALIZATION AND TREATMENT**

While it is always desirable to employ Group 1 disposal methods (see page 7, above), 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 of the 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. Many of the “first-choice methods” listed are methods typically used for small-scale disposal of chemical waste in legitimate laboratories, which have not been tested outside a controlled laboratory setting (these methods are labelled “laboratory method”). It is recognized that it may not be possible to apply those methods under all circumstances and in all locations. If that is the case, then the next best environmentally safe method must be chosen, which is provided second or third in the lists below. It is the role of the specialist to decide what is the most practical treatment method to be applied under the specific circumstances of a given seizure, taking into account all health, environmental, technical and legal considerations. (See Section 7, below.)

**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. The practical details and environmental concerns described in that section refer.**

**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 VI for minimum health and safety procedures.) Precautions that must be taken before chemical neutralization and treatment is to proceed include making every effort to:

(a) Ensure trained personnel are present to conduct the treatment and oversee the disposal (see Annex VII for a suggested outline for a training course.);

(b) Ensure proper safety equipment is available, for example:
   (i) Rubber gloves (nitrile);
   (ii) Full face piece respirator;
   (iii) 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.
Details related to neutralization of acids and bases in a laboratory environment, including relevant model calculations, are included in Annex IV.

**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 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. They are outlined in Annex II.

**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. 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.

**4.1 GENERAL METHODS**

Note on the use of information provided in Section 4.1: Methods are listed by chemical, or group of chemicals, and in order of their environmentally safety, starting with the most desirable method/approach for each chemical/group of chemicals. Methods typically used for small-scale disposal of chemical waste in legitimate laboratories, which have not been tested outside a controlled laboratory setting are labelled “laboratory method”.

In many cases, chemicals can also be disposed of directly, by one or more of the disposal methods described in Section 1 (e.g., incineration followed by disposal of the incineration ash). These methods are not included separately in this section, and the reader is referred back to Section 1, and the decision tree on page 9.

**METHOD 1. - ACIDS**

General comment: Always dilute acids at a ratio of approximately 1:10 prior to neutralization. To that end, add slowly the acid to water (never the other way round).

**Method 1.1: Inorganic Acids (e.g., Hydrochloric acid)**

- Dilute acids 1 to 10 with water (dilute acids are less dangerous)
- Select a basic material, such as sodium bicarbonate, potassium bicarbonate, calcium bicarbonate, limestone. 7 Strong bases (e.g., sodium hydroxide and potassium hydroxide) must be diluted 1:10 with water prior to utilization
- Neutralization procedure

7 If ammonia-based compounds are used for neutralization, care has to be taken to avoid incompatibility reactions that release ammonia fumes. Hydrochloric acid and sulphuric acid are compatible with ammonium hydroxide.
1. Slowly add dilute acid to a solution of the basic material selected above. (Always check pH.)
2. Continue the process until a pH between 6 and 8 is obtained.
   - Dilute the solution further, approximately 1 to 10, with water.
   - Dispose of the neutralized acid in the sewer system or, in remote area, by burial in a trench.

Method 1.2: Specific Acids

a. GLACIAL ACETIC ACID, ACETIC ACID
   Method 1 (laboratory method)
   Neutralize (pH 6-8) with 5% sodium hydroxide or sodium carbonate and dispose of in sewer system, using copious amounts of water.

   Method 2 (organic acids)
   Dilute the organic acid in an organic solvent (flammability rating 2 or 3) and burn. (See Method 3 below.)

b. OXALIC ACID (laboratory method)
   Oxalic acid is decomposed to carbon dioxide, carbon monoxide, and water by heating in concentrated sulphuric acid. Wear nitrile rubber gloves, laboratory coat, and eye protection when using this method. In the fume hood (if possible) oxalic acid is added to concentrated sulphuric acid in a round-bottom flask. Using a heating mantle, the mixture is maintained at 80-100°C for 30 minutes. The sulphuric acid can be reused for the same procedure since the only nonvolatile product of the decomposition is a small quantity of water. Otherwise allow the reaction mixture to cool to room temperature, then slowly and carefully pour the sulphuric acid into a pail of cold water (or cold water and ice), neutralize with sodium carbonate to a pH of 6-8, and dispose of in sewer system, with copious amounts of water.

Neutralize Acid (NA1) (laboratory method)
Non-oxidizing acids that may generate heat upon neutralization
Concentrated acids such as formic, hydrochloric, hydrobromic and lactic acids
   - Dilute the acid with water 1:10 (i.e., slowly add acid to water).
   - Neutralize by slowly adding 6 N sodium hydroxide solution, stirring continually
   - As heat builds up, add more water.
   - Monitor pH change with a suitable indicator or check periodically with pH paper.
   - When pH 6-8 is reached, the solution may be disposed of in the sewer system with 18 parts of water.

Neutralize Acid 2 (NA2) (laboratory method)
Oxidizing acids, such as nitric and perchloric acids
   - Dilute the acid with 10 parts water.
   - Neutralize with a 6 M solution of potassium or sodium hydroxide. The solution may turn yellow or brown as nitric oxide forms when neutralizing nitric acid. If potassium hydroxide is used, a white precipitate of potassium perchlorate will

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8 Ammonium hydroxide is incompatible with nitric acid and should never be used for neutralization of that acid.
form. This precipitate may be disposed of in the sewer with the rest of the solution.
- Monitor pH with pH paper or other suitable indicator.
- When a pH 6-8 is reached, the solution may be disposed of in the sewer system with 18 parts of water.

Neutralize Acid 3 (NA3) (laboratory method)
Concentrated (57%) Hydriodic acid
- Dilute the dark orange/brown solution with 10 parts of water.
- Rinse bottle with water and add rinsate to rest of solution to be neutralized.
- Add 6 M sodium hydroxide or other suitable base.
- Monitor pH changes with pH paper as the colour of the solution will interfere with most indicators. The solution will become nearly colourless as pH 7 is approached. When a pH 6-8 is reached, the solution may be disposed of in the sewer system with 18 parts of water.

METHOD 2. - BASES

Caustic Alkali (e.g., sodium hydroxide) and Ammonia
General comments: Always dilute base at a ratio of approximately 1:10 prior to neutralization. To that end, add slowly the base to water (never the other way round). Note that effervescence is common with older base solutions due to carbon dioxide absorption.

Method 2.1: General
- Dilute alkali 1 to 10 with water (dilute alkali are less dangerous).
- Select an acidic material. Strong acids (e.g., hydrochloric acid, sulphuric acid) must be diluted 1:10 or greater prior to utilization.
- Neutralization procedure:
  1. Slowly add dilute base to a solution of the acidic material selected above. (Always check pH.)
  2. Continue the process until a pH of between 6 and 8 is obtained.
- Dilute the solution further, approximately 1 to 10, with water.
- Dispose of the neutralized base in the sewer system or, in remote area, by burial in a trench.

Method 2.2: (laboratory method)
Neutralize Base 1 (NB1)
Potassium hydroxide, sodium hydroxide, etc.
- Add up to 2 liters of the alkali solution to 10 liters water.
- Slowly add a dilute acid solution.
- Monitor pH changes with pH paper.
- When pH<9 is reached, the solution may be disposed of in the sewer system with an excess of water.

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9 Sodium perchlorate, by contrast, is water-soluble and will remain in solution; note that both sodium and potassium perchlorate may explode when dry.
10 See footnote 7 above.
METHOD 3. - Organic solvents (e.g. Ethanol)

Peroxide forming chemicals (indicated by an asterisk in Table 3 in Section 2 above), 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, below.

Method 3.1: Solvents with flammability rating 2 or 3
- Burn in pit or trench, in an area 10 meters away from combustible material, or in a 45/55-gallon drum (use slow burning fuse to ignite).

It should be noted that all solvents with flammability rating 2 or 3 can also be disposed of by fuel blending, i.e., used for energy recovery in relevant industries. (See under ‘recycling/reuse’, Section 1, page 10.)

Method 3.2: 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 in Method 3.1.

METHOD 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.

**Removal of peroxides** (this method can be used in remote areas, if the solutions are available, or in a laboratory setting)

If the solution tests positive for peroxides, the following steps must be followed to remove them:

1. Add 10 ml of 5% 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 mls of glacial acetic acid to the solution.
2. Keep adding this solution until the ethyl ether does not test positive for peroxides.

**Note**: If the solution appears to contain dried crystals on its interior surface or the liquid appears to contain a slurry of crystals, no attempt should be made to remove the peroxides. The container should be carefully disposed of as dangerous, shock sensitive material.

Method 4.1:
- Dilute ether 1:3 with higher alcohol (e.g., isopropyl alcohol) or other available solvent of flammability rating 2 or 3.
- Burn in a barrel or a trench using “det cord”.

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Method 4.2: (Large quantities or samples contaminated with peroxides)
- Transport (safely) to an open area.
- Ignite with an excelsior train, slow burning fuse, or “det cord”.

METHOD 5. - Organic acid halides (e.g., acetyl chloride)
(Laboratory method)
- 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 in the sewer system or, in remote area, by burial in a trench.
- Always remember that organic halides may react violently with water.

METHOD 6. - Aldehydes (e.g., benzaldehyde)
Organic halogen compounds (e.g., benzyl chloride)
Peroxide forming chemicals (indicated by an asterisk in Table 3 in Section 2 above), 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, above.

Method 6.1:
- Dissolve in an available flammable solvent (flammability rating 2 or 3) and burn in 45/55-gallon drums, or an open pit.

Method 6.2:
- In an open pit filled with sodium bicarbonate, slowly add the chemical.
- Cover with scrap wood, and burn.

METHOD 7. - Aliphatic amines (e.g., diethyl 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 in the sewer system or, in remote area, by burial in a trench.

METHOD 8. - Carbon disulfide
Any metal or electrical equipment used in this method or contact surfaces should be grounded (earthed) to avoid ignition by static discharge.
- Absorb the carbon disulfide onto sand, ash, or vermiculite in a 45/55-gallon drum, or a pit.
- Cover with water.
- Burn (ignite with “det cord”).
METHOD 9. - Inorganic Salts (e.g., Aluminum Chloride)

(Laboratory method)
- Add the salt to a large excess of water.
- Add excess of soda ash, sodium (calcium) carbonate, and let stand 24 hours.
- Remove aqueous layer, check the pH and neutralize with acid or basic material, if necessary, to pH 6-8.
- Dispose of in sewer with a large excess of water.
- The sludge may be disposed of in a landfill, in accordance with local regulations.

METHOD 10. - Oxidizing agents (e.g., potassium permanganate, hydrogen peroxide, sodium dichromate)

Method 10.1 (laboratory method)
- Add oxidizing agent to a large volume of a concentrated solution of sodium hypo-bisulfite (sodium metabisulfite) or a ferrous salt.
- Acidify with dilute sulphuric acid.
- When reduction is complete (i.e., when heat generation stops), neutralize the solution with soda ash or dilute hydrochloric acid.
- Dispose of in sewer system with a large excess of water.

Method 10.2 (developed for potassium permanganate in solid state or aqueous solutions)
- Dissolve 450 grams (1 lb) of potassium permanganate, in 8.0 litres of water.
- Prepare a trench at least 50 feet 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:
  1. Small amount at a time: must change colour from purple to brown.
  2. Heat may be generated: adjust pouring rate so it all turns brown.
  3. 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.

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

Method 10.3: Special procedures for calcium hydroxide, hydrogen peroxide & potassium permanganate
- Acidify to pH 2 with dilute sulphuric acid.
- Add 50% excess of aqueous sodium bisulfite.
- Temperature will start to increase; if not, add more sodium bisulfite.
- Adjust pH 6 to 8.
- Dispose of in the sewer system or, in remote area, by burial in a trench.
Method 10.4: Peroxides (e.g., hydrogen peroxide)
- Mix or absorb the peroxide onto sand or vermiculite.
- Wet with 10% sodium hydroxide.
- In a 45/55-gallon drum or open pit, ignite with slow burning fuse.

Method 10.5: Sodium dichromate (laboratory method)
- Add the solid dichromate to a container of water (about 5g/100ml). (The maximum batch size depends upon the size of the available glassware.)
- Acidify with dilute sulphuric acid to a pH of 3 (about 40-60 ml).
- Slowly, and with stirring, add solid sodium thiosulfate (about 15g per 100ml-batch) until the solution becomes cloudy and blue coloured.
- Neutralize the solution with sodium carbonate. After a few minutes, a blue-grey flocculent precipitate is formed.
- Filter immediately through Celite®, or let stand for a week, when much of the supernatant can be decanted. The remaining liquid is allowed to evaporate or filtered off.
- The liquid can be washed into drain.
- The solid residue should be washed with hot water to remove sodium sulphate, then dried, packaged, labelled, and sent to a landfill.

METHOD 11. - Cyanides (e.g., sodium cyanide)

Method 11.1:
- Place in a large container (e.g., 45/55-gallon drum) and make alkaline (pH > 10) with a sodium hydroxide solution.
- Add an excess of ferrous sulphate solution.
- After approx. 1-2 hrs, dispose of with an excess of water in sewer system or, in remote area, by burial in a trench.

Method 11.2: (Conversion to thiocyanate)
- Add the cyanide to an alkaline solution (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 landfill or, in remote area, by burial in a trench.

METHOD 12. - Hydrides (e.g., lithium aluminium hydride)

Method 12.1: (remote location)
- Place the chemical in a trench or pit away from flammable material and burn using “det cord”. This method will result in a fire.

Method 12.2: (laboratory method)
- Decompose with ethyl acetate (adequate glassware, dropper and stirrer required).
- Dispose of in the sewer system or, in remote area, by burial in a trench.
Method 12.3: **(laboratory method for small volumes)**
- In a large container, spray the hydride with dry butyl alcohol.
- Add water by spraying or fogging.
- Remove the solid into another container.
- Neutralize with hydrochloric acid; let settle.
- Dilute liquid with a large excess of water (to obtain a butyl alcohol concentration of less than 20%).
- Dispose of in the sewer system or, in remote area, by burial in a trench.
- Dispose of solid residue in a landfill or other location, which is in compliance with local regulations.

**METHOD 13. - Organic amides (e.g., formamide)**
- Dissolve or mix with flammable solvent (flammability rating 2 or 3) and proceed as in Method 3.2.

**METHOD 14. - Non-Metallic compounds (e.g., phosphorous trichloride)**
**(Laboratory method)**
- 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 the sewer system.

**METHOD 15. - Non-hazardous, solid chemicals**
The following list, adapted from [6], lists solid chemicals, which are not considered hazardous and are therefore suitable for disposal with regular waste in a landfill.

**A. Organic Chemicals:**
- Activated carbon
- Sugars and sugar alcohols
- Starch
- Citric acid and its Na, K, Mg, Ca, NH₄ salts
- Lactic acid and its Na, K, Mg, Ca, NH₄ salts
- Urea ¹¹

**B. Inorganic Chemicals:**
- Silica
- Sulphates: Na, K, Mg, Ca, Sr, NH₄
- Phosphates: Na, K, Mg, Ca, Sr, NH₄
- Carbonates: Na, K, Mg, Ca, Sr, NH₄
- Oxides: B, Mg, Ca, Sr, Al, Si, Ti, Mn, Fe, Co, Cu
- Chlorides: Ca, Na, K, Mg, NH₄
- Borates: Na, K, Mg, Ca

¹¹ The preferred option for disposal of urea, if pure/not contaminated, is use as fertilizer. Urea should not be used for neutralization of acids; it reacts with sodium hypochlorite to form nitrogen trichloride, an explosive.
C. Tablet excipients

Typical tablet excipients, binders, dyes and cutting agents are classified as non-toxic and can be disposed of in a landfill. Inorganic pigments, such as cadmium orange (CdS) should be disposed of by method 17, below.

METHOD 16. - Phosphorous (Yellow & Red)

Yellow phosphorous:
- Place the chemical under water in a 45/55-gallon drum (typically, the original container as is placed in the drum and covered with additional water).
- As the water evaporates (in the course of up to several days) the exposed phosphorous will ignite and burn.

Red phosphorous:
- Place the chemical in a 45/55-gallon drum or a pit or trench (with no ignitable material present).
- Ignite with an excelsior train or other means of ignition from a safe distance (at least 10 meters).

METHOD 17. - Arsenic, Antimony and Bismuth Compounds

- Use Method 9 above.
- Then encapsulate the slurry and dispose of in a hazardous waste landfill, in accordance with all applicable requirements. The liquid should be disposed of in sewer with a large excess of water.

METHOD 18. - Alkali Metals

(Laboratory method)
- Small amounts of the metal (approximately 1 gram) are allowed to react with an alcohol (e.g., ethyl alcohol) in a slow, controlled fashion (for example, in a cooled reaction flask) to generate the metal alkoxide and hydrogen.
- The hydrogen gas is released into the atmosphere.
- The metal alkoxide is subsequently hydrolyzed with water: Water is added to the mixture drop-wise to yield the metal hydroxide and alcohol. *(This procedure presents a high fire risk!)*
- The solution is then disposed of in the sewer system.

METHOD 19. - Aqueous solutions of water-miscible flammable organic solvents (e.g., solutions of less than 18% acetone, ethanol, methanol and other water-soluble and water-miscible solvents)

Method 19.1: (laboratory method)

Most aqueous solutions can be disposed of in the sewer, following the guidelines contained in local regulations.

Method 19.2:
- Add solution to an available flammable solvent (flammability rating 2 or 3).
- Dispose of mixture in same manner as Method 3.1., above.
Method 19.3:
- Pour the organic solvent on an absorbent material (e.g., sand), and let evaporate.

METHOD 20. - Iodine
(Laboratory method)
- In the fume hood, if possible, cautiously add iodine to a solution of sodium thiosulfate (300 ml of 4%) 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 larger than 9, iodine will re-dissolve).
- When reduction is complete, add sodium carbonate or dilute hydrochloric acid to neutralize the solution.
- Dispose of in the sewer system with excess of water.

METHOD 21. - Sodium Hypochlorite
(Laboratory method)
- To the sodium hypochlorite solution add a large excess of a bisulfite or a ferrous salt and acidify with dilute sulphuric acid.
- When the reduction is complete, add soda ash or dilute hydrochloric acid to neutralize the solution.
- Dispose of in the sewer system with a large excess of water.

Recycling is also possible: Waste treatment facilities

METHOD 22. – Gases and compressed/liquefied gases

Method 22.1:
Gases and liquefied gases should not be moved; they should be kept in their original containers, and passed to a specialized disposal company.

Method 22.2:
Gases may also be slowly vented to air by a specialist in a safe open area.
### 4.2. ALDRICH METHODS

Aldrich treatment and disposal methods [7] are used for disposal of wastes from legitimate laboratories that utilize chemicals during their work. They require scientific glassware and equipment, and an environmental management infrastructure, which may not be available in remote jungle locations.

Aldrich treatment and disposal methods are identified by a letter code, which is also followed in this manual. Methods not applicable to the chemicals covered by this manual are omitted.

<table>
<thead>
<tr>
<th>Aldrich code</th>
<th>Treatment/Disposal method</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.</td>
</tr>
<tr>
<td>B</td>
<td>The material should be ignited in the presence of sodium carbonate and slaked lime (calcium hydroxide), or the substance should be mixed with vermiculite and then with the dry caustics, wrapped in paper and burned in a chemical incinerator equipped with an afterburner and scrubber.</td>
</tr>
<tr>
<td>C</td>
<td>This combustible material may be burned in a chemical incinerator equipped with an afterburner and scrubber.</td>
</tr>
<tr>
<td>D</td>
<td>Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting, as this material is highly flammable.</td>
</tr>
<tr>
<td>G</td>
<td>Under an inert atmosphere cautiously add the material to dry butanol in an appropriate solvent. The chemical reaction may be vigorous and/or exothermic. Provisions must be made for venting of large volumes of highly flammable hydrogen and/or hydrocarbon gases. Neutralize the solution with aqueous acid. Filter off any solid residues for disposal as hazardous waste. Burn the liquid portion in a chemical incinerator equipped with an afterburner and scrubber.</td>
</tr>
<tr>
<td>H</td>
<td>Neutralize the solution and add filtering agent (10g per 100 ml). Evaporate the liquid and bag the residual solid for burial in a landfill site approved for hazardous-waste disposal.</td>
</tr>
<tr>
<td>I</td>
<td>Dissolve the solid in (or dilute the solution with) a large volume of water. Carefully add a dilute solution of acetic acid or acetone to the mixture in a well-ventilated area. Provisions should be made to vent safely the hydrogen gas given off during the decomposition. Check acidity of the solution and adjust to pH 1 if necessary. Let stand overnight Neutralize the solution (pH 7). Evaporate the solution and bury the residue in a landfill site approved for hazardous waste disposal.</td>
</tr>
<tr>
<td>K</td>
<td>Contact a specialist disposal service.</td>
</tr>
<tr>
<td>L</td>
<td>The material should be dissolved either in water or acid solution, or it should be oxidized to a water-soluble state. Precipitate the material as the sulfide, adjusting the pH of the solution to 7 to complete precipitation. Filter the insolubles and</td>
</tr>
</tbody>
</table>
dispose of them in a hazardous-waste site. Destroy any excess sulfide with sodium hypochlorite. Neutralize the solution before flushing down the drain.

N For small quantities, cautiously add to a large, stirred excess of water. Adjust pH to neutral, separate any insoluble solids or liquids, and package them for hazardous waste disposal. Flush the aqueous solution down the drain with plenty of water. The hydrolysis and neutralization reactions may generate heat and fumes, which can be controlled by the rate of addition.

O Bury in a landfill site approved for the disposal of chemical and hazardous waste.

P Material in the elemental state should be recovered for reuse or recycling.

R Catalysts and expensive metals should be recovered for reuse or recycling.

S Treat a dilute basic solution (pH 10-11) of the material with a 50% excess of commercial laundry bleach. Control the temperature by the addition rate of bleach and adjust pH if necessary. Let stand overnight. Cautiously adjust solution to pH 7. Vigorous evolution of gas may occur. Filter any solids for burial in a chemical (i.e., hazardous waste) landfill. Precipitate any heavy metals by addition of sulfide and isolate for burial. Additional equivalents of hypochlorite may be needed if the metal can be oxidized to a higher valence state. For metal carbonyls, the reaction should be carried out under nitrogen.
PART III
5. SAFE HANDLING AND STORAGE OF CHEMICALS

A. General guidelines for the 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.

4. Whenever possible, 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:
   (a) Package them in the original containers, wherever possible;
   (b) Separate containers to prevent breakage;
   (c) Segregate by chemical hazard groups; and
   (d) Transport must follow dangerous goods legislation.

7. Chemicals should not be stored or handled more than is absolutely necessary.

8. When chemicals must be stored, store them by groups (e.g., acids, bases, volatiles, oxidizers, etc.).

9. Retain the minimum amount of chemicals required for evidentiary purposes (with appropriate labelling to maintain the chain of custody).
10. Never mix unknown chemicals.

11. Take special care when opening containers, because solvent vapours may have built up significant pressure inside, especially at elevated ambient temperatures.

12. 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. Alternatively, clean tools and containers in between these activities to prevent cross-contamination.

B. Guidelines for the safe storage of seized chemicals

When chemicals are seized they must be separated and stored as per chemical class characteristics. Development of a chemical segregation and storage plan, including an incompatibility analysis, is recommended. The following procedures can be applied to clandestine laboratories in urban settings, or in remote areas.

In an area away from the illicit laboratory, separate the chemicals as per class characteristics. The sampling and disposal of chemicals will then proceed as to class characteristics.

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

(a) Storage of chemicals per class (i.e., avoid storing incompatible compounds together):
   (i) **Flammables or combustibles** (e.g., acetone, alcohols, kerosene, methyl ethyl ketone, petroleum ether, etc.)
   (ii) **Halogenated organic compounds** (e.g., chloroform, methylene chloride, etc.).
   (iii) **Ammonia**
   (iv) **Oxidizing agents** (e.g., potassium permanganate, sodium dichromate, sodium hypochlorite, etc.)
   (v) **Alkalis** (e.g., ammonium hydroxide, potassium hydroxide, sodium hydroxide, etc.)
   (vi) **Acidics** (e.g., hydrochloric acid, nitric acid, sulphuric acid, etc.)
   (vii) **Solids** (All solids should be separated.)
   (viii) **Compressed gases**
   (ix) **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).

(b) 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 landfill.
(c) Regular safety inspections of the storage and handling area, including of the storage containers.

(d) Easy access to every container (for preventive inspection and timely response to leakages/spills).

(e) Must have the capacity to handle deteriorated containers and repackage leaking containers.

(f) Proper ventilation.

(g) Maintenance of a supply of absorbent material (e.g., sand or vermiculite) to be used as segregation barriers and for absorbing spills.

C. Chemicals Spills.

In case of chemical spills, the following practices should be employed:

(a) Secure the area;
(b) Identify, if possible, what the chemical is;
(c) Use appropriate safety procedures and personal protective equipment;
(d) Use a chemical absorbent to absorb the chemical;
(e) Place material in suitable containers for transportation; and
(f) Dispose of in a landfill.

Chemical absorbents: Vermiculite is a suitable chemical absorbent; however it is expensive and limited budgets may prevent it use. If vermiculite is not available, another suitable absorbent material is sand.
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:

   (a) Chemical waste disposal companies;
   (b) Petroleum industry;
   (c) Pulp industry;
   (d) Chemical industry;
   (e) Pharmaceutical industry;
   (f) Hospitals;
   (g) Universities; and
   (h) 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.

Example scenarios where specialist expertise would come into play are:

(a) 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 might give advice on:
   (i) the separation of chemicals as to compatibility/hazards;
   (ii) taking samples where necessary;  
   (iii) treatment/disposal methods that should be used; and
   (iv) supervising, coordinating and monitoring the disposal.

(b) When chemicals and/or drugs are seized in a clandestine laboratory location, the expert may also:
   (i) secure the clandestine laboratory site;
   (ii) provide information on what drugs are being made;
   (iii) provide information on hazards in the laboratory;
   (iv) provide information on what exhibits to seize;
   (v) provide information on what exhibits need to be analyzed; and
   (vi) take samples where 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.

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12 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:

(a) The establishment of ownership;
(b) The lack of legal authority to seize and dispose of these chemicals;
(c) The handling of these substances in a manner that is consistent with protecting the health and safety of the personnel processing them;
(d) The disposal of substances in a manner that is consistent with current environmental concerns and legislation;
(e) The need to check the bona-fides of companies that are contracted for disposal or recycling of chemicals to ensure their legitimacy; and
(f) 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 the 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 UN 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:

1. 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.).
2. 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.).

3. 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.

4. 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:**

1. 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.

2. 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.

3. 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.

4. 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.
REFERENCES


2. “Report of the Meeting of the Expert Group on Pre-trial Destruction of Seized Narcotic Drugs, Psychotropic Substances, Precursors and Essential Chemicals, Vienna, Austria, 13-17 November 1989” (Legal/administrative aspects; E/CN.7/1990/7/Add.1)


FURTHER READING
(chronologically)


UNODC Laboratory and Scientific Section, Basic information on substances frequently used in the illicit manufacture of narcotic drugs or psychotropic substances (Article 12, 1988 Convention), for use by non-laboratory officials (SCITEC/11, 1996).


Royal Canadian Mounted Police, Occupational Health Section Health Services Directorate, Chemical Threats to Police Officers from Clandestine Drug Labs (1996).


UNODC Laboratory and Scientific Section, Data sheets on substances frequently used in the illicit manufacture of narcotic drugs or psychotropic substances, 1988 Convention (SCITEC/9/REV.1, 1993).

O. Nieto de Rojas, Aspectos Técnicos Determinantes En La Destrucción, Almacenamiento Y Transporte De Drogas Controladas, Solventes Precursores e Insumos Decomisados (Colombia, 1993).


The following four single key references are specifically recommended:


GLOSSARY

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

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.

Chemicals: The term as used in these guidelines refers to all chemicals used in the clandestine manufacture of drugs (in particular, cocaine, heroin, amphetamine, methamphetamine, ecstasy-type substances and methaqualone). It also includes chemicals used to make or recycle other controlled chemicals, and chemical waste that may be found at clandestine laboratory sites.

Cleanup: Used in these guidelines to refer to the entire process of chemical identification, safe handling, transportation, treatment and disposal.

Destruction: The term destruction, although often used colloquially in connection with the disposal of chemicals, e.g., by incineration and burning, is not used in these guidelines. Instead, the term treatment is used, indicating that even those treated products still need to be disposed of in an environmentally safe way.

Disposal: For purposes of this document, the term refers to the act or process of getting rid of 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.

Engineered landfills: A landfill with appropriate protective lining, approved for the disposal of hazardous waste. Engineered landfills are also used for non-hazardous or municipal wastes, but have different requirements.

Excess: Excess, as used in these guidelines, means adding more in weight or volume of the chemical/substance being used to neutralize another substance.

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.

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.
Landfill: Refers to the disposal on land of solid waste and solid waste residues (e.g., ash from incineration), whether by use of excavations or by creation of a landform above grade, where the term “fill” is used in the engineering sense. For the purposes of this document, two types of landfills are referred to, engineered landfills, and remote area burials. (see there).

Neutralization: Chemical reaction in which an acid and a base interact with the formation of a salt; with strong acids and bases the essential reaction is the combination of hydrogen ions with hydroxyl ions to form water.

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 can be used in remote locations for open air burning, or as a landfill (remote area burial), when more environmentally safe disposal options are not practicable.

Recycling: For the purpose of these guidelines, the terms recycling and reuse include the following options:

(a) Returning commercially labelled, factory-sealed containers to the original supplier or, through auction sales, to vetted legitimate chemical handlers;

(b) Sale, auction or donation to public/academic institutions that may have a direct legitimate need for them (e.g., schools, universities, hospitals, etc.); and

(c) Recovery/transformation into products for which there is a legitimate use.

The term recycling, as used in these guidelines, typically (especially for options (b) and (c) above) applies to chemicals found in their original, factory-sealed containers, with original labels, and which have not been contaminated.

Remote area burial: See “pit”.

Segregation or Separate Storage: Refers to a concept of chemicals storage, where different classes of chemicals (i.e., acids, bases, etc.) are stored in separate containers, or in different places in an open chemical storage area to minimize risk.

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”.
ANNEXES
Annex I

CHEMICALS USED IN THE ILLICIT MANUFACTURE OF DRUGS

The table below lists, in alphabetical order, key chemicals used in the clandestine manufacture of cocaine, heroin, amphetamine/methamphetamine, ecstasy-type substances, and methaqualone.

Substances in Table I and II of the 1988 Convention are highlighted. (For comprehensiveness all chemicals in Tables I and II of that Convention are included, even if they are used for other drugs that those covered in these guidelines.)

<table>
<thead>
<tr>
<th>CHEMICAL</th>
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<tr>
<td>Acetic acid</td>
<td>1, 2, 3, 4</td>
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<td>Acetic anhydride</td>
<td>1, 2, 3, 5</td>
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<tr>
<td>Activated carbon</td>
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<td>Allobenzene</td>
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<td>Ammonia (gas)</td>
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<td>Ammonium acetate</td>
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<td>Calcium oxide (quick lime)</td>
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<td>LSD*</td>
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<td>Ethyl acetate</td>
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<td>Iodine</td>
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<td>Isopropyl alcohol</td>
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<td>Kerosene</td>
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<td>Lithium aluminium hydride</td>
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<td>Lysergic acid</td>
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*LSD = (+) - Lysergide*
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* PCP = phencyclidine
<table>
<thead>
<tr>
<th>CHEMICAL</th>
<th>Used in Manufacture of</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium sulphate</td>
<td>1, 3</td>
</tr>
<tr>
<td>Sulphuric acid</td>
<td>1, 2, 3, 4</td>
</tr>
<tr>
<td>Tartaric acid</td>
<td>2, 3</td>
</tr>
<tr>
<td>Tetrahydrofuran</td>
<td>3, 4</td>
</tr>
<tr>
<td>Thionyl chloride</td>
<td>2, 3</td>
</tr>
<tr>
<td>Toluene</td>
<td>1, 3, 4, 5</td>
</tr>
<tr>
<td>o-Toluidine</td>
<td>5</td>
</tr>
<tr>
<td>Triethylamine</td>
<td>5</td>
</tr>
<tr>
<td>Xylene</td>
<td>1</td>
</tr>
</tbody>
</table>
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. Available test papers 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

These test papers should be used following the suppliers’ instructions, and in conjunction with the flow chart in Section 3 above.

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 above will then help to determine the most appropriate disposal method.

After taking appropriate safety precautions (see safe handling for chemicals above) 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.

1. **Water reactivity**
   Carefully add a few crystals of the unknown to a one millilitre 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 these tests.
2. **Water solubility**
Add a few crystals, if a solid, or five drops, if a liquid, to one millilitre 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.

3. **pH**
If a liquid, test directly with pH paper and observe result. If a solid, place a few crystals of the material in one millilitre of water, test with pH paper, and observe the result.

4. **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.

5. **Presence of peroxides**
Any of these tests (A-E) 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 by suppliers.

   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)

      C.1. **Iodide tests:**
         a. 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.
         Or
         b. Add 1-3 ml of the liquid to be tested to an equal volume of acetic acid, and add a few drops of 5% potassium iodide solution and shake. The appearance of a yellow to a brown colour indicates the presence of peroxides.
         Or
         c. Add substance to be tested to 1 ml of a freshly prepared 10% 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% peroxides.

      C.2. **Iodide/starch test:** Add 0.5 ml of the solution to be tested to a mixture of 1 ml of 10% potassium iodide solution and 0.5 ml of dilute hydrochloric
acid to which has been added a few drops of starch solution just prior to the test. The appearance of a blue to blue-black colour within a minute indicates the presence of peroxides.

C.3. Other: Prepare a solution of 5 ml of 15% 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.

6. Presence of sulfide
The test for inorganic sulfides 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. Conclusion: Development of a brown-black colour on the paper indicates generation of hydrogen sulfide. Because of the toxicity of the hydrogen sulfide formed during this test, only a small sample should be tested, and appropriate ventilation should be used.

7. Presence of cyanide
The 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% aqueous sodium hydroxide (solution A), 10% aqueous ferrous sulphate (solution B), and 5% ferric chloride (solution C). Mix 2ml of the sample with 1ml of distilled water and 1ml each of solutions A, B, and C. Add enough concentrated sulphuric acid to make the solution acidic. Conclusion: Development of a blue colour (Prussian blue, from ferric ferrocyanide) indicates cyanide. Because of the toxicity of the hydrogen cyanide formed during this test, only a small sample should be tested, and appropriate ventilation should be used.

8. Presence of halogen
Heat a piece of copper wire until red in a flame. Cool the wire in distilled or de-ionized water, and then dip the wire into the unknown. Again heat the wire in the flame. Conclusion: The presence of halogen is indicated by a green colour around the wire.

9. Chemical test to determine the presence of specific acids
Prepare 3 separate solutions of the acid to be tested by adding 1-2 drops of the acid to 1 ml of de-ionized water
i. SILVER NITRATE TEST:
Add 1-2 drops of 5% silver nitrate reagent* to the solution and observe the precipitate (ppt), if any. If a ppt is observed add 1-2 drops of concentrated ammonium hydroxide and observe if the ppt dissolves.
ii. BARIUM NITRATE TEST:
Add 1-2 drops of 5% barium nitrate reagent* and observe the ppt, if any.
iii. BASIC BARIUM NITRATE TEST:
Add 1-2 drops of 50% NaOH, and make sure pH is basic.

* All reagents should be prepared according to an established procedure.
Add 1-2 drops of 5% barium nitrate reagent* and observe the ppt, if any.

<table>
<thead>
<tr>
<th>Acid</th>
<th>Silver nitrate</th>
<th>Silver nitrate + NH₄OH</th>
<th>Barium nitrate</th>
<th>Basic Barium nitrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBr</td>
<td>Pale yellow ppt</td>
<td>Dissolves</td>
<td>No ppt</td>
<td>No ppt</td>
</tr>
<tr>
<td>HI</td>
<td>Yellow ppt</td>
<td>White ppt</td>
<td>No ppt</td>
<td>No ppt</td>
</tr>
<tr>
<td>HCl</td>
<td>White ppt</td>
<td>Dissolves</td>
<td>No ppt</td>
<td>No ppt</td>
</tr>
<tr>
<td>H₂SO₄</td>
<td>No ppt</td>
<td>No ppt</td>
<td>White ppt</td>
<td>White ppt</td>
</tr>
<tr>
<td>HNO₃</td>
<td>No ppt</td>
<td>No ppt</td>
<td>No ppt</td>
<td>No ppt</td>
</tr>
<tr>
<td>H₃PO₄</td>
<td>No ppt</td>
<td>No ppt</td>
<td>No ppt</td>
<td>White ppt</td>
</tr>
<tr>
<td>H₃PO₂</td>
<td>Black ppt</td>
<td>No ppt</td>
<td>No ppt</td>
<td>No ppt</td>
</tr>
</tbody>
</table>

ppt = precipitate

* All reagents should be prepared according to an established procedure.
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 (GHS)” [8]. 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.

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 73ºF (23ºC).

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 100ºF (38ºC).

2: Liquids, which must be heated before ignition can occur; solids which give off flammable vapours. Flash point > 100ºF but < 200ºF (>38ºC but <93 ºC).
1: Material, which must be preheated before ignition can occur. Flash point > 200°F (93°C).

0: Materials that will not burn.

Note: 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.

D. Hazard Rating (Sax, [4])

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 (LD$_{50}$) below 400 mg/kg or a lethal concentration (LC$_{50}$) below 100 ppm or the material is explosive, spontaneously flammable or highly reactive.

2: Indicates an LD$_{50}$ of 400-4000 mg/kg or an LC$_{50}$ of 100-500 ppm or the material is highly flammable or reactive.

1: Indicates an LD$_{50}$ of greater than 4000 mg/kg or an LC$_{50}$ of greater than 4000 ppm, or that the material is combustible.
SAMPLE CALCULATIONS FOR NEUTRALIZATION OF ACIDS AND BASES
(based on: University of Wisconsin Chemical Safety and Disposal Guide, 1993 [9])

(For laboratory use)

The following is a guide to help plan the neutralization of acids and bases under laboratory conditions, applying basic stoichiometry. (The quantitative relationship between reactants and products in a chemical reaction.)

At clandestine laboratory sites, dictated by field conditions and circumstances, the approach to chemical neutralization will be more crude. Typically, the point where fuming has stopped will be taken as the end point of the neutralization reaction, because it is recognized that a stoichiometric approach is not applicable to chemicals seized at clandestine laboratory sites.

Safety Note:
Always add acid or base to water as recommended in the tables to dilute them prior to neutralization.

1. Before starting the procedure, calculate quantities of acid or base needed for neutralization. The relative strengths of commonly used acids and bases are summarized in the adjacent tables.
2. Try a small batch first. Measure a few milliliters of waste acid into a beaker and gradually add a measured amount of base while testing its pH and observing its reaction. Assess the amount of heat and fumes generated, and the amount of base needed. Use these observations for scaling up your neutralization. Remember that, when scaling up, the lower ratio of surface area to volume may make heat dissipation a problem. Add ice going slow, and stirring, all help.
3. Add the maximum amount of concentrated acid or base solution listed in the following tables to 10 L water in a 5-gallon bucket. A rule of thumb is to dilute up to 18 moles of acid protons per 10 liters of water.

<table>
<thead>
<tr>
<th>Concentrated Acid</th>
<th>Amount to furnish one mole of acid proton (“Strength”)</th>
<th>Maximum volume per neutralization in a 5-gallon bucket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glacial Acetic Acid</td>
<td>57.1 ml</td>
<td>1.5 L</td>
</tr>
<tr>
<td>Formic Acid 88%</td>
<td>43.6 ml</td>
<td>1.2 L</td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td>83 ml</td>
<td>2.2 L</td>
</tr>
<tr>
<td>Hydrofluoric acid 50%</td>
<td>34.6 ml</td>
<td>0.75 L</td>
</tr>
<tr>
<td>Nitric acid</td>
<td>67 ml</td>
<td>1.0 L</td>
</tr>
<tr>
<td>Perchloric acid</td>
<td>83 ml</td>
<td>1.0 L</td>
</tr>
<tr>
<td>Phosphoric acid 85%</td>
<td>45.6 ml</td>
<td>1.2 L</td>
</tr>
<tr>
<td>Sulphuric acid</td>
<td>27.7 ml</td>
<td>0.75 L</td>
</tr>
<tr>
<td>Trichloroacetic Acid, 18% Solution</td>
<td>817 ml</td>
<td>3.0 kg/L (30%)</td>
</tr>
<tr>
<td>Base</td>
<td>Amount to furnish one mole of base protons</td>
<td>Notes</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Ammonium Hydroxide (15 M)</td>
<td>67 ml</td>
<td></td>
</tr>
<tr>
<td>Calcium Hydroxide</td>
<td>37 g</td>
<td>Add as a powder to neutralize acid</td>
</tr>
<tr>
<td>Magnesium Hydroxide</td>
<td>29 g</td>
<td>Add as a powder to neutralize acid</td>
</tr>
<tr>
<td>Potassium Hydroxide</td>
<td>56 g</td>
<td>Dissolve 336 g KOH per litre of water to make 6N solution</td>
</tr>
<tr>
<td>Sodium Bicarbonate</td>
<td>84 g</td>
<td>Causes foaming</td>
</tr>
<tr>
<td>Sodium Carbonate</td>
<td>53 g</td>
<td>Causes foaming</td>
</tr>
<tr>
<td>Sodium Hydroxide</td>
<td>40 g</td>
<td>Dissolve 240 g NaOH per litre of water to make 6N solution</td>
</tr>
</tbody>
</table>

**Sample Calculation**

300 ml of ammonium hydroxide, 1.5 L of hydrochloric acid, 250 ml of sulphuric acid, 400 ml 18% trichloroacetic acid solution

**Step One:** Calculate how many moles of acid protons you have.
- Hydrochloric acid: 1500 ml ÷ 83.0 ml/mole = 18 moles
- Sulphuric acid: 250 ml ÷ 27.2 ml/mole = 9 moles
- Trichloroacetic acid: 400 ml ÷ 871 ml/mole = 0.5 moles

Total amount = 28 moles acid

**Step Two:** Calculate how many moles of base you have:
- Ammonium hydroxide: 300 ml ÷ 67 ml/mole = 5 moles base

**Step Three:** Subtract moles of base from moles of acid:
- 28 moles acid - 5 moles base = 23 moles base needed

**Step Four:** Calculate the grams of sodium hydroxide you would need to complete the neutralization:
- 23 moles base × 40 g/mole NaOH = 918 grams NaOH

**Conclusion:** Therefore, an additional 918 grams sodium hydroxide is needed to complete the neutralization.
Annex V

EQUIPMENT AND MATERIALS REQUIRED FOR DISPOSAL ACTIVITIES 14

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

(a) Barricade tape
(b) Threshold level gas detectors
(c) Non-sparking tools, including hammer, pliers, wrench, crescent screwdrivers, scoop
(d) No smoking signs
(e) Fire extinguishers (3) types: Carbon dioxide, halon, dry chemical
(f) Fire blanket
(g) First aid kit
(h) Eye wash
(i) Explosion proof fluorescent light
(j) Spill absorbent
(k) Spare caps: rubber, cork, etc
(l) Army knife
(m) Safety line
(n) Explosion proof flashlight
(o) Pipettes 10 ml (peroxide test)

Based on practical experience, actual items should be tailored to suit local circumstances.

14 Personal protective equipment (PPE) and other safety equipment are listed in Annex VI.
Annex VI

MINIMUM HEALTH AND SAFETY PROCEDURES, INCLUDING PERSONAL PROTECTIVE EQUIPMENT

Safety is a personal and institutional/management responsibility. Each individual must know what hazards are present and personnel must maintain constant vigilance for unsafe and potentially hazardous conditions. This Annex provides for minimum health and safety procedures that should be applied when chemicals are handled for disposal. It also summarizes the safety equipment recommended by most fire departments for different levels (A to D) of hazards.

Health and safety procedures

It is recognized that different situations will call for different safety procedures. These may include some or all of the following:

- 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

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, monogoggles
- 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)
- Hard hat with face shield

The following lists of PPE outline the best to worst case scenarios, with some examples of the type of equipment:

Level A. (highest level of protection; totally encapsulated)

This level ensures protection against highly corrosive and toxic materials, which have severe acute hazards by skin contact or by gas or vapour skin absorption. It is also recommended when materials are not identified or in a confined space. Level A safety equipment includes:
- Self contained breathing apparatus (SCBA)
- Fully encapsulated chemical resistant suits
- Chemical resistant gloves
- Chemical resistant safety boots
- Two-way radio communication
- Hard hat

**Level B.**
This level is usually used in clandestine laboratories in North America. It requires the highest level of respiratory protection, but the environment is not considered acutely toxic to skin contact or by gas or vapour skin absorption
- Full face piece SCBA
- Chemical resistant clothing
- Chemical resistant gloves
- Chemical resistant safety boots
- Hard hat
- Two way radio communication

**Level C.**
This level is used after all of the chemical hazards have been identified. The criteria for wearing respiratory protection is present and the environment is not considered to be toxic via skin contact. Equipment includes:
- 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, work function precludes splashes, and any potential for inhalation or contact with hazardous levels of chemicals.
- Coveralls
- Safety boots
- Safety glasses
- Hard hat
- Face mask

It is recognized that in many circumstances, level A-D protection may not be available. However, minimum safety precautions should always be employed. They include wearing safety glasses, rubber gloves, coveralls, and some type of filter mask.
Annex VII

SUGGESTED CONTENTS 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.

The suggested outline incorporates all elements of the present guidelines. Preferably, the training course should be designed in a modular way, so that tailored courses can be offered to different individuals and at different levels, focussing on the special needs and problems of those groups of individuals.

Suggested Outline

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

(b) Frequently encountered chemicals

(c) Properties and hazards of individual chemicals

(d) Clandestine laboratory sites (jungle laboratories vs. laboratories in urban settings)

(e) Hazard assessment of the area, possible booby traps

(f) Specific chemical dangers with the manufacture of specific drugs

(g) Safety procedures used in seizing chemicals and chemical drug laboratories

(h) Safety equipment used in seizing and processing seized chemicals

(i) Evidence collection and sampling

(j) Safe handling and storage of hazardous chemicals

(k) Transportation of dangerous goods

(l) Decontamination procedures

(m) Testing and chemical neutralization/treatment of chemicals (practical exercise):
   (i) Acids
   (ii) Bases
   (iii) Solvents
   (iv) Specific chemicals
      1. Organic solvents with flammability rating of 4 (e.g., ethyl ether)
      2. Potassium permanganate
      3. Acetic anhydride
      4. Cyanides

(n) Different types of disposal methods

(o) Potential in-country resources

(p) The role of the specialist

(q) 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 a minimum period of three years post training.
Annex VIII

MODEL SCENARIOS

Model scenario 1:
Seizure of 85, 55-gallon drums labelled phenyl-2-propanone 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 phenyl-2-propanone.
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 chemical company was contacted and arrangements were made to recycle the chemical.
   B. If that had not been possible, other options for disposal would have included to:
      ▪ Contact local manufacturing companies to try and recycle the chemical; or
      ▪ Contract a local waste disposal company for disposal.

Model scenario 2:
The seizure of 140 plastic containers (15 liters each) 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, Method 3.2 (page 31, above) was followed:
      ▪ 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.
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 area around 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. The 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 no waste hauler is available for transportation, and a local waste disposal company (i.e., an all-inclusive option, including transportation) is also not available, another option for disposal would have been to follow Method 3 (page 31, above):
      ▪ 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:
Model scenario 4: Cocaine processing (“jungle”) laboratories

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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.

1. 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. Containers should never be carried on the shoulder or leaning against the body when moved.

1.1 Neutralization of acids and bases
If conditions require on-site destruction, acids should be neutralized using the bases also found there.
- An excess of bases should be placed in a hole on the ground, to which a considerable quantity of water is then added (creating a kind of slurry).
- At the same time acids should be diluted in water, pouring the acid slowly into the water to avoid splashing (always add acid to water). Depending on the quantities, dilution of the acid can be carried out in 60-gallon drums.
- The diluted acid is then carefully poured into the alkaline slurry. Vapours will immediately begin to form. These vapours are toxic and should not be inhaled under any circumstances.
On contact with the base, the acid is neutralized, forming sulphate salts, which are less harmful to humans and to the environment.

It is important to remember that, when neutralizing acids an excess of alkaline bases is required and, if possible, the acid should first be diluted with water.

If ammonium hydroxide, or sodium or potassium hydroxide, or other basic solutions are found at the site, these should be added to the alkaline slurry in which the acid will be neutralized.

1.2 Disposal of combustibles
There are various disposal options for combustibles (e.g., solvents) encountered in coca paste laboratories. Destruction should be the least preferred option, considering that combustibles are vital for community development (transportation industry, food preparation, etc.). The possibility of utilizing them for the betterment of the community should be considered. If combustibles need to be destroyed, open air burning is suggested, if possible in the containers in which they were found. Do not burn more than thirty gallons of fuel in 60-gallon drums.

1.3 Destruction of drugs
Depending on where the drugs (finished or semi-finished basic cocaine paste) are found, on-site destruction, after evidentiary samples are taken, may be the only viable alternative. Burning: Seized drugs may be burnt with the combustibles, if that operation is carried out. Dilution: The drugs may also be mixed with the acids in the dilution process and then neutralized. In such cases, an excess of drug must never be added. If considerable quantities of harvested but unprocessed coca leaf are found, they may be destroyed when the combustibles are burnt.

1.4 Points to be considered
- Chemicals must never be disposed of by dumping into streams or water basins.
- The process of dismantling coca paste laboratories does not pose major risks since the quantities of chemicals found are usually small and are easy to neutralize.
- All personnel must use minimum safeguards, i.e., safety glasses, respiratory protection (masks or filters) and protective footwear and gloves when handling chemicals.
- No smoking or eating can be allowed the dismantling process.

2. 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.

2.1 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 that would be used in an actual industrial plant will be found in this area.

2.1.1 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.

2.1.2 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.

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

2.1.4 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.
Different chemicals must not be stored together as this may result in the formation of toxic gases, or cause explosions.

If the time needed to neutralize or solubilize the substances is available, the steps outlined above for coca paste laboratories should be followed. However, if it were necessary to destroy the complex using explosive charges, the operation should be carried out by specially trained personnel.

2.2 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.

2.3 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.

2.4 Chemical storage zone
This area in a production complex that poses the greatest risks. 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.

If substances are stored in enclosed premises, adequate ventilation must be ensured.