Hazardous Waste Management

TRANSFORMING THE WASTE PILLAR INTO ACTION

10th December, 2019
Webinar
for EHAN

Martin Guard
REACT

Outline of presentation

- Introduction
- Types of hazardous waste
- Physical, health and environmental hazards
- Appropriate storage and segregation of HAZMAT/wastes
- Examples of poor handling, storage and segregation of HAZMAT/wastes
- Improved supply change management – expired goods
- Incineration of specific hazardous wastes
- Autoclaving/sterilization
- Chemical disposal treatments
  - Dilution & neutralization
  - Alkaline hydrolysis
  - Required resources
- Alternative disposal treatments
  - Encapsulation, bulb crushers

Introduction

- Hazardous waste primarily results from ‘end of life” equipment or from expired or non-needed/despoiled products/chemicals/reagents – especially during liquidation/site closure
- Standard control systems are generally elaborated for UN facilities but often these are not well developed, poorly followed or enforced and not consistent between missions
- Systems for military/police contingents less defined and depends on contingent – often difficult to control
- Classified as hazardous wastes – the handling, storage, segregation and disposal treatments need to be done properly to avoid environmental and public health and safety impacts

Introduction contd.

- Problems often occur with poor storage and/or deteriorating containers/packaging and removed labels
- Hazmat/waste are often just stored at facilities and accumulated rather than undertaking ongoing disposal treatments
- Often not clear or simple as to how to dispose of the wider range of Hazardous materials within a mission/camp
- **Improved inventory,** better guidance, better training, ongoing systematic disposal & treatment, and introduction of more ‘take back’ schemes would help to resolve this problem.

Types of hazardous wastes at missions

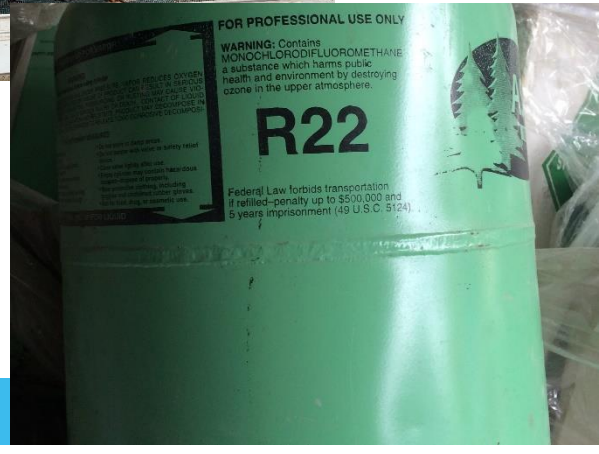
- **Hazardous components**
  - E-waste
  - Fluorescent light bulbs
  - Lead acid batteries
  - AC Gases
- **Biomedical wastes**
  - Infected wastes and sharps
  - Expired pharmaceuticals
- **Firing ranges**
  - Lead bullets/fragments
- **Water treatment/hospital disinfectants**
  - Calcium/Sodium hypochlorite (powder/liquid bleach)
  - Chlorine – various concentrations/ Trichloroisocyanuric acid
  - Sodium metabisulfite
  - Ortho-Phthalaldehyde
- **Water coagulants**
  - Aluminum sulfate
  - Ferric chloride
- **pH adjusters**
  - Sodium hydroxide
  - Calcium carbonate
  - Sodium carbonate
  - Sulfuric acid (car battery acid)
  - Sodium bisulfate
- **Scale Inhibitors and other acids**
  - Citric Acid
  - Phosphonic acid
  - Hydrochloric acid (muriatic)
- **Hach Lange Water testing reagents**
  - LCK reagents
- **Paints and Solvents**
  - Lead paint
  - Solvents
  - Wood preservatives (creosotes)
- **X-ray chemicals**
  - Developers and fixers
- **Waste Petroleum, oil, lubricants (POL)**
  - Contaminated soils

Types of pesticides

- Malathion - insecticide spraying
- Deltamethrin – insecticide fogging
- Dichlorvos - insecticide fogging, spraying (banned EU 1998)
- Cypermethrin – insecticide fogging
- Chloropyrfis – insecticide spraying
- Glyphosate – herbicide spraying
- Lamda-cyhalothrin – insecticide spraying

Physical, health and environmental hazards

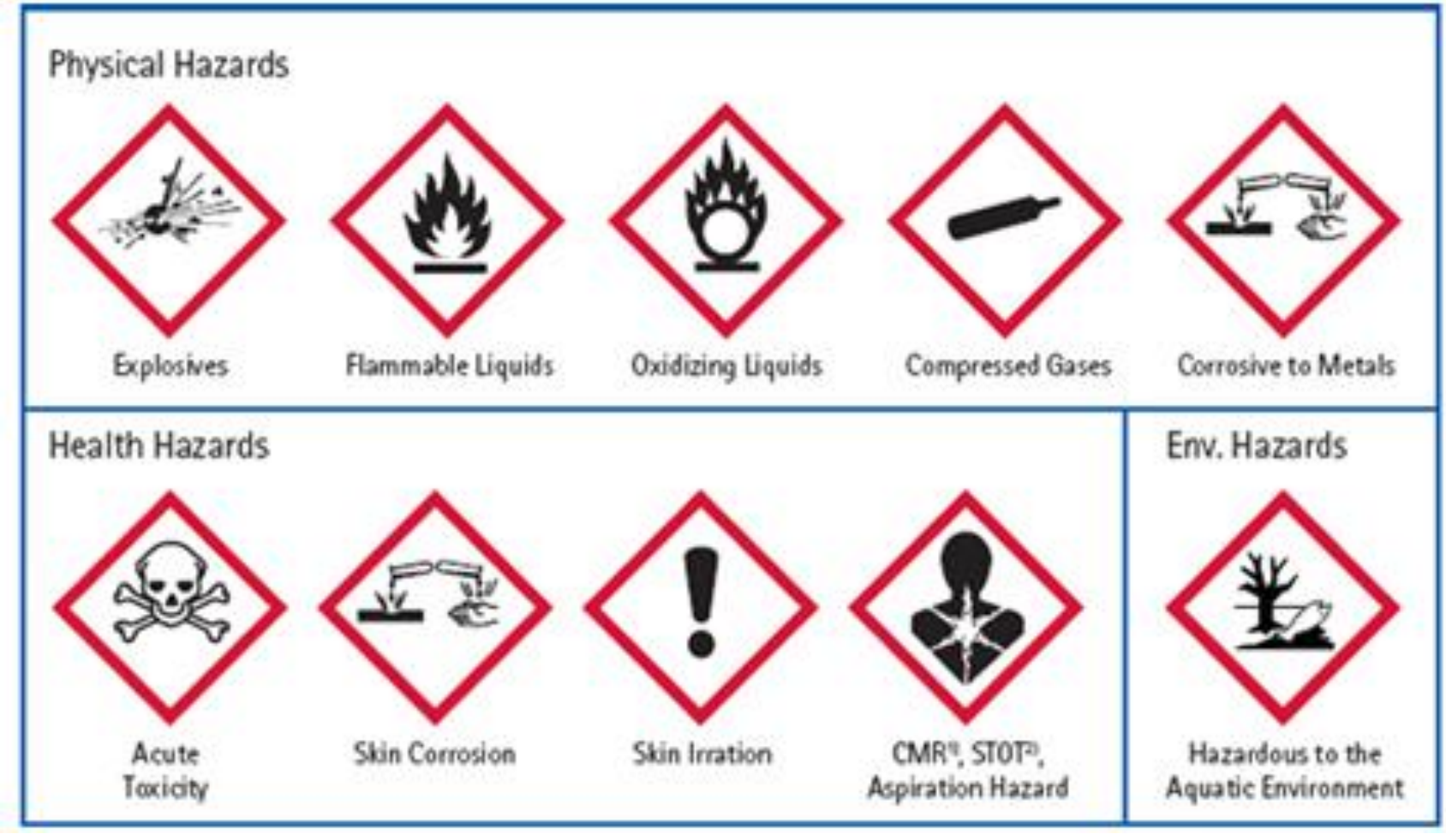
- **E-waste**
  - CRT screens – barium front and lead back, - toxic powders
  - Mercury switches – toxic metal/vapors
  - Brominated plastics – fire retardant – highly toxic dioxins
  - Various types of batteries – lead acid, alkaline and lithium – explosive and toxic electrolytes
- **Fluorescent tubes and bulbs** – mercury vapor
- **AC gases** – some found on missions are banned
  - CFC's, HCFC's - R11, R22 – lifetime 20-100 years when free chlorine atoms can destroy millions of molecules of Ozone
- **Lead bullets** – toxic soluble metal – standard 1200mg/kg soil



Physical, health and environmental hazards

The Globally Harmonized System (GHS)

The hazard categories are numbered from 1 to 5. The LOWER the number, the GREATER the severity of the hazard. So, category 1 hazards are the most dangerous.



Hazardous Materials Identification System (HMIS)

Material Safety Data Sheet
Nitric acid, 70% MSDS

Section 1: Chemical Product and Company Identification

Product Name: Nitric acid, 70%

Catalog Codes: SLN1963, SLN1549

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Water; Nitric acid, fuming

CI#: Not applicable.

Synonym: Nitric Acid, 70%

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Water	7732-18-5	30
Nitric acid, fuming	7697-37-2	70

Toxicological Data on Ingredients: Nitric acid, fuming: VAPOR (LC50): Acute: 244 ppm 0.5 hours [Rat]. 344 ppm 0.5 hours [Rat].

Section 3: Hazards Identification

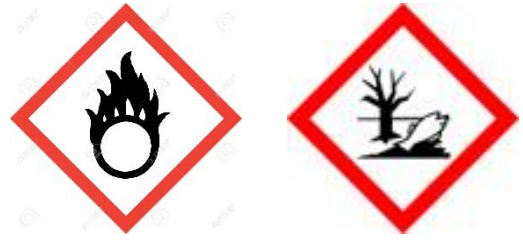
Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to lungs, mucous membranes, upper respiratory

p. 1

Physical, health and environmental hazards

- **Always examine labels and read the Materials Safety Data Sheet for each product**
  - Trichloroisocyanuric Acid (industrial disinfectant and bleaching agent) can affect you when inhaled and can. irritate and burn the skin and eyes
  - Is REACTIVE and a DANGEROUS EXPLOSION HAZARD. Not compatible with ammonia & calcium hypochlorite
  - Trichloroisocyanuric Acid is not combustible, but it is a STRONG OXIDIZER that enhances the combustion of other substances. Releases chlorine gas
  - Trichloroisocyanuric Acid is very toxic to aquatic organisms



Physical, health and environmental hazards

MSDS

- Sodium Carbonate can affect you when inhaled and can. irritate and burn the skin and eyes
- Reactive with acids. Slightly reactive to reactive with moisture
- Hygroscopic. Combines with water with evolution of heat

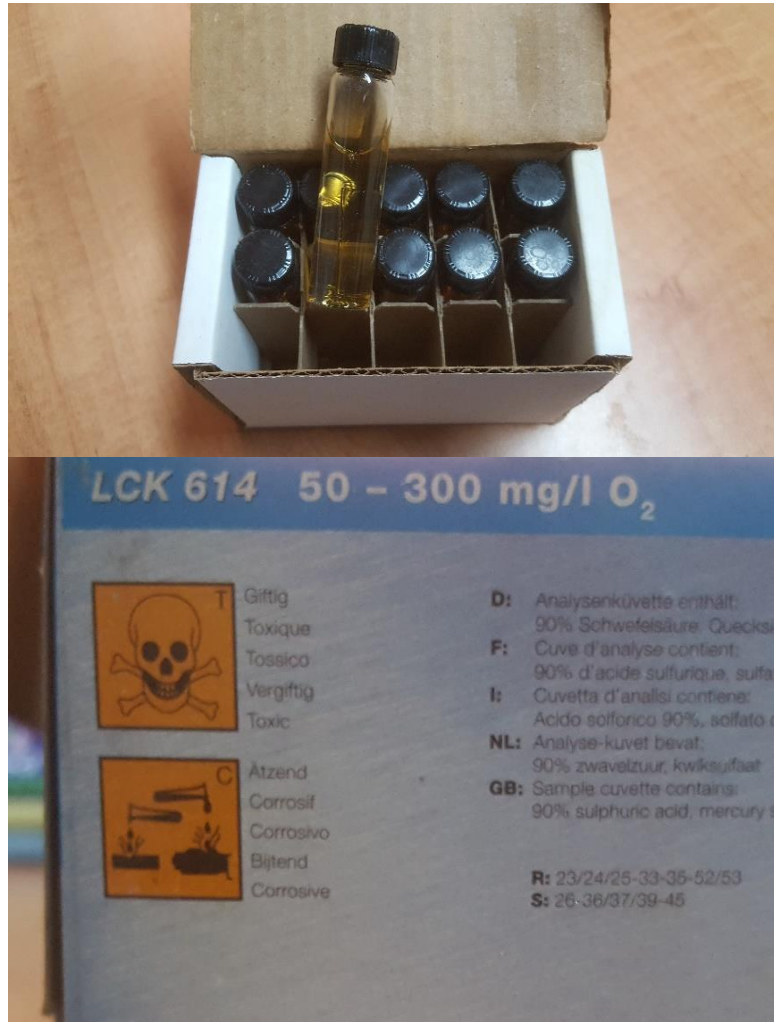
Physical, health and environmental hazards

- **MSDS**
  - Deltamethrin is neurotoxic to humans and very toxic to aquatic organisms
  - Avoid strong bases. Avoid reaction with oxidizing agents
  - Avoid all personal contact, including inhalation. Wear protective clothing when risk of exposure occurs

Physical, health and environmental hazards

- **MSDS**

  - LCK water reagents
  - Highly toxic to humans and the environments
  - Avoid all personal contact, including inhalation. Wear protective clothing when risk of exposure occurs
  - Recycling through takeback required



Appropriate storage and segregation of HAZMAT/wastes

Class or Subsidiary Risk		Flammable Gas	Non-Toxic Non-Flammable Gases	Toxic	Oxidizing Gas	Flammable Liquids	Flammable Solids	Spontaneously Combust	Dangerous When Wet	Oxidizing Agent	Organic Peroxide	Toxic Substance	Corrosive
	Flammable Gas	Suitable to store together	0m	3 m	3 m	3 m	3 m	3 m	3 m	Isolate	Isolate	3 m	3 m
	Non-Toxic Non-Flammable Gases	0m	0m	0m	0m	3 m	3 m	3 m	3 m	Isolate	Isolate	3 m	3 m
	Toxic	3 m	0m	May Not be compatible check SDS & notes	3 m	3 m	3 m	3 m	3 m	Isolate	Isolate	3 m	3 m
	Oxidizing Gas	3 m	0m	3 m	0m	3 m	3 m	3 m	3 m	Isolate	Isolate	3 m	3 m
	Flammable Liquids	3 m	3 m	3 m	3 m	0 m	3 m	3 m	3 m	Isolate	Isolate	3 m	3 m
	Flammable Solids	3 m	3 m	3 m	3 m	3 m	0 m	3 m	3 m	Isolate	Isolate	3 m	May Not be compatible check SDS & notes
	Spontaneously Combust	3 m	3 m	3 m	3 m	3 m	3 m	0 m	3 m	Isolate	Isolate	3 m	3 m
	Dangerous When Wet	3 m	3 m	3 m	3 m	3 m	3 m	3 m	0 m	Isolate	Isolate	3 m	3 m
	Oxidizing Agent #	Isolate	Isolate	Isolate	Isolate	Isolate	Isolate	Isolate	Isolate		Isolate	3 m	3 m
	Organic Peroxide	Isolate	Isolate	Isolate	Isolate	Isolate	Isolate	Isolate	Isolate	Isolate	0 m	Isolate	3 m
	Toxic Substance	3 m	3 m	3 m	3 m	3 m	3 m	3 m	3 m	3 m	Isolate	0 m	3 m
	Corrosive	3 m	3 m	3 m	3 m	3 m	May Not be compatible check SDS & notes	3 m	3 m	3 m	3 m	3 m	May Not be compatible check SDS & notes

Appropriate storage and segregation of HAZMAT/wastes

GUIDELINES

1. In all cases the manufacturers MSDS should be consulted
2. Combustible liquids shall be segregated in the same manner as Class 3 flammables
3. Do not store “Dangerous when wet” chemicals in areas with water suppression systems i.e. sprinklers

Contact with flammables or combustible substance causes vigorous oxidation reactions resulting in spontaneous heat production and possible fire/explosion

ISOLATE

This requirement refers to organic peroxides, for which dedicated stores or storage cabinets are recommended. Adequate separation from other laboratories/buildings/boundaries is required

SEGREGATE

May not be compatible with its own class. Refer to manufacturers MSDS.
A distance of >3-5m is required between chemical storage cabinets where the aggregate capacity is <250kg or L
If the aggregate capacity is >250kg or L cabinets must be 10m apart or have a fire rated wall in between them
For other Dangerous goods external to cabinets, the distance is measured from the edge of the spill catchment area. Consult MSDS from specifications

Examples of poor handling, storage and segregation of HAZMAT/wastes

- Sodium Metabisulfite with Chlorine on top of Citric acid
- Segregate from acids and oxidizers by minimum of 2m
- Store away from heat and moisture and protected from physical damage – container damage - Sulphur release eating away container
- Correct PPE used when handling
- MSDS sheets placed on product – not done!!
- Bunded concrete base
- Emergency response plan/spill kits available

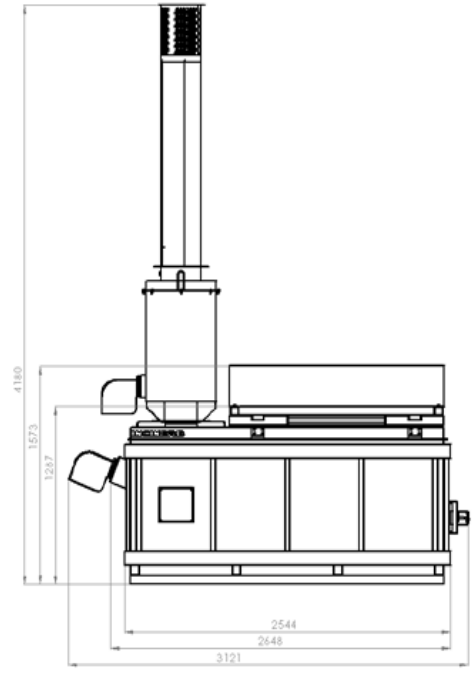
Examples of poor handling, storage and segregation of HAZMAT/wastes

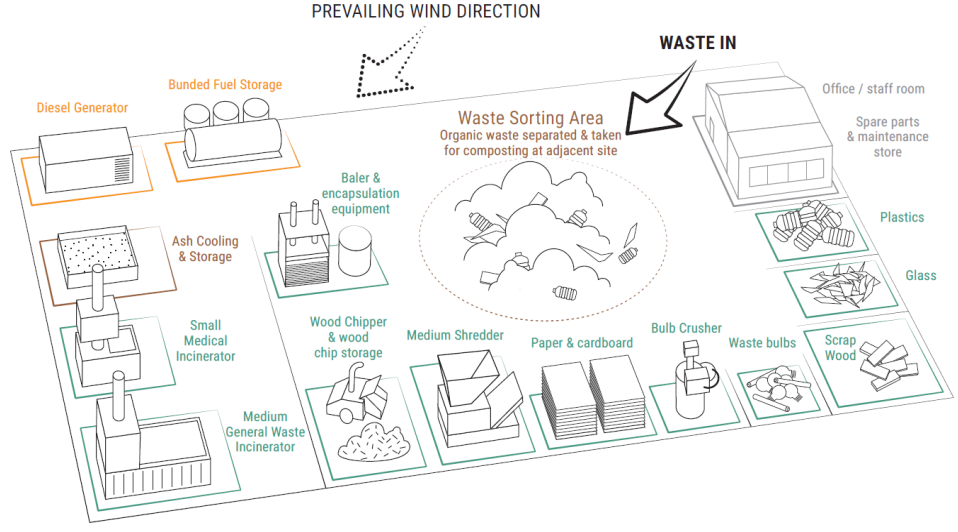
Improved supply change management – expired goods

- Oversupply of water treatment chemicals is a major problem in missions – especially chlorine products, alkaline/acid products but also pesticides
- Stockpiles accumulate due to expiration (but best before date! – some products to be used 5% more!!!)
- Often poorly stored with packaging failing
- Procured quantities for any specific product should be calculated to relate to actual usage rates combined with lifespan of the products (e.g. expiry dates). The latter information should be gained from the vendor prior to final purchase

Incineration of hazardous materials

- Certain hazardous materials may be incinerated;
  - High quality incineration unit
  - Oil filters (no more than two each burn cycle)
  - Small amounts of pesticide (after carefully soaking into cardboard/scrap paper)
  - Expired pharmaceuticals – in biomedical incinerator





Autoclaving/ Sterilization of hazardous materials

- Certain hazardous materials may be autoclaved, sterilized;
  - Autoclaving high heat but does not reduce volume
  - Sterilization – shreds materials and then uses heat x microwave or heat pressure destruction
  - Mainly for biomedical wastes

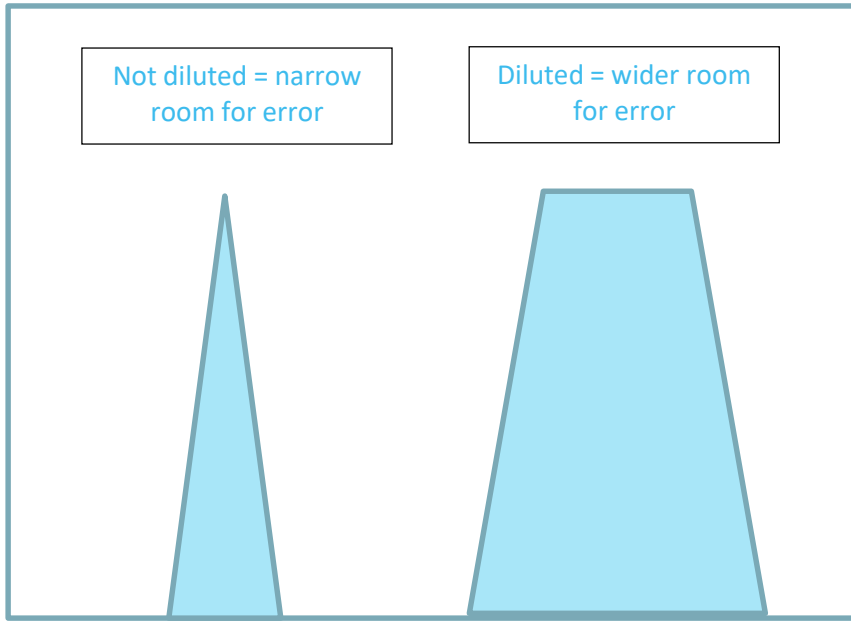
Disposal of e-wastes, AC gases, lead acid batteries

- **E-waste** must be processed through formal e-waste processing – not informal sector
- Requires proper verification of contractors capabilities – *e-waste assessment report 1*
- **Lead acid batteries** – dangers of lead pollution – these are not dealt with well
- **AC gases** – specialized recovery, reclaiming or destruction
- **Used Tyres** - danger of retreading, should not be landfilled as they come to the surface
- **Contractor verification** - needs to be improved

Chemical disposal treatments

Neutralization of alkaline or acid products

- Aim is to use one product to counter the extreme pH value of the other
  - Acid pH 1-6,
  - Neutral pH 7-8
  - Alkaline pH 9-14
- No dilution vs dilution
- No dilution more dangerous as any reaction is greater between the chemicals
- Dilution enables adequate buffering for error and less extreme reactions when mixing



Chemical disposal treatments

Neutralization of alkaline or acid products

- Dilution 10-20:1 first by adding product to water – not other way round – highly dangerous
- Can produce both a high heat reaction and release of toxic gases as product added- conduct it slowly
- Once diluted – further addition of alkaline or acid product to adjust pH to between 6.5-7.5
- Be careful not to use too much
- Once pH adjusted can disperse solution onto tarmac/ concrete surface for evaporation

Chemical disposal treatments

Alkaline hydrolysis of pesticides

- Dilution 20:1 first by adding product to water
- Once diluted –addition of alkaline product to adjust pH to between 10- 12 - decomposition of the active ingredient will take place (time dependent on product e.g Malathion 3 days, Deltramethrin 7 days)
- Thereafter the solution should be neutralized using the addition of an acid to bring the pH level to between 7-8.5
- Once pH adjusted can disperse solution onto tarmac/ concrete surface for evaporation
- All plastic containers should be tripled rinsed and then shredded or crushed to prevent their re-use

Chemical disposal treatments

Resources required

- Sufficient space for the dilution and alkaline hydrolysis procedure
- A working pH meter
- Appropriate sized water tank for the treatment and water supply
- 1 large plastic scoop to add alkaline material
- Acid product for neutralization

Chemical disposal treatments

Resources required

- **PPE** consisting of safety boots, disposable overalls, disposable rubber gloves, cartridge filter masks, safety goggles and eyewash kits.

Color Coding for 3M™ Chemical Cartridges		
6001	Organic Vapor	Black
6002	Acid Gases	White
6003	Organic Vapor/Acid Gases	Yellow
6004	Ammonia/Methylamine	Green
6005	Formaldehyde/Organic Vapor	Olive/Black
6006	Multi-Gas/Vapor	Olive
6009	Mercury Vapor/Chlorine Gas	Orange

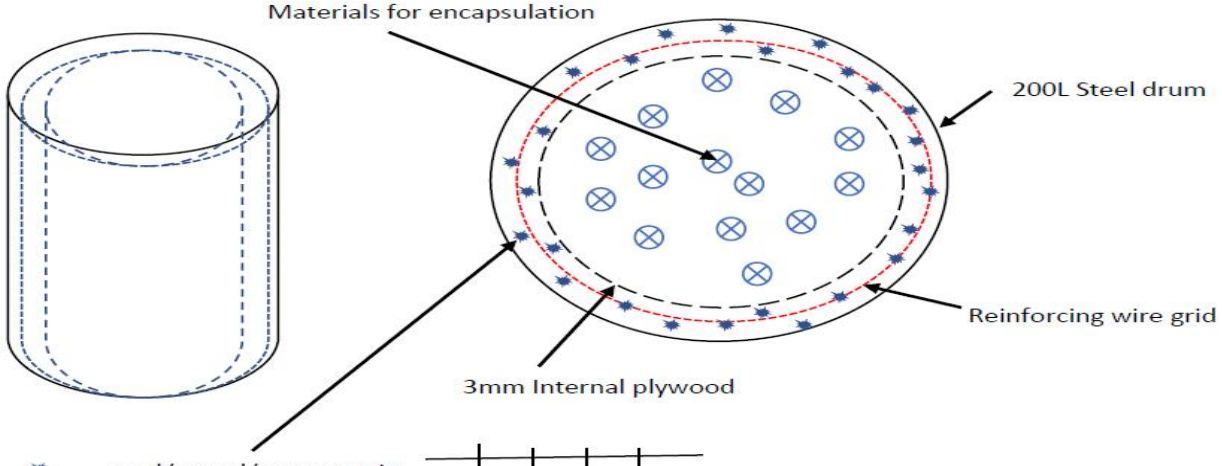
Alternative disposal treatments

Encapsulation

- Mixing cement, sand gravel to encapsulate the material
- Used for small amounts of liquid/powder chemicals/biomedical waste ash
- Can use sand soaks to take up the liquid prior to mixing with the cement slurry
- Some form of mould should be used- double buckets or steel drums
- In MINUSTAH concrete culverts were used

Alternative disposal treatments

Encapsulation



Alternative disposal treatments

Bulb crushers

https://www.youtube.com/watch?v=QOQU5w2YILE

Information on appropriate storage and disposal treatments

- Many advice notes on chemical treatments developed by REACT
- Many online sources
- Storage - http://www.lboro.ac.uk/media/wwwlboroacuk/content/healthandsafety/downloads/LU%20Chemical%20StorageJuly2017.pdf
- Storage - http://www.hsa.ie/eng/Publications_and_Forms/Publications/Chemical_and_Hazardous_Substances/Storage_of_Hazardous_Chemicals_in_Warehouses_and_Drum_Stores.pdf