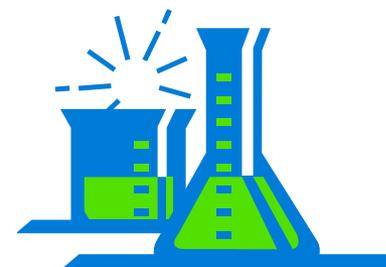
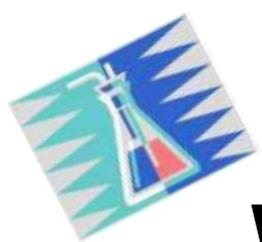


Waste Management and Disposal

- ***Nonhazardous waste***
- ***General guidelines- Storage - Packaging***
- ***Special categories***
 - ***Metal waste***
 - ***Radioactive and mixed waste***
 - ***Biological waste***
 - ***Unknown and orphan waste***
- ***Treat on-site***

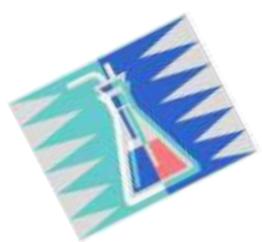




Waste management: nonhazardous waste

- ***Used oil (uncontaminated) is not considered hazardous waste. Label Containers "USED OIL", not "hazardous waste."***
- ***Uncontaminated PPE (gloves, wipes)***
- ***Triply rinsed glassware (bottles, droppers, pipettes)***
- ***Salts (KCl , $NaCl$, Na_2CO_3)***
- ***Sugars - Amino acids***
- ***Inert materials (uncontaminated resins and gels)***

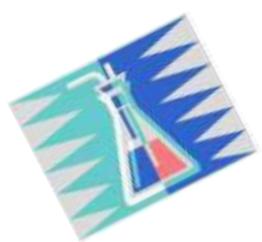




Waste management: General guidelines

- Secure and lock waste storage area
- Post signs to warn others
- Keep area well ventilated
- Provide fire extinguishers and alarms, spill kits
- Provide suitable PPE
- Provide eye wash, safety showers
- Do not work alone

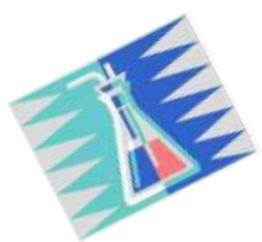




Waste management: General guidelines

- Insure against leakage; dyke area if possible
- Label all chemicals, containers, vials
- Separate incompatible chemicals
- Keep gas cylinders separate
- Keep radioactive material separate
- Know how long waste can be stored
- Provide for timely pick-up

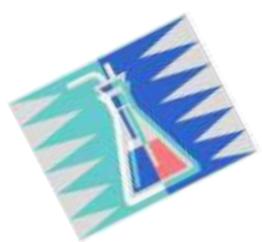




Waste - Storage guidance

- *Container should not react with the waste being stored (e.g. no hydrofluoric acid in glass).*
- *Similar wastes may be mixed if they are compatible*
- *Whenever possible, **wastes from incompatible hazard classes should not be mixed** (e.g. organic solvents with oxidizers).*
- *Containers must be kept closed except during actual transfers. Do not leave a funnel in a hazardous waste container.*
- ***Chemical containers that have been triple-rinsed and air-dried in a ventilated area can be placed in the trash or recycled.***





Waste – General guidance

Certain metals cause disposal problems when mixed with flammable liquids or other organic liquids

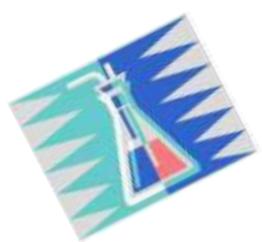
Pressure can build up in a waste vessel

Corrosion can occur in storage vessel

Secondary containment is necessary

Glass waste containers can break



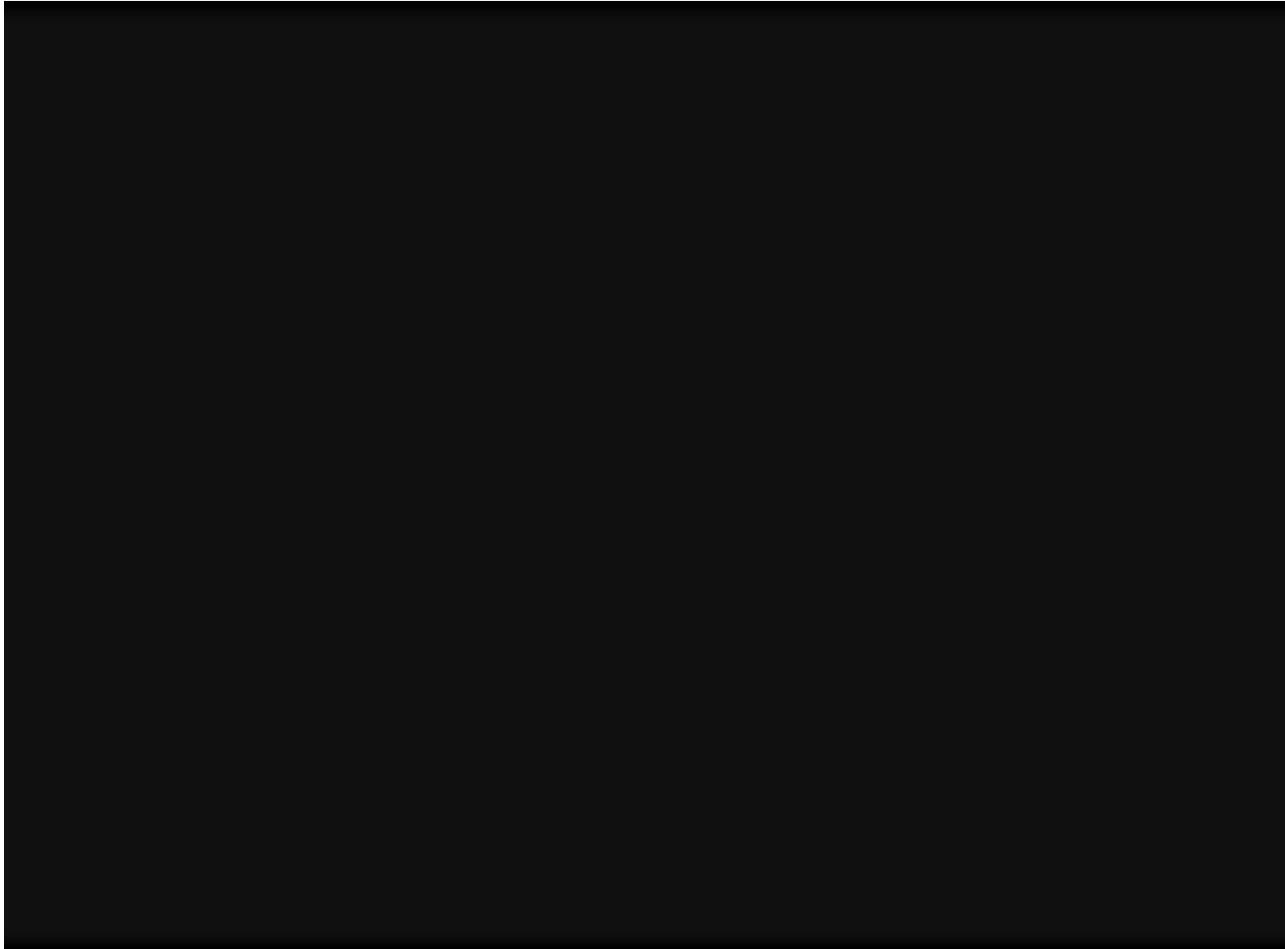


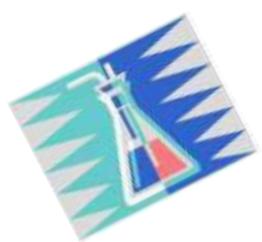
Dangerous waste management





Video – Fire at Apex Waste Facility





Best practice – Orphan control

Before moving to new job meet with new lab occupant

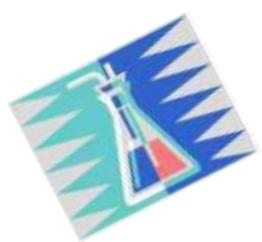
- ***This can be a new employee or new student***
- ***Label all chemicals and samples carefully***
- ***Make notations in common lab book***

Dispose of all unneeded or excess chemicals

- ***Put into chemical exchange program***
- ***Dispose of as hazardous waste***



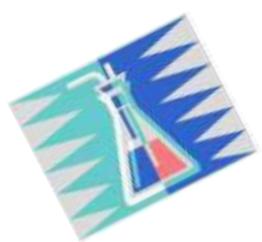
Do not leave any chemicals behind except by agreement



Waste management

- **Recycle, reuse, redistill, if possible**
- **Dispose by incineration, if possible**
- **Incineration is NOT the same as open burning**





Chemical recycling

Reuse by others in the organization or community

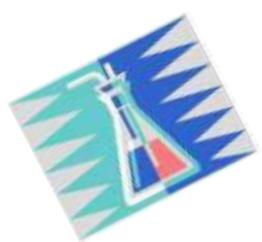
An active chemical exchange program

Beware of accepting unusable chemicals

Reuse in experiments in the laboratory

Exchange for credit with suppliers by agreement

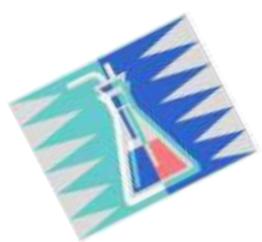




What should not be recycled

- ***Gas cylinders past their pressure testing date***
- ***Used disposable pipettes and syringes***
- ***Chemicals and assay kits past their expiration***
- ***Obviously degraded chemicals***
- ***Used tubing, gloves and wipes***
- ***Others?***

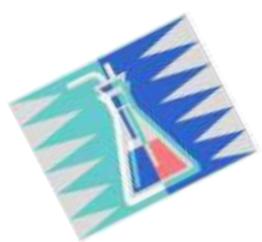




What should be recycled or redistributed?

- *Excess unopened chemicals*
- *Excess laboratory glassware (unused or clean)*
- *Consumables with no expiration*
- *Solvent that can be purified*
 - *Lower purity suitable for secondary use?*
- *Precious or toxic metals*
 - *Hg, Ag, Pt, Pd, Au, Os, Ir, Rh, Ru*
- *Others?*



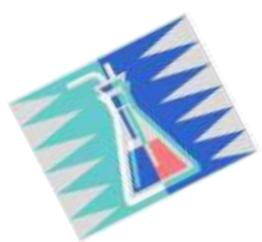


Laboratory wastes are packaged in small containers

Lab packs consists of small containers of compatible waste, packed in absorbent materials.

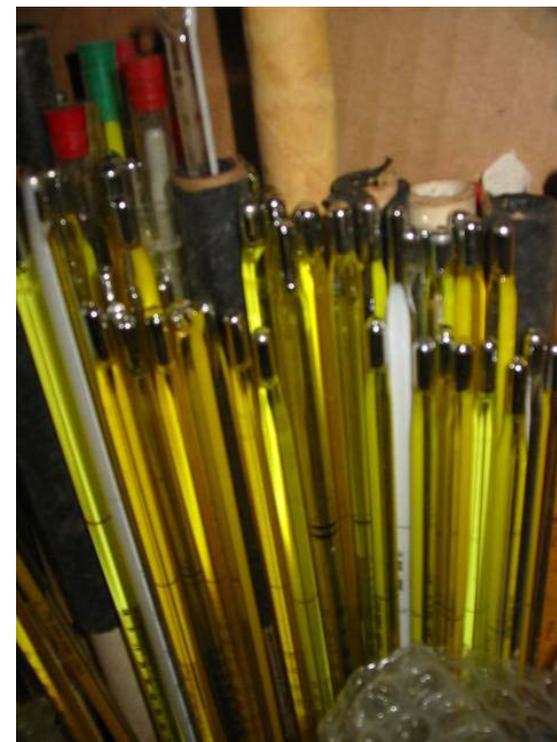


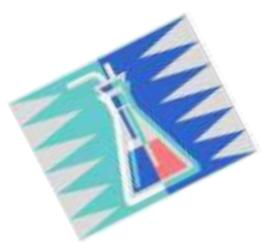
Lab packs segregated at hazardous waste facility



Mercury metal disposal

- **Collect pure liquid mercury in a sealable container. Label as "MERCURY FOR RECLAMATION"**
- **Place broken thermometers and mercury debris in a sturdy sealable plastic bag, plastic or glass jar. Label the container "Hazardous Waste - MERCURY SPILL DEBRIS".**
- **Never use a regular vacuum to clean up a mercury spill - contaminates vacuum, heat evaporates the mercury**
- **Never use a broom to clean up mercury – spreads smaller beads - contaminates the broom.**





Unknown “orphan” waste

Avoid if at all possible -- requires analysis before disposal!

Pre-screen

Crystals present ? (potential peroxide formation)

Radioactive (Geiger counter)

Bio waste? (interview history)

Screen

Prepare for the worst – wear gloves-goggles-hood

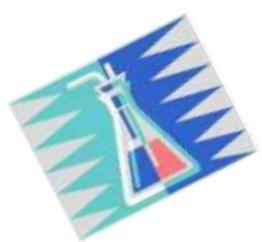
Air reactivity

Water reactivity

Flammability

Corrosivity





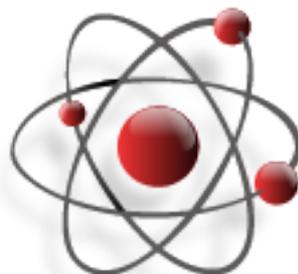
Unknown waste characterization*

Physical description - Water reactivity - Water solubility

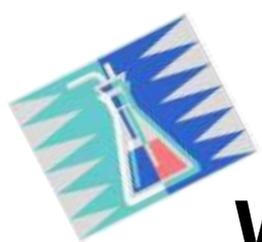
pH and neutralization information

Presence of:

- ✓ ***Oxidizer***
- ✓ ***Sulfides or cyanides***
- ✓ ***Halogens***
- ✓ ***Radioactive materials***
- ✓ ***Biohazards***
- ✓ ***Toxics***



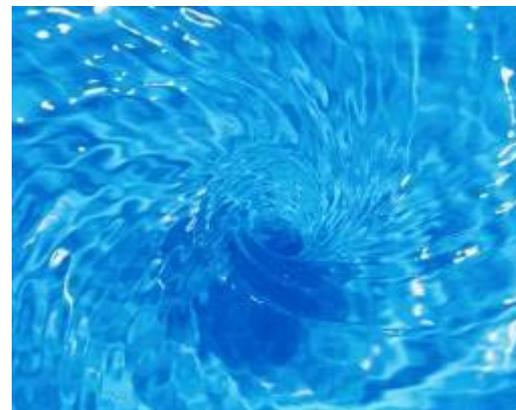
****Prudent Practices in the Laboratory: Handling and Disposal of Chemicals,” National Academy Press, 1995 Section 7.B.1***

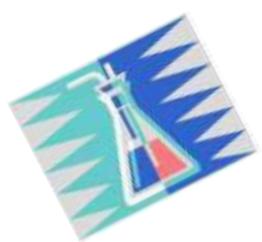


Waste management: Down the drain?

If legally allowed:

- Deactivate & neutralize some liquid wastes yourself
 - e.g., acids & bases
 - Don't corrode drain pipes
- Dilute with lots of water while pouring down the drain
- Be sure that you do not form more hazardous substances
 - Check reference books, scientific literature, internet





Treating on site – volume reduction

Evaporation – if not excessive

- ***Roto evaporation for recovery***
- ***Do not evaporate corrosives or radioactives***
- ***Only in laboratory hood***
- ***Beware toxics and flammables***



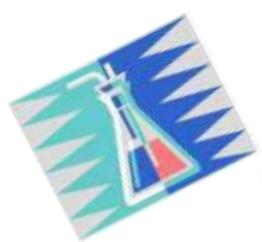
Adsorption

- ***Activated carbon***
- ***Ion exchange resin***
- ***Activated alumina***



Precipitation - Extraction

Handbook of Laboratory Waste Disposal, Martin Pitt and Eva Pitt, 1986. ISBN 0-85312-634-8



Treating on site – chemical conversion

Requires chemical expertise - may not be allowed by regulations - specific to each chemical

Dilution to reduce hazard

- H_2O_2 , $HClO_4$, HNO_3
- ***Never add water to concentrated acid***
- ***Neutralization acid base -gentle***

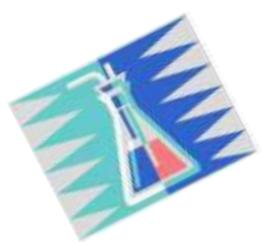
Hydrolysis (acid and base)

- ***Active halogen compounds with NaOH***
- ***Carboxamides with HCl***

Oxidation-reduction



Handbook of Laboratory Waste Disposal, Martin Pitt and Eva Pitt, 1986. ISBN 0-85312-634-8

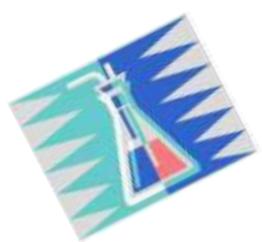


Emissions from incineration vs. open burning

	Open Burn ($\mu\text{g}/\text{kg}$)	Municipal Waste Incinerator ($\mu\text{g}/\text{kg}$)
PCDDs	38	0.002
PCDFs	6	0.002
Chlorobenzenes	424150	1.2
PAHs	66035	17
VOCs	4277500	1.2



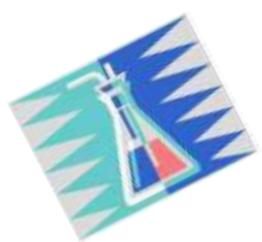
Source: EPA/600/SR-97/134 March 1998



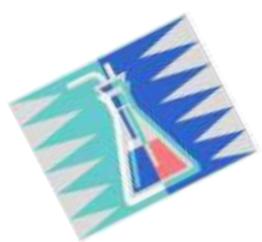
Waste management: Waste disposal service

- Is disposal service licensed?
- How will waste be transported?
- How will waste be packaged?
- Where will material be disposed?
- How will it be disposed?
- Maintain written records

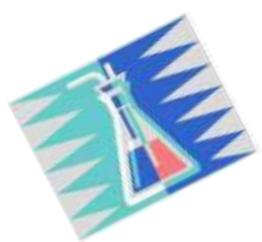




Class Discussion –Waste management



Class Discussion –Next Steps



Exam and workshop evaluation form

- Exam
- Please help us improve this workshop by filling out and returning this form.

