Practical Chemistry

HazMat ID for HHW Personnel

Josh Prouty

1

What is Hazardous?

Hazardous materials generally have one or more properties that make them hazardous.

- Flammable or Combustible
- Corrosives (Acidic or Alkaline)
- Reactive (Fumes or Heat when mixed)
- Toxic (Poisonous to humans or animal life)

Not all labels are created equal and product could still meet definition of hazardous.

- Non-toxic- Could still be flammable i.e. hand santizer or corrosive i.e. vinegar cleaner.
- Biodegradble- Likely to be corrosive, many lye-based drain cleaners are biodegradble.
- Organic- Could be toxic i.e. copper based fungicide used in organic farming.
- When in doubt look at SDS for active ingredients.

2

2

Packaging Identification

What's in a bottle

3

3

Packaging Types

- Packaging can reveal a lot about the physical properties even without a label.
- Oil-Based Paints will not likely be found in plastic containers due to solvents eating the container. Key Words: Combustible, Oil-based, Solvent, Alkyd)

Water-based paint can be in either plastic or metal containers. Key words: Latex, Acrylic, Water-based, or water clean up When in doubt assume its hazardous i.e. oil-based.

4

4

Corrosives

- Strong Corrosives are sometimes in color coded glass or plastic bottles.
- Typically they are in distinctive containers that are similar regardless of the brand.
- Cleaners of all types are typically either a solvent (flammable or a corrosive

Acids-Mostly Red Cap

Alkaline- Blue Cap

5

Cleaners

- Rust, lime, and calcium removers are typically a Mild Acid because minerals naturally dissolve in acids.
- All Purpose, Bathroom, and Kitchen Cleaners are typically a Mild Alkaline solutions which foam/bubble when shaken.

Mild Acid

Mild Alkaline

6

6

Oxidizers

- Some oxidizers can also be identified by their package.

Liquid Pool Chlorine often comes in this distinctive yellow container with the active ingredient being Sodium Hypochlorite >10%.

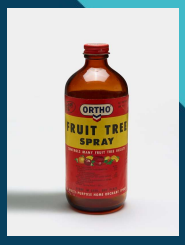
Many solid oxidizers (pool shock tabs) come in these distinctive containers with ratchet or safety top lids. Non-Chlorine Bleach like Oxiclean, also come in a distinctive laundry detergent style cleaner.

7

7

Poisons

- Some poisons can be identified by their distinctive packaging or cap.



Hydramethalnon (Amdro) is unique in using this shaker top plastic container.

Chevron/Ortho pioneered the use of this yellow cap in a brown bottle for their pesticide line that is now used by many others.
The brown glass moonshine style bottle is also a good indicator that this is likely an old pesticide

8

8

Petroleum, Oil, and Lubricants (POL)

Many automotive products (POL) can be identified by their distinctive packaging or appearance

Antifreeze will often be in these type of 1-gallon jugs with a safety cap. Fluid will also be dyed a bright color like orange, green, red, or yellow.

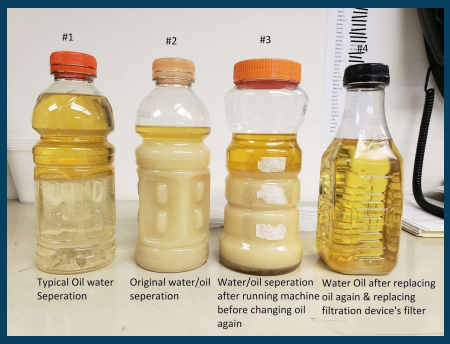
Oil products will often be in these distinctive 1 or 5 qt or even 1pt containers.

9

9

Petroleum Oil and Lubricants (POL) Continued

Many automotive products (POL) can be identified by their distinctive packaging or appearance



Water contaminated oil will often have a mayonnaise type appearance due to forming an emulsion.

Dirty antifreeze can vary in color and consistency depending on contamination

10

10

Battery by shape and type

Ni-MH (Nickel Metal Hydride)

Nickel Metal Hydride performs well in high drain devices and can be recharged up to 1,000 times. It's cadmium-free, but can be pricey.

Ni-MH batteries can typically be found in cordless power tools, digital cameras, two-way radios and cordless phones.

Ni-Cd (Nickel Cadmium)

Nickel Cadmium is the least expensive of secondary/rechargeable batteries, and can be recharged up to 1,000 times. Cadmium can be toxic to the environment and should be recycled.

Ni-Cd can typically be found in cordless power tools, digital cameras, two-way radios and cordless phones.

SSLA/Pb (Small Sealed Lead Acid)

Small Sealed Lead Acid (SSLA/Pb) batteries are simple to manufacture and have one of the lowest discharge rates of any rechargeable battery.

SSLA/Pb can typically be found in emergency devices, emergency exit signs, security systems, mobility scooters and UPS back-ups.

11

11

Batteries Continued

Li-Ion (Lithium Ion)

Lithium Ion has excellent performance in high drain devices, though it can be considered expensive.

Li-Ion can typically be found in cell phones, laptops, two-way radios, and cordless power tools.

Primary/Single Use

Primary/Single-Use batteries cannot be recharged and must be disposed of once they wear out. Alkaline, lithium, silver oxide, zinc-air, zinc-carbon, and zinc-chloride, commonly known as AA, AAA, 9V, D-cell, and button cell are all types of primary batteries.

Primary/Single-Use batteries are most commonly used in low-drain devices, such as flashlights, clocks, watches, remote controls, and smoke detectors.

NiMH Cells from hybrid cars

Wet Cell NiCad- These are specialty batteries that are used in the aerospace industry and require special handling with only a few recyclers accept them.

12

12

Label Identification

What's in a name

13

13

Chemistry Systematic Naming Functional Groups

Systematic Naming

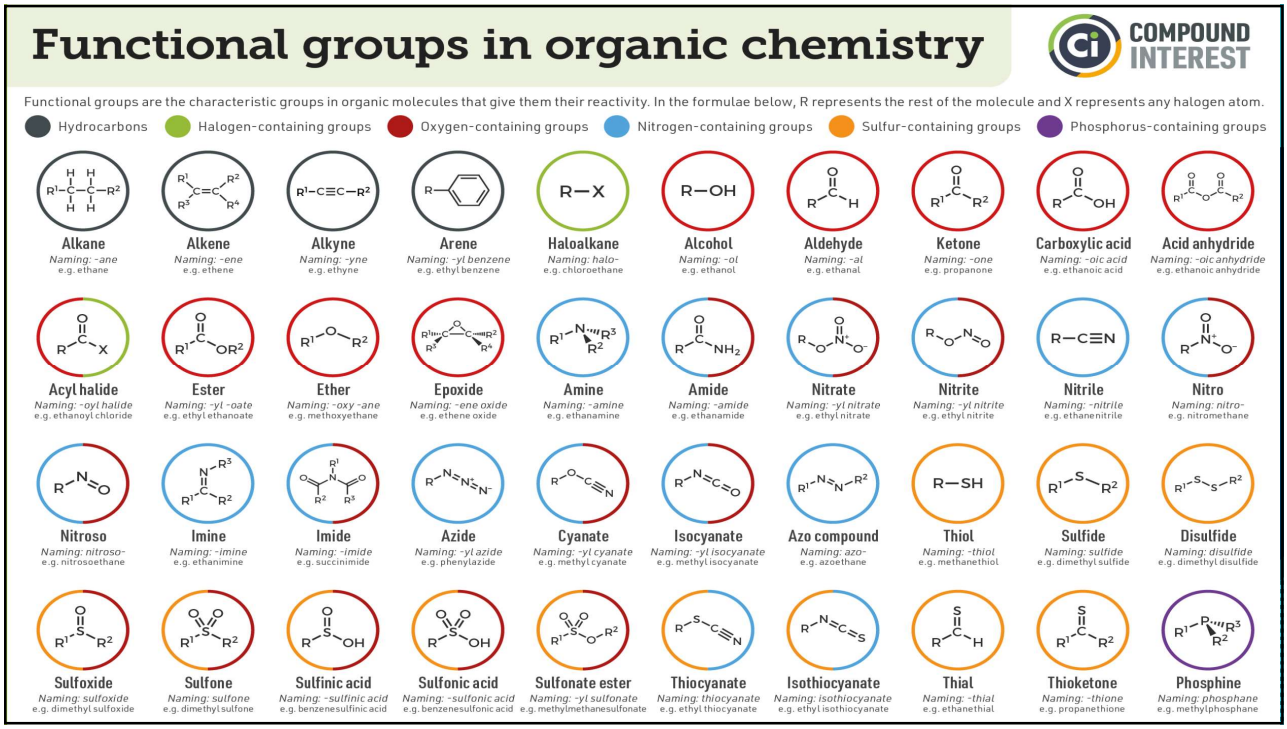
- Organic chemistry uses a naming system of prefixes and suffixes that can help identify the makeup of a chemical.
- Prefixes are typically number-based. Mono/Un=1, Di/Bi=2, Tri/Pro/Tert=3, Quad/Bu/Tetra=4, etc.
- Suffixes typically identify the functional group. –ol=Alcohols, -ene=Alkene
- Inorganic Chemistry suffixes indicate functional group or oxidation state.
- -ide=binary compounds NaCl, KI, HCl, etc.
- -ite=1-2 oxygen atoms on ion NaHClO hypocholorite, NaHClO2 chlorite
- -ate=3-4 oxygen atoms MgClO3 chlorate, K2CrO4 chromate, NaClO4

Functional Groups

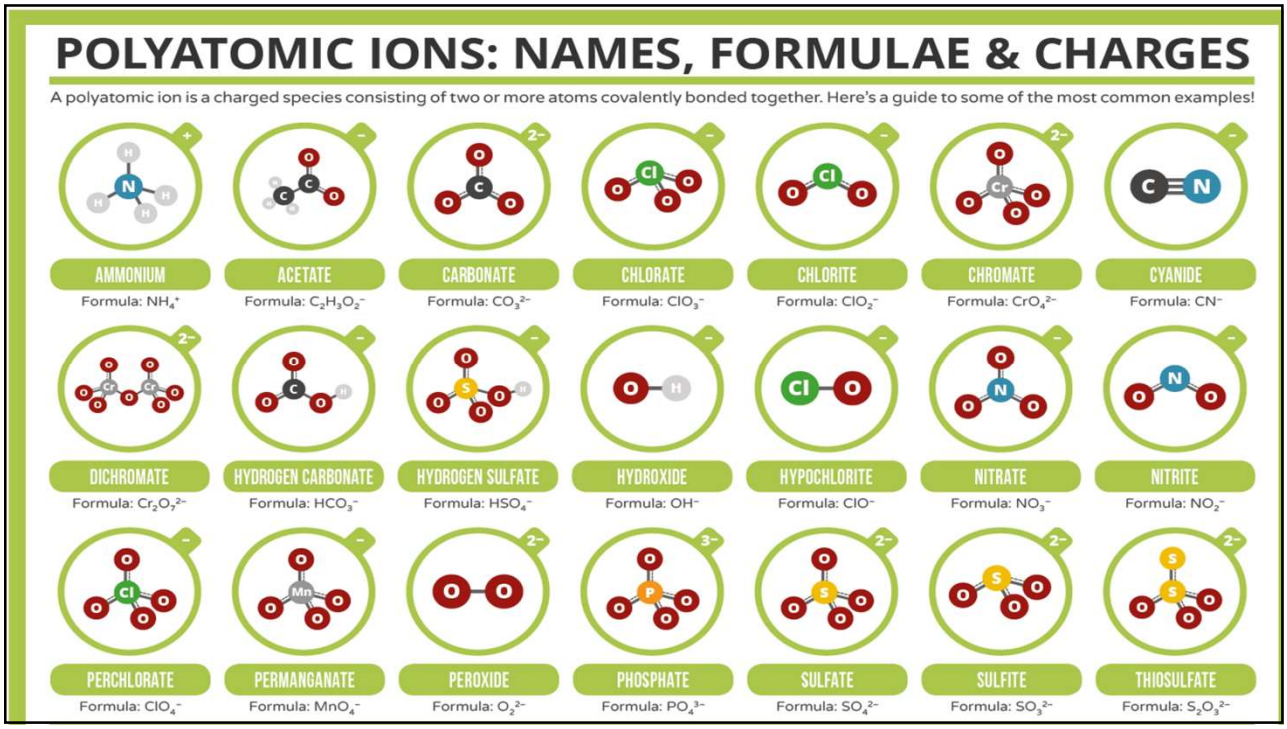
- Functional groups can be considered classes of chemicals that share common properties useful to haz mat identification.
- A knowledge of the most common functional groups and their suffixes can allow you to identify properties of an unknown chemical just from the name.
- Ex. Isopropanol= ISO=Isomer or non standard form, Propan= 3 carbon chain, -ol=alcohol. A 3 carbon alcohol in a non standard formation.

14

14


Functional groups in organic chemistry
COMPOUND INTEREST
Functional groups are the characteristic groups in organic molecules that give them their reactivity. In the formulae below, R represents the rest of the molecule and X represents any halogen atom.
Hydrocarbons
Halogen-containing groups
Oxygen-containing groups
Nitrogen-containing groups
Sulfur-containing groups
Phosphorus-containing groups
Alkane
Naming: -ane
e.g. ethane
Alkene
Naming: -ene
e.g. ethene
Alkyne
Naming: -yne
e.g. ethyne
Arene
Naming: -yl benzene
e.g. ethyl benzene
Haloalkane
Naming: halo-
e.g. chloroethane
Alcohol
Naming: -ol
e.g. ethanol
Aldehyde
Naming: -al
e.g. ethanal
Ketone
Naming: -one
e.g. propanone
Carboxylic acid
Naming: -oic acid
e.g. ethanoic acid
Acid anhydride
Naming: -oic anhydride
e.g. ethanoic anhydride
Acyl halide
Naming: -oyl halide
e.g. ethanoyl chloride
Ester
Naming: -yl -oate
e.g. ethyl ethanoate
Ether
Naming: -oxy -ane
e.g. methoxyethane
Epoxide
Naming: -ene oxide
e.g. ethene oxide
Amine
Naming: -amine
e.g. ethanamine
Amide
Naming: -amide
e.g. ethanamide
Nitrate
Naming: -yl nitrate
e.g. ethyl nitrate
Nitrite
Naming: -yl nitrite
e.g. ethyl nitrite
Nitrile
Naming: -nitrile
e.g. ethanenitrile
Nitro
Naming: nitro-
e.g. nitromethane
Nitroso
Naming: nitroso-
e.g. nitrosoethane
Imine
Naming: -imine
e.g. ethanimine
Imide
Naming: -imide
e.g. succinimide
Azide
Naming: -yl azide
e.g. phenylazide
Cyanate
Naming: -yl cyanate
e.g. methyl cyanate
Isocyanate
Naming: -yl isocyanate
e.g. methyl isocyanate
Azo compound
Naming: azo-
e.g. azoethane
Thiol
Naming: -thiol
e.g. methanethiol
Sulfide
Naming: sulfide
e.g. dimethyl sulfide
Disulfide
Naming: disulfide
e.g. dimethyl disulfide
Sulfoxide
Naming: sulfoxide
e.g. dimethyl sulfoxide
Sulfone
Naming: sulfone
e.g. dimethyl sulfone
Sulfinic acid
Naming: -sulfinic acid
e.g. benzenesulfinic acid
Sulfonic acid
Naming: -sulfonic acid
e.g. benzenesulfonic acid
Sulfonate ester
Naming: -yl sulfonate
e.g. methylmethanesulfonate
Thiocyanate
Naming: thiocyanate
e.g. ethyl thiocyanate
Isothiocyanate
Naming: isothiocyanate
e.g. ethyl isothiocyanate
Thial
Naming: -thial
e.g. ethanethial
Thioketone
Naming: -thione
e.g. propanethione
Phosphine
Naming: phosphane
e.g. methylphosphane

15


POLYATOMIC IONS: NAMES, FORMULAE & CHARGES
A polyatomic ion is a charged species consisting of two or more atoms covalently bonded together. Here's a guide to some of the most common examples!
AMMONIUM
Formula: NH4+
ACETATE
Formula: C2H3O2−
CARBONATE
Formula: CO3 2−
CHLORATE
Formula: ClO3−
CHLORITE
Formula: ClO2−
CHROMATE
Formula: CrO4 2−
CYANIDE
Formula: CN−
DICHROMATE
Formula: Cr2O7 2−
HYDROGEN CARBONATE
Formula: HCO3−
HYDROGEN SULFATE
Formula: HSO4−
HYDROXIDE
Formula: OH−
HYPOCHLORITE
Formula: ClO−
NITRATE
Formula: NO3−
NITRITE
Formula: NO2−
PERCHLORATE
Formula: ClO4−
PERMANGANATE
Formula: MnO4−
PEROXIDE
Formula: O2 2−
PHOSPHATE
Formula: PO4 3−
SULFATE
Formula: SO4 2−
SULFITE
Formula: SO3 2−
THIOSULFATE
Formula: S2O3 2−

16

Properties of Functional Groups

Flammable Functional Groups

Common Strongly Flammable Functional Groups

- Alkanes –ane
- Alkene –ene
- Alkyne –yne
- Alkyd- a type of polyester (***al***cohol + organic a***cid***)
- Alcohol –ol, glycol/diol (2 alcohol groups), glycerin/glycerol (3 alcohol groups)
- Ethers –ether i.e. Dimethyl ether
- Ketone –one
- Haloalkane- ie. Chloromethane, Chloroform

Corrosive Functional Groups

Common functional groups that are acidic or basic

- Carboxylic acid –oic acid
- Amine –amine
- Amide –amide
- Aldehyde- al (ex. propanal)

17

17

Properties of Functional Groups

Reactive Functional Groups

Common Reactive Functional Groups

- Aldehyde –al or aldehyde
- Ether –ether
- Cyclic Ether –Tetrahydrofuran, or oxolane

Nitrogen containing compounds are often reactive

- Nitrate –nitrate NO3
- Nitrite –nitrite N02
- Isocyanate –isocyanate Potassium Isocyanate(KNCO)
- Fulminate Potassium Fulminate(KCNO)
- Azide –azide Sodium Azide (NaN3)
- Amine –amine NH3
- Amide -amide

Toxic Functional Groups

Common functional groups that are toxic and could release fumes.

- Cyanides
- Cyanates Potassium Cyanate (KOCN)
- Dioxins
- Arsenate
- Haloalkane - Choloroform

18

18

Common Pesticides and Naming

Pesticides is the generic term for all substances that are meant to be toxic when applied to a pest species, weed, or other organism.

Common Pesticides

- DDT (banned)
- Deet
- Permethrin
- Carbaryl (currently being relabeled)
- Lindane (banned)
- Chlordane (banned)
- Nicotine
- Bifenthrin
- Pyrethrins
- Chlorpyrifos (banned 2021)
- Malathion
- Zinc Phosphide
- Arsenic baits

Common Herbicides

- 2-4-D
- 2-4-5-T (banned)
- Glyphosate
- Triclopyr
- Atrazine
- Picloram
- Paraquat

19

19

Common Pesticides and Naming

Pesticides is the generic term for all substances that are meant to be toxic when applied to a pest species, weed, or other organism.

Common Algaecide

- Simazine
- Benzalkonium Chloride
- Copper Sulfate

Common Fungicide

- Chlorothalonil
- Captan
- -azole (fluconazole)
- Liquid Copper compounds (Copper Sulfate)

20

20

Common Corrosives and Naming

Corrosives are anything that has a pH less than 5 or more than 8. These include many cleaning chemicals. Beware Biodegradable doesn't mean non-hazardous.

Common Alkaline

- Most Drain Cleaners (Draino, Red Devil)
- **Beware of acid drain cleaners (Hair Clog Remover)**
- Lye (Sodium Hydroxide)
- Potash (Potassium Hydroxide)
- Simple Green
- Most All-purpose cleaners
- Bleach <10% (Sodium hypochlorite)

Common Acid

- Hydrochloric Acid (HCL)- Muriatic Acid
- Phosphoric Acid Cleaner
- Sulfuric acid drain cleaner
- Acidic Tile Cleaner
- CLR (Calcium Lime Rust) Cleaner
- Naval Jelly/ Rust Remover Jelly

21

21

Common Oxidizers and Naming

Oxidizers generally fit into a couple of common categories and must be segregated by chemical (i.e. Chlorine vs Bromine vs Peroxide). Pool Cleaners, Gardening Chemicals, and Industrial Chemicals. Notice that oxygen atoms are a common theme in name/formula of most oxidizers.

Common Pool Oxidizers

- Sodium hypochlorite >10%
- trichloro-s-triazinetrione tablets (Trichlor)
- Potassium Monopersulfate, or Potassium Peroxymonosulfate (Non Chlorine Shock)
- 1-Bromo-3-Chloro-5,5-dimethylhydantoin (Bromine Tabs)

Common Gardening

- Potassium Nitrate Fertilizer
- Stump Out (KNO3)

Industrial Chemical/Cleaner

- Nitric Acid –HNO3
- Hydrogen Peroxide H2O2 >3%
- Sodium Percarbonate (Oxyclean)
- Peroxides
- Silver Nitrate
- Methyl Ethyl Ketone Peroxide (MEKP)

22

22

Questions?

Joshua Prouty, CPM
Hazardous Waste Coordinator
Solid Waste and Resource Recovery
5125 NE 63rd Ave • Gainesville • FL • 32609
352-334-0440 (office)

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23

23