

Aromatic Reactions

REACTS WITH

PRODUCTS

HAZARDS

Hydrogen +catalyst
(Industrial reaction only
UNLIKELY in field)

Cycloalkanes

Increased
Flammability

Halogens + catalyst
Catalyst could be RUST!

Halogenated
aromatic +HX

Acid gas,
increased toxicity

Nitric Acid

Nitroaromatics

unstable, explosive

Sulfuric acid

Sulfonic Acids

Less hazardous

Alcohol Reactions

REACTS WITH

PRODUCTS

HAZARDS

Acids (HCl, etc)

Alkyl Halides

Strong solvents,
water insoluble,
pollutant, may be
anaesthetic

Acid (H_2SO_4)

Sulfate esters
Aldehydes
Alkenes, polymers

Toxic, mutagen
Toxic, reactive
Increased volatility,
May increase
flammability
Flammable,
peroxides

Ethers

Alcohol Reactions

REACTS WITH

PRODUCTS

HAZARDS

Acids (carboxylic)

Esters

May increase flammability

Carboxylic acid

Esters

May release acid gas and (Acyl halides, anhydrides, amides, esters, be very exothermic.

Strong Base

Salts (?)

Strongly basic solutions dissolve glass slowly

Alcohol Reactions

REACTS WITH

PRODUCTS

HAZARDS

Metals (Na, Li, Mg)

Salts + Hydrogen

Strongly basic
H₂ gas flammable

Aldehydes, Ketones

Acetals, Ketals

May be very
exothermic

Amines

More complex
amines

May reduce or
increase toxicity
and flammability

Oxidizers

Aldehydes,
Ketones

Strongly exothermic

Aldehyde Reactions

Reacts With

Amines

Alcohols

Oxidizers

Water

Products

Imines

Hemiacetals,
Acetals

Carboxylic
Acids

“Hydrates”

Hazards

Many biologically active

Many biologically active

May generate significant
HEAT and be
uncontrollable

Water-soluble- May be
more toxic than aldehyde

Ketone Reactions

REACTS WITH

PRODUCTS

HAZARDS

Alcohols

KETALS

Normally reduced hazard

Amines, ammonia

Imines

May be more toxic

Oxidizers

Carboxylic Acid

May be violently exothermic

STRONG BASE

Polymerization

MAY BE VIOLENT

Carboxylic Reactions

REACTS WITH

Bases (NaOH, NH₃)

Products

Salts

Hazards

Exothermic, salts may be toxic

Alcohols

Esters

More volatile,
Flammable?

Amines

Salts

Exothermic, toxic?

Oxidizers

Smaller acids

Same as parent?

Metals

Salts

May increase Toxicity

Mercaptans, Thiols

Reactions

REACTS WITH

PRODUCTS

HAZARDS

Bases

Salts

May increase solubility-
Useful for DECON

Ammonia, amines

Amines +H₂S

SIGNIFICANT TOXIC
HAZARD

Acids

Various products
+ H₂S(?)

May increase SH
compounds in air

Reducing agents

H₂S(?)

May increase air toxics

Mercaptans, Thiols Reactions

REACTS WITH

PRODUCTS

HAZARDS

Carboxylic acids+
Derivatives

Thioesters

May increase toxicity

Oxidizing Agents

Sulfur Oxides

Increase air toxicity?
MAY BE VIOLENT

Aldehydes and Ketones

Thioacetals and
Thioketals

Possible SIGNIFICANT
Increase in TOXICITY

Acyl Halide Reactions

REACTS WITH

Water

Alcohols

Amines

PRODUCTS

Parent Acid +HX

Ester + HX

Amides +HX

HAZARDS

Corrosive, may be
Exothermic

Increased volatility
Corrosive

May increase Toxicity
Corrosive

Amide Reactions

REACTS WITH

PRODUCTS

HAZARDS

Water

Acid + Amine

May be more Toxic

Alcohol

Esters + amine

May be more toxic,
Flammability?

Amines

Another Amide

May be more toxic

Amines Reactions

REACTS WITH

PRODUCTS

HAZARDS

ACIDS (HCL H₂SO₄,etc) Salts +HEAT

Heat of reaction
may cause
VIOLENT
Boiling

Acyl Halides, Esters. Acid Anhydrides
Amides +HEAT

May be violent

Alcohols

More complex amines

Amines Reactions

REACTS WITH

PRODUCTS

HAZARDS

Nitrous acid, nitrites “Nitroamines”

Toxic, carcinogens

Oxidizers

Nitrogen oxides,
Nitrates

Violent reaction
Products may explode

Halogens

“chloramines”,etc

TOXIC, EXPLOSIVE!
May form powerful
contact explosives

Amines Reactions

REACTS WITH

PRODUCTS

HAZARDS

Fire- total burning

Nitrogen oxides

Toxic fumes

Fire-partial burning

Hydrogen Cyanide

TOXIC fumes

TOXIC runoff

Nitrogen Compound Reactions

REACTS WITH

PRODUCTS

HAZARDS

Water (nitriles)

Free Cyanides

Toxic vapors

Water (nitroalkanes)

Free Nitrates

and runoff

Bases (nitriles)

Free Cyanides

Toxic vapors

Bases (nitrates)

Free Nitrates

and runoff

Acids (nitriles)

Carboxylic acids and
ammonium salts

May react
exothermically

Acids (nitrates)

Free Nitrates

Possible
explosion

Nitrogen Compound Reactions

REACTS WITH

Oxidizers(nitriles)
Oxidizers, nitrates

Halogens(nitriles)
Halogens (nitrates)

Hypochlorite

PRODUCTS

Destroy Cyanide group

Chloramines
unstable intermediates

Carboxylic acid and
chloramines at low pH
Amines and amides at
high pH

HAZARDS

May be violent
May initiate
explosion

Toxic Explosive
Toxic Explosive

Toxic, Explosive

**PREFERRED
ROUTE of
decontamination**

Organophosphate Reactions

REACTS WITH

Strong Base

Alcohols

Acids, aqueous

Oxidizers

Products

Salts, alcohols

Other esters

Phosphoric acid
Alcohols

Varies

Hazards

Decontamination
Method

May be MORE toxic
or less toxic, may
increase volatility

Less Phosphate toxicity

May be violent reaction
increasing spread of
Contamination