

SAFETY AND HYGIENE REGULATIONS



Servei de Prevenció de Riscos Laborals
UNIVERSITAT POLITÈCNICA DE CATALUNYA

INCOMPATIBILITY BETWEEN CHEMICALS

CODE

SHR 301

Date:

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02

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INCOMPATIBILITY BETWEEN CHEMICALS

Products that could react violently with each other should not be stored together, particularly in quantities above a certain amount. In case of fire, falls, breakages or any other kind of incident, bottles or packaging could be damaged and the products that they contain could come into contact and cause dangerous reactions.

Incompatibilities are particularly important for solid or liquid chemical products that are not classified into other groups, due to their high level of danger. These products include pure reagents (oxidising agents, pyrophoric substances, highly reactive compounds, highly toxic compounds, etc.). These products must never be mixed with each other or with products from other groups. Whenever possible these products, in quantities equal to or less than 1 litre, should be kept in their original container. In case of doubt, the person responsible should be consulted.

Flammable or combustible liquids should not be stored together in the same area as oxidising agents or toxic or highly toxic substances that are not combustible, **unless these are stored in safety cabinets.**

Flammable or combustible toxic or highly toxic liquids can be stored together in the same area as other flammable or combustible liquids if both can be extinguished in an accident using the same fire extinguishing agent.

Organic peroxides in fragile containers and polychlorinated biphenyl cannot be stored in an area that contains flammable or combustible liquids that do not also have these properties, unless the necessary measures are adopted so that, in the case of an accident, they do not cause dangerous reactions (for example: use of safety cabinets, separation using built structures, etc.)

SEPARATION BETWEEN FAMILIES OF INCOMPATIBLE PRODUCTS

Depending on the size of the store, products can be separated using either an **island system** or **shelving units**.

The island system consists of dedicating a set of shelving units to a specific family of chemicals, for example acids, and grouping these units so that there are passageways around them. In this way, a store can be made up of different islands, each dedicated to one family, and inert reagents can be grouped together in shelving units along one of the walls.

If the stock is not very large, the island system may not be needed and shelving units can be distributed along the walls, with inert substances put in between the incompatible substances. For example, acids can be gathered together vertically on a series of selves, so that one column is occupied by acids. Next to this column will be a column of inert substances, or materials such as fibre glass, standard solutions, etc., followed by a column of bases. In this way, acids and bases can be separated properly without using up too much space.

Examples of potential incompatibilities:

Acids with bases
Sulfuric acid with sodium hydroxide
Strong acids with weak acids that emit gases
Nitric acid with hydrochloric acid Hydrochloric acid with cyanide or sulphurs
Oxidising agents with reducing agents
Nitric acid with organic compounds
Water with various compounds
Water with anhydrides, carbides, halides, acid halides, hydrides, isocyanates, alkali metals

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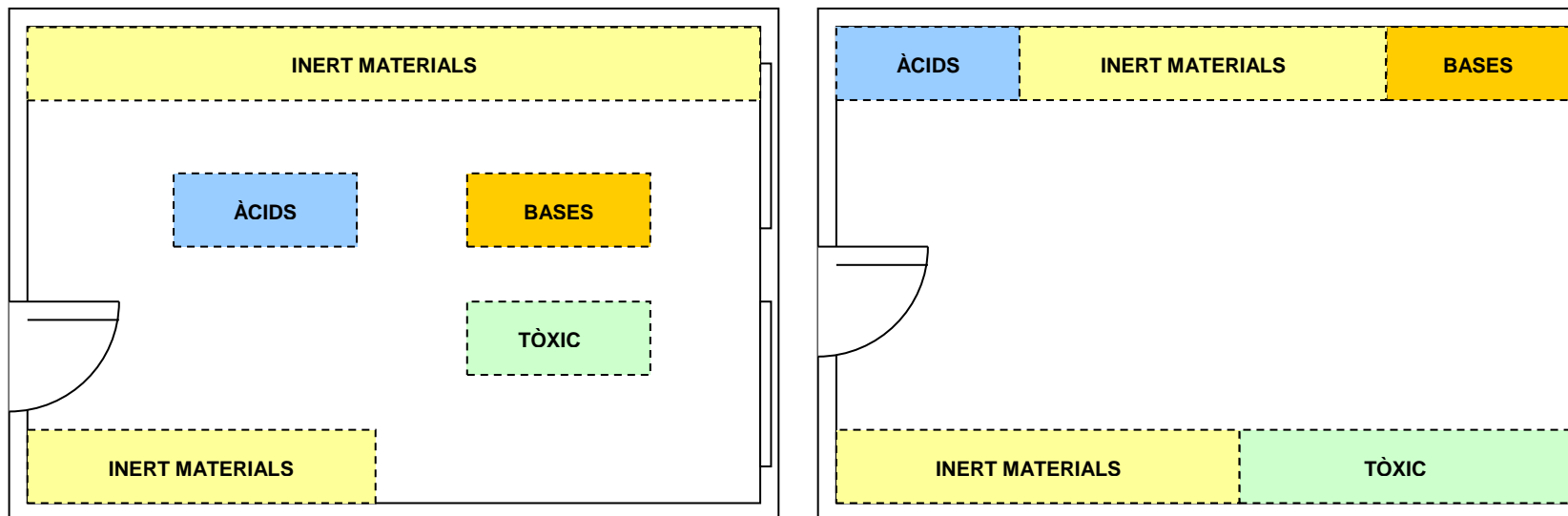
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Examples of the storage of acids, bases and toxic substances

ARRANGEMENT OF CONTAINERS ON SHELVES

Reagents can be arranged on the shelves of the corresponding shelving unit according to the following criteria:

- Heavy containers will be placed on lower shelves, together with strong acids and bases. The more aggressive they are, the lower the level they should occupy.
- Inert reagents should be grouped in the best way possible to make them easy to find.
- Reagents that are sensitive to water should be placed at a distance from water pipes and flammable materials.

In short, the separation between products is designed to eliminate risks and is based on a logical criterion, taking into account the reactivity of the different substances.

Special mention should be given to peroxide-forming substances (diethyl ether, isopropyl ether, dioxane, etc.). These compounds can undergo peroxidation in contact with air and cause explosions in evaporation or distillation operations if their temperature increases or if they are mixed, knocked or exposed to friction, etc. Whenever possible, ethers should have an inhibitor. However, if a container has been opened, peroxides may start to form. Consequently, ether containers that have been **opened should not be kept for more than 6 months and in general should be kept no longer than 1 year**, unless they contain an efficient inhibitor.

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**TABLE OF INCOMPATIBILITIES FOR
STORAGE OF DANGEROUS
SUBSTANCES / PREPARATIONS**

INCOMPATIBILITIES						
	YES	NO	NO	NO	NO	NO
	NO	YES	(3)	(3)	(3)	(2)
	NO	(3)	YES	(3)	(1)	YES
	NO	(3)	(3)	YES	YES	YES
	NO	(3)	(1)	YES	YES	YES
	NO	(2)	YES	YES	YES	YES

(1) Can be stored together if corrosive products are not packaged in fragile containers

(2) Can be stored together if certain prevention measures are adopted.

These are general criteria

(3) Can be stored together in protected safety cabinets

Note: there are specific protocols for the storage of radioactive products.

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Compounds that react strongly with water	Compounds that react violently with air or oxygen (spontaneous combustion)	Groups of incompatible substances	
<ul style="list-style-type: none"> ● Strong anhydrous acids ● Alkylmetals and metalloids ● Amides ● Anhydrides ● Carbides ● Fluorine ● Phosphides ● Acid halides ● Acyl halides ● Inorganic anhydride halides (except alkali metals) ● Alkali metal hydroxides ● Hydrides ● Imides ● Alkali metals ● Alkali metal oxides ● Inorganic peroxides ● Silicides 	<ul style="list-style-type: none"> ● Alkylmetals and metalloids ● Arsines ● Boranes ● Phosphines ● White phosphorus ● Phosphides / hydrides ● Metal carbonyls ● Finely divided metals ● Nitrides / Alkali metals ● Silenes ● Silicides 	<p>Oxidising agents with:</p>	<p>Flammable substances, carbides, nitrides, hydrides, sulfides, alkylmetals, aluminium, magnesium and zirconium in powder</p>
		<p>Reducing agents with:</p>	<p>Nitrates, halogens, oxides, peroxides, fluorine</p>
		<p>Strong acids with:</p>	<p>Strong bases</p>
		<p>Sulfuric acid with:</p>	<p>Sugar, cellulose, perchloric acid, potassium permanganate, chlorates, thiocyanates</p>

Dangerous reactions of acids

REAGENT	REAGENT	RELEASES
Hydrochloric acid	<ul style="list-style-type: none"> ● Sulphurs ● Hypochlorites ● Cyanides 	<ul style="list-style-type: none"> ● Hydrogen sulfide ● Chlorine ● Hydrogen cyanide
Nitric acid	Some metals	Nitrogen dioxide
Sulphuric acid	<ul style="list-style-type: none"> ● Formic acid ● Oxalic acid ● Ethyl alcohol ● Sodium bromide ● Sodium cyanide ● Sodium thiocyanate ● Hydrogen iodide ● Some metals 	<ul style="list-style-type: none"> ● Carbon monoxide ● Carbon monoxide ● Ethane ● Bromine and sulphur dioxide ● Carbon monoxide ● Carbonyl sulfide ● Hydrogen sulfide ● Sulphur dioxide

Substances that easily form peroxides

- Allyl compounds
- Diene compounds
- Isopropyl compounds
- Vinylacetylene compounds
- Vinyl compounds
- Isopropylbenzene, styrene, tetrahydronaphthalene
- Ethers
- Haloalkanes
- N-alkylamide, ureas

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CHEMICAL SUBSTANCE	INCOMPATIBILITIES	CHEMICAL SUBSTANCE	INCOMPATIBILITIES	CHEMICAL SUBSTANCE	INCOMPATIBILITIES	CHEMICAL SUBSTANCE	INCOMPATIBILITIES
Acetylene	Chlorine, bromine, copper, fluorine, silver and mercury	Azides	Acids	Hypochlorite	Acids, activated carbon	Potassium permanganate	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic matter, aniline, nitromethane and combustible materials
Acetone	Concentrated nitric acid and mixtures with sulphuric acid	Bromine	See chlorine	Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens	Hydrogen peroxide	Ethyl and methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerine, ethylene glycol, ethyl and methyl acetate, furfural
Acetic acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides and permanganates	Activated carbon	Calcium hypochlorite and all oxidising agents	Arsenic	Some reducing agents	Sodium peroxide	Organic and inorganic acids
Hydrogen cyanide	Nitric acid and alkalis	Cyanides	Acids	Mercury	Acetylene, fulminic acid and ammonia	Organic peroxides	Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid
Chromic acid and chromium	Acetic acid, naphthalene, camphor, glycerine, alcohols and flammable liquids in general	Potassium chlorate	Sulphuric acid and other acids	Alkali metals and alkaline earth metals	Water, carbon tetrachloride, chlorinated hydrocarbons, carbon dioxide and halogens	Potassium	Reducing agents
Anhydrous hydrofluoric acid	Ammonia, aqueous or anhydrous	Chlorates	Ammonium salts, acids, powdered metals, sulphur, finely divided combustible or organic material	Ammonium nitrate	Acids, powdered metals, inflammable liquids, chlorine compounds, nitrites, sulphur, finely divided combustible organic materials	Selenides	Carbon tetrachloride, carbon dioxide, water
Concentrated nitric acid	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids and gases, copper, brass and some heavy metals	Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane, and other petroleum gases, hydrogen, sodium carbide, benzene, finely divided metals and turpentine	Nitrates	Sulphuric acid, ammonium nitrate and other ammonium salts	Sodium	Fuming nitric acid and oxidizing gases
Oxalic acid	Silver and mercury	Copper	Acetylene and hydrogen peroxide	Sodium nitrite	Acids	Hydrogen sulfide	Acids
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, fats and oils	Chlorine dioxide	Ammonia, methane, phosphorus and hydrogen sulfide	Nitrites	Inorganic bases and amines	Sulphurous compounds	Reducing agents
Sulphuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate (compounds similar to light metals, such as sodium and lithium)	Phosphorus (white)	Air, oxygen, alkalis and reducing agents	Nitropropanes	Water	Tellurium	Sodium
Anhydrous ammonia	Mercury (for example in manometers), chlorine, calcium hypochlorite, iodine, bromine, anhydrous hydrofluoric acid	Fluorine	All other chemical substances	Calcium oxide	Oils, fats and hydrogen; flammable liquids, solids and gases	Carbon tetrachloride	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Aniline	Nitric acid, hydrogen peroxide	Hydrocarbons	Fluorine, chlorine, bromine, chromic acid, sodium peroxide	Oxygen	Sulfuric acid and other acids. See also chlorates		
Silver	Carbon tetrachloride, carbon dioxide and water	Isopropylbenzene hydroperoxide	Organic and inorganic acids	Potassium perchlorate	Glycerine, ethylene glycol, benzaldehyde, sulphuric acid		

Sources of information:

- ✓ NTP 479: Prevenció del risc en el laboratori químic: reactivitat de los productos químicos (II), and
- ✓ NTP 725: Seguridad en el laboratorio: almacenamiento de productos químicos

For further information, see the website <http://www.insht.es>, Notes de Prevenció (NTP)