



## Expired Chemicals

1. It is important to understand that there is a difference between **"Expiration Date"** and **"Shelf Life"**.

### "Expiration Date"

the maximum time an open reagent will last before mandatory disposal.

### "Shelf Life"

the time a properly sealed and stored reagent will remain intact.

2. The most crucial factor in the decision of whether to work with expired reagents is **risk management**.

3. Most chemicals absorb water or decompose, becoming less dangerous over time.

4. Storage conditions – temperature, light exposure, humidity – must be considered when deciding whether to keep on working with an expired reagent.



**Storage conditions** are listed in the SDS, section 7



**Before using expired reagents**, check whether they were stored according to their manufacturer's recommendations.

5. **Rules-of-thumb in absence of information:**

State	Dispose of after [years from opening]
Powders	3 yrs. from opening
Liquids	2 yrs. from opening
Solvents	2 yrs. from opening

6. General reasons to dispose of reagents:

- 1** Change in **physical appearance** of the reagent / container
- 2** **Uncharacteristic smell** of reagent / murkiness
- 3** **Precipitate in the liquid**
- 4** **Discoloration**



7. Peroxide-forming chemicals (PFCs) which react with the oxygen in the air, forming combustible peroxides

**The most dangerous PFCs** are organic solvents containing oxygen (ethers).

**The two most popular PFCs** are ether (diethyl ether, ethyl ether) ((CH<sub>3</sub>CH<sub>2</sub>)<sub>2</sub>O) and tetrahydrofuran (THF) (C<sub>4</sub>H<sub>8</sub>O).

Diethyl ether and THF are stabilized by the vendors with anti-PFCs, so a closed and unused bottle poses a minor safety risk, even if its expiration date has passed. **However**, an open bottle is a prominent risk of producing peroxides.

**PFCs must never be stored for more than 6 months.**

Make sure you dispose of all 6m.-old PFCs bottles *via* the chemical waste facility.

**A list of prevalent PFCs:**

**acetaldehyde** (C<sub>2</sub>H<sub>4</sub>O), **acetone** (C<sub>3</sub>H<sub>6</sub>O), **benzyl alcohol** (α-cresol) (C<sub>7</sub>H<sub>8</sub>O), **butadiene** (C<sub>4</sub>H<sub>6</sub>), **cyclohexene** (C<sub>6</sub>H<sub>10</sub>), **cyclopentene** (C<sub>5</sub>H<sub>8</sub>), **ether** ((CH<sub>3</sub>CH<sub>2</sub>)<sub>2</sub>O), **di-isopropyl ether** (C<sub>6</sub>H<sub>14</sub>O), **dioxane** (C<sub>4</sub>H<sub>8</sub>O<sub>2</sub>), **ethylene glycol dinitrate** (C<sub>2</sub>H<sub>4</sub>N<sub>2</sub>O<sub>6</sub>), **ethylene oxide** (C<sub>2</sub>H<sub>4</sub>O), **formaldehyde** (CH<sub>2</sub>O), **isopropyl ether** (C<sub>6</sub>H<sub>14</sub>O), **methyl acetylene** (propyne) (C<sub>3</sub>H<sub>4</sub>), **methyl ethyl ketone** (MEK) (butanone) (C<sub>4</sub>H<sub>8</sub>O), **methyl isobutyl ketone** (MIBK) (C<sub>6</sub>H<sub>12</sub>O), **THF** (C<sub>4</sub>H<sub>8</sub>O), **vinyl acetate** (C<sub>4</sub>H<sub>6</sub>O<sub>2</sub>), **vinylidene chloride** (1,1-dichloroethylene, 1,1-DCE)

8. Which reagents could be safely used past their expiry date?

**Next page shows full table**

9. Recommended shelf life of prevalent reagents [yrs]:

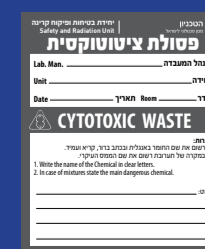
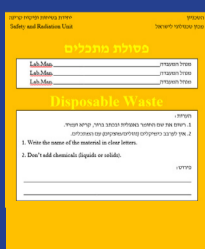
<b>0.5</b>	<b>Citric acid</b> <b>Dodecylbenzenesulphonic acid</b>	<b>2</b>	<b>Silver nitrate</b> <b>Sodium chloride</b> <b>Sodium hydroxide</b> <b>Sulfuric acid</b> <b>Tetramethylammonium hydroxid</b>
<b>1</b>	<b>Formaldehyde</b>	<b>3</b>	<b>Butylated Hydroxytoluene</b> <b>Carbon disulfide</b> <b>Chloroform</b> <b>Chromium trioxide</b> <b>Hydrogen peroxide</b> <b>Isopropyl alcohol</b> <b>Nitric acid</b> <b>Phosphoric acid</b>
<b>2</b>	<b>Acetic acid</b> <b>Ammonium hydroxide</b> <b>Chromic acid</b> <b>Diethyl ether</b> <b>Dimethylformamide</b> <b>Ethanol</b> <b>Formic acid</b> <b>Hydrochloric acid</b> <b>Hydrofluoric acid</b> <b>Iodine</b> <b>Perchloric acid</b> <b>Potassium dichromate</b> <b>Potassium hydroxide</b> <b>Potassium permanganate</b>	<b>5</b>	<b>Azobisisobutyronitrile</b> <b>Ceric ammonium nitrate</b>
		<b>6</b>	<b>Imidazole</b>

## Safety Updates

A new courseware has been uploaded to our website:

**Handling chemical waste**

(Heb+Eng)





## Expired Chemicals

Does it have an expiry date?	Reagent	Remarks	Examples
YES ✓	Buffer salts, powder	Stable	Sodium citrate ( $\text{Na}_3\text{C}_6\text{H}_5\text{O}_7$ )
	Salts	<ul style="list-style-type: none"> <li>Hygroscopic salts will absorb water &gt; desiccate / warm gently in low-humidity atmosphere</li> <li>Preferably dispose of max. 1 yr. after opening</li> </ul>	
	PMSF, powder	Stable Phenylmethylsulfonyl fluoride ( $\text{C}_7\text{H}_7\text{FO}_2\text{S}$ )	
	Heavy metal, salts	Very stable (Antiseptic)	Nickel sulfate ( $\text{NiSO}_4$ ), Cobalt chloride ( $\text{CoCl}_2$ ), Silver nitrate ( $\text{AgNO}_3$ ), Gold chloride ( $\text{AuCl}_3$ )
	Heavy metal, solutions	Very stable (Antiseptic)	
	Antibiotics, powder	Stable	
	Ammonium persulfate ( $(\text{NH}_4)_2\text{S}_2\text{O}_8$ ), powder	Stable	
	Resins, inc. epoxy-s	Once the bottle seal is broken - the resin oxidizes > the hardener will turn yellow. Yellowing doesn't impact the curing properties.  Polyester UV resins - dispose after 6m.	
	SDS	Stable	
Sugar, powder	Stable		
NO ✗	Antibiotics, solutions		
	Ammonium persulfate ( $(\text{NH}_4)_2\text{S}_2\text{O}_8$ ), solutions	Hydrolyzes rapidly in aqueous solutions into ammonium sulfate ( $(\text{NH}_4)_2\text{SO}_4$ ), sulfuric acid ( $\text{H}_2\text{SO}_4$ ), hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) and ammonia ( $\text{NH}_3$ ) <ul style="list-style-type: none"> <li>Write down the solution's preparation date</li> <li>Dispose in 6m.</li> </ul>	
Check	Buffer solutions	Microbes & fungi will eventually grow inside	Magnesium chloride ( $\text{MgCl}_2$ ), potassium phosphate ( $\text{KH}_2\text{PO}_4$ , $\text{K}_2\text{HPO}_4$ , $\text{K}_3\text{PO}_4$ ), calcium carbonate ( $\text{CaCO}_3$ )
	Reducing agents	<ul style="list-style-type: none"> <li>Aliquots (DTT, BME) - <math>t_{1/2}</math> = hours to days</li> <li>Powder (DTT, BME) - stable for 1-3 yrs.</li> <li>TCEP - 4°C - 1m.</li> </ul>	<ul style="list-style-type: none"> <li>DTT (dithiotreitol) (<math>\text{C}_4\text{H}_{10}\text{O}_2\text{S}_2</math>)</li> <li>BME (<math>\beta</math>-mercaptoethanol) (<math>\text{C}_2\text{H}_6\text{OS}</math>)</li> <li>TCEP (tris(2-carboxyethyl) phosphine) (<math>\text{C}_9\text{H}_{15}\text{O}_6\text{P}</math>)</li> </ul>
	PMSF, solution	<ul style="list-style-type: none"> <li><math>t_{1/2}</math> = 30'</li> <li>Stock solutions: 100mM with IPA (stable for a few months in 4°C or for a few years in -20°C)</li> </ul>	
	Sugar, solutions	Microbes will grow in them over time	
Check (by oxidizing potassium iodide to produce a brown solution)	Hydrogen peroxide	Stable if kept constantly in dark; decomposes when exposed to light <ul style="list-style-type: none"> <li>Dispose of any transparent bottle</li> </ul>	