

Information Sheet

Peroxide Forming Chemicals

1. Introduction

Some organic solvents can under normal storage conditions form unstable and dangerous level of peroxides in the presence of atmospheric oxygen via a process of auto-oxidation. If the levels of peroxide become high enough there is a potential for them to form peroxide crystals which are explosive. These crystals often form in and around the bottle neck. This can also occur due to natural evaporation and the concentration of residues. These crystals are sensitive to shock, friction, and heat. This is why ageing solvents can present a significant risk as high levels of peroxide can build up over time. See list in Section 5.

2. Storage, Labelling and Risk Assessment

As with all chemicals the use of these peroxide forming chemicals must be specified in risk assessments and assessed appropriately. The pre-purchase and chemical risk assessment templates can be found here: [Laboratory Safety - Swansea University](#)

2.1 Selection of solvent:

- Where possible safer alternatives to these chemicals should be used.
- If a safer alternative is not available, then a peroxide forming chemicals that contains an antioxidant (stabilising agent) should be used.
- Many peroxide forming chemicals can be supplied with stabilisers which prevent the buildup of dangerous levels of peroxides.
- In general, they can be used for most laboratory work, including use as solvents which can be removed by distillation or rotary evaporation.
- It is also important to avoid the purchase of large volumes (e.g. 2.5 litres) of peroxide forming chemicals which are not needed.
- Extra consideration should be made when using vacuum distillation/ evaporation and testing done as pointed out in testing for peroxides section.

2.2 Storage:

- Peroxide forming chemicals need to be stored properly since the peroxides are formed by an auto-oxidation process.
- Bottles/ containers need to be kept sealed when not in use to prevent exposure to air.
- They need to be stored in the dark as storage in sunlight can cause auto-oxidation.
- Store in cool places as the auto-oxidation occurs quicker at higher temperatures (some will state they need to be kept in a fridge or below a specific temperature).

2.3 Labelling:

- Bottles must be labelled appropriately as per the "Safe Storage, Labelling and Stock Management of Chemicals Information Sheet."

- In addition to this labelling these peroxides will need a testing label too (as seen below).
- As peroxides are formed by an auto-oxidation process, and their concentration increases with time, all these solvents must be labelled with the date they were opened and date or conditions for disposal. Where testing is not being carried out the disposal date will be a year after opening or in the case of Isopropyl Ether (Di-isopropyl Ether) the disposal date will be 3 months from opening.
- **Unlabelled, open bottles must be considered potentially unsafe and be disposed of as hazardous waste.** Contact the [Health, Safety and Resilience \(HS&R\) Team](#) to arrange disposal.

Warning! Peroxide Forming Chemical					
Date of opening:					
Do not use after:					
Tested for Peroxide:					
Test date and result:					
Date	Date	Date	Date	Date	Date
Result	Result	Result	Result	Result	Result
Date	Date	Date	Date	Date	Date
Result	Result	Result	Result	Result	Result

Example of label to be added to peroxide forming chemicals (print from Appendix 1).

3. Testing for Peroxide Levels

Peroxide levels in the solvent are to be checked to ensure that levels remain safe. This can be done using a potassium iodide indicator or more conveniently rapid and user-friendly test strips can be purchased. The frequency of checks will depend on a few factors to do with the chemicals or their intended use.

3.1 Test Frequency

Inhibited ethers and other peroxides forming chemicals	These must be tested every 6 months. If testing has not occurred at least once every 6 months, then the solvent will need to be disposed of within a year of opening.
Uninhibited Ethers and other peroxide forming chemicals	These must be tested on opening, and every 3 months subsequently. If testing has not occurred at least once every 3 months, then the solvent will need to be disposed of within a year of opening.

Isopropyl ether (Di-isopropyl Ether)	This must be tested before each use. If it this is not tested for a 3 month period it will need to be disposed of.
Ethers and other peroxide forming chemicals that are to be used in vacuum distillation/ evaporated to dryness	These must be checked immediately prior to use.

3.2 Testing and Action Levels

Level of Peroxide	Action
0 to 30mg/l	Acceptable for all routine lab work, including vacuum distillation and evaporation to dryness. Note however, that even with less than 30 ppm of peroxide, if a large volume of ether is distilled to dryness, then a noticeable level of peroxide could, potentially, still build up. Therefore, ensure that the quantity of ether being used is as small as is necessary
Greater than 30 to 100 mg/l	Acceptable for all routine lab work, except for vacuum distillation and evaporation to dryness. If the peroxide level is approaching 100 ppm, then it should be considered for disposal. Label bottle as waste as normal and record the level of peroxide.
Greater than 100 mg/l	Do not use. Contact Departmental Safety Advisor as soon as possible. If the level of peroxide is greater than 100 mg/l, then the peroxide test strip will either be darker blue than the 100 mg/l colour reference chart or turn brown. In this event, the ether contains a significant level of peroxide and should be treated as hazardous. Contact the Departmental Safety Advisor as soon as possible, label as not to be used, inform other lab workers and isolate the bottle.

Following testing the test date and result must be recorded on the bottles label (shown above). In the event of the concentration being greater than 100mg/l please contact [HS&R Team](#). If the chemical is within the range and needs to be disposed of follow normal hazardous waste procedures.

Empty bottles of these solvents must be cleaned/ rinsed to prevent residue. The way they are cleaned will need to be assessed using the information available on SDS and risk assessment, as the process may vary dependant on the exact solvent.

4. Disposal of Peroxide Forming Chemicals

For any peroxide forming chemicals that has no visible peroxide formation, has a peroxide test level <100mg/l, which is no longer required or out of date they can be disposed of via the normal hazardous waste procedures. Please contact estates-waste@swansea.ac.uk for more information.

Any peroxide forming chemical that has visible evidence of peroxide formation, such as crystals, either in the solution or around the lid or has a peroxide test level of >100 mg/l.

Do not open/ use the chemical, isolate from use, and contact the Health Safety and Resilience and Sustainability Team as soon as possible.

5. List of Organic Solvents Known to Form Peroxides

Certain types are more prone to peroxide formation than others (this list is for guidance only and is not exhaustive).

1) Severe Peroxide Hazard on Storage with Exposure to Air

- Di-isopropyl Ether (isopropyl ether)
- Divinylacetylene (DVA)
- 1,1 dichloroethene (Vinylidene Chloride)

2) Peroxide Hazard on Concentration

- Acetaldehyde diethyl acetal (acetal)Ethylene glycol dimethyl ether (glyme)
- Cumene (isopropylbenzene)
- Ethylene glycol ether acetates (ethanediol)
- Cyclohexene
- Cyclopentene
- Furan
- Decalin (decahydronaphthalene)
- Methylacetylene
- Diacetylene (butadiene)
- Methylcyclopentane
- Dicyclopentadiene
- Methyl isobutyl ketone
- Diethyl ether (ether)
- Tetrahydrofuran (THF)
- Diethylene glycol dimethyl ether (diglyme)
- Tetralin (tetrahydronaphthalene)
- Dioxane
- Vinyl ethers

3) Hazard of Rapid Polymerization Initiated by Internally Formed Peroxides

- Chloroprene (2-chloro-1,3-butadiene)
- Vinyl acetate
- Styrene
- Vinylpyridine

6. Appendices

Appendix 1

Warning! Peroxide Forming Chemical					
Date of opening:					
Do not use after:					
Tested for Peroxide:					
Test date and result:					
Date	Date	Date	Date	Date	Date
Result	Result	Result	Result	Result	Result
Date	Date	Date	Date	Date	Date
Result	Result	Result	Result	Result	Result