***STANDARD OPERATING PROCEDURE – C009***

**WORKING WITH PEROXIDE FORMING CHEMICALS**

1. **Objectives**

This Standard Operating Procedure (SOP) describes basic chemical safety information for peroxide forming chemicals to ensure the safety of laboratory personnel by minimizing the dangers posed by fire and health hazards. Additionally, this SOP seeks to optimize the effectiveness of experimental processes.

1. **Personal Protective Equipment**

To ensure safety during work with peroxide forming chemicals, appropriate personal protective equipment (PPE) must be worn. This includes:

* Long pants and closed-toe shoes to protect against spills and splashes.
* A long-sleeved, buttoned lab coat to minimize skin exposure.
* Safety glasses or goggles to protect against splashes or flying debris.
* Disposable nitrile/neoprene gloves to prevent direct contact with hazardous chemicals.
  + **NOTE:** The chemical’s SDS should always be checked prior to start of work to ensure proper glove selection.
* If the user has long hair, it should be tied back.

1. **Potential Hazards**

When working with peroxide forming chemicals, safety precautions must be taken to manage and maintain a safe working environment. There are several hazards a user can come into contact with and these include:

* **Fire Hazard:** Chemicals in this band can form peroxides over time and can become sensitive to heat, shock, and/or friction. Accumulation of peroxide formers in the laboratory has resulted in numerous explosions. Peroxide formation is an autoxidation reaction that can be initiated by light, heat, concentration, contamination, and/or loss of an inhibitor.

Peroxide-forming chemicals can be divided into three categories:

* + Class A: Forms explosive levels of peroxides without concentration. These are the most hazardous and can form explosive peroxide levels even if not opened.
    - Examples: Isopropyl ether, Potassium metal, Sodium amide
    - Test Frequency: Test or discard after 3 months of receiving.
  + Class B: Form explosive levels of peroxides upon concentration through distillation, evaporation, or exposure to air after opening.
    - Examples: Benzyl alcohol, Tetrahydrofuran, Diethyl ether
    - Test Frequency: Test or discard after 12 months.
  + Class C: May autopolymerize as the result of peroxide formation.
    - Examples: Acrylic acid, Acrylonitrile
    - Test Frequency: Test or discard after 12 months.
* **Health Hazard:** Chemicals in this band are irritating to eyes, skin and respiratory tract and their vapors may cause drowsiness and dizziness. Repeated skin exposures may cause dryness or cracking.

1. **Training**

Ensure all personnel have received proper training on their hazards and safe handling techniques.

* MC03 Chemical Safety II / Hazardous Waste Management
* MC07 Chemical Safety I / Chemical Safety for Laboratory Users

1. **Procedures**
2. Storage

* Avoid friction, grinding, and all forms of impact near peroxides, especially solid peroxides. Do not use glass containers with screw caps or glass stoppers. Polyethylene containers with screw tops may be used.
* Store peroxides at the lowest possible temperature consistent with their solubility or freezing point to minimize the rate of decomposition. Do not store them at or lower than the temperature at which the peroxide freezes or precipitates because peroxides in these forms are extremely sensitive to shock and heat.
* Store all peroxidizable compounds in tightly closed, air-impermeable, light-resistant containers, away from light, heat, direct sunlight, sources of ignition, oxidizers, and oxidizing agents. Storage under nitrogen may be advisable in some cases.
* Do not use metal spatulas to handle peroxides because metal contamination can lead to explosive decomposition. Magnetic stirring bars can unintentionally introduce iron, which can initiate an explosive reaction of peroxides. Teflon, ceramic or wooden spatulas and stirring blades may be used if it is known that the material is not shock sensitive.
* Do not allow these compounds to evaporate to near dryness unless absence of peroxides has been shown.
* Purchase peroxide formers with inhibitors added by the manufacturer when possible.
* For peroxide forming compounds, mark the receipt and opening date on the container and discard within the time frame listed in the table above (or by the manufacturer’s expiration date, if listed on the container).
* If a peroxide-forming chemical or container is of unknown age or history, if crystals or solid masses are visibly present on or in the container or lid, or if the chemical shows discoloration, string-like formations, or liquid stratification, do not open the container.

1. Handling

* Fume hoods, or other locally exhausted ventilation, must be used whenever handling organic peroxides or peroxide forming compounds.
* Test for peroxides before any distillation or purification of peroxide forming chemicals. Use extreme caution when concentrating or purifying peroxide forming chemicals as explosions can occur.
* Never allow peroxide formers to evaporate to dryness, such as during distillation, always leave a minimum of 20% liquid.
* Peroxide crystals formed in a chemical container are particularly likely to accumulate within the threads of the screw cap and may explode when subject to heat, light, friction, or mechanical shock (e.g. unscrewing the cap). Never open, move, or disturb a bottle that is suspected to have peroxides.
* Explosive peroxides can form when exposed to air, stored for a time, or upon concentration. Peroxide formers that might be exposed to air over an extended peroxide of time should be tested for peroxides.
* For liquids evidence of possible peroxide formation includes: formation of solids or crystals, visible discoloration, and liquid stratification.
* For solids evidence of possible peroxide formation includes: formation of a surface crust, and discoloration of the solid.
* Alkali metals and amides should be evaluated based on visual criteria only. There are no peroxide tests that can be used on these materials.
* Never open, disturb, or move a container suspected of having peroxides.

1. Disposal of peroxide forming chemicals

* Refer to the SOP titled “Disposal of hazardous chemical waste” for more details. Pretreat the peroxide forming chemicals before disposal whenever feasible.
* Check the waste log sheet and avoid incompatibilities.

1. **Spills, Incidents and Reporting**

* All spills must be cleaned up following Standard Operating Procedure.
* In the event of a fire, activate the fire alarm and evacuate the area. Do not activate the emergency ventilation system, as they can exacerbate combustion.
* If inhaled, move person into fresh air.
* For ingestion, rinse mouth with water
* In the case of skin/eye contact, remove contaminated clothing or contact lenses and flush the affected area with water for at least 15 minutes. Obtain medical attention immediately.
* Report any accidents that result in injuries to the PI and/or the departmental safety officer (DSO) immediately.
* For serious incidents, notify the Security Unit immediately by calling the 24-hour hotline on **2358 8999**.

1. **References**

* Wellesley College. (2011). *Standard operating procedure for peroxide-forming chemicals*. https://www1.wellesley.edu/sites/default/files/assets/departments/ehs/files/sop\_peroxides.pdf
* Texas Woman's University. (n.d.) *Standard operating procedure: Peroxide forming chemicals*. <https://twu.edu/media/documents/risk-management/Peroxide-Forming-Chemicals-SOP.pdf>
* Health, Safety and Environment Office, The Hong Kong University of Science and Technology (n.d.). *Classes of Peroxidable Chemicals.* From https://hseo.hkust.edu.hk/chem-info/peroxidizable-chemical/classes
* Health, Safety and Environment Office, The Hong Kong University of Science and Technology (n.d.). *Peroxidizable Chemicals.* From <https://hseo.hkust.edu.hk/chem-info/peroxide-chemicals>
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