



# **Osmium Tetroxide (OsO<sub>4</sub>) Handling Brochure**

## Introduction

OsO<sub>4</sub> (CAS Number: 20816-12-0) is a useful chemical compound that finds application as a staining and fixing agent for use in electron microscopy, as well as a chemical catalyst for the synthesis of specialty organic chemicals.

The chemical properties of OsO<sub>4</sub> are such that use and handling of the chemical is often considered daunting. Although its volatility and toxicity certainly makes it a dangerous chemical, but when following the proper procedure and taking the necessary precautions, OsO<sub>4</sub> can be used to its full potential with limited risk to the user.

This booklet was designed with the purpose of guiding both the novice and

experienced user of OsO<sub>4</sub> in the general use of the chemical, in its various forms, and is based the queries and problems that our customers have experienced in the past.

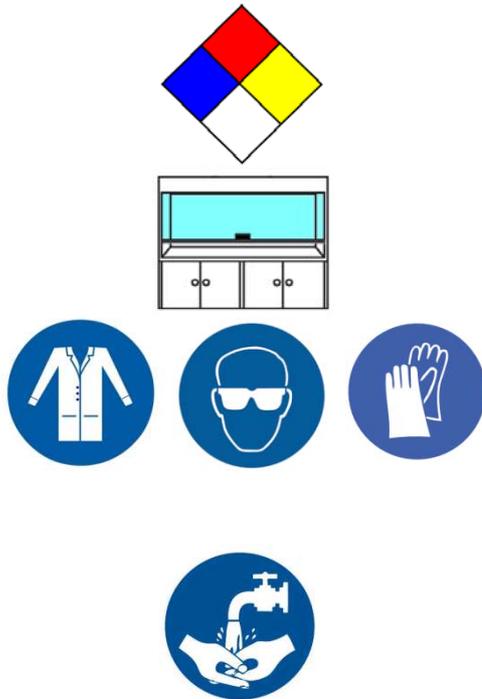
Although this brochure offers advice on many aspects of OsO<sub>4</sub> handling, it cannot replace the necessary training that must be given to all new users of the chemical, prior to use. Also, this booklet serves only as a general guide on OsO<sub>4</sub> use and it is recommended that each laboratory in which OsO<sub>4</sub> is regularly used, should implement standard operating protocols for storage, use and disposal of the chemical according to the specific circumstances and standard practices that apply.

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## General Handling of OsO<sub>4</sub>

### DO



- Always consult the MSDS before attempting to handle or use OsO<sub>4</sub>
- Always handle OsO<sub>4</sub> in a certified fume hood
- Always wear the appropriate personal protective equipment when handling OsO<sub>4</sub> – Lab coat, safety glasses, disposable nitrile gloves
- Wash hands thoroughly after handling OsO<sub>4</sub>

### DON'T



- Avoid contact with skin and eyes
- Do not ingest or inhale dust or vapors
- Do not eat or drink while handling OsO<sub>4</sub>
- Do not smoke while handling OsO<sub>4</sub>

## Storing OsO<sub>4</sub>

OsO<sub>4</sub> is the most potent oxidizing agent and, as such, care must be taken to store both pure OsO<sub>4</sub> and its stock solutions in access controlled areas that are secure to unauthorized access.

Unopened ampoules of OsO<sub>4</sub> should be stored in a cool (below 25°C), dry place away from direct sunlight. Ampoules can be safely stored under these conditions, in their original packaging, for up to three years. It is, however, important to inspect the outer packaging every 3 months to ensure that no leaking (indicated by discoloration of plastic packaging) has occurred.

Never store OsO<sub>4</sub> or its solutions in plastic containers – plastic is permeable to OsO<sub>4</sub>. Always use glass containers.

Always store OsO<sub>4</sub> away from organic solvents, strong reducing agents and food stuffs.

It is recommended that OsO<sub>4</sub> solutions be stored in glass Schott Duran (or equivalent) bottles with Teflon-lined caps. It is common practice to cover these bottle lids with Parafilm®, which discolors when it comes into contact with OsO<sub>4</sub> and can therefore act as an early warning sign for leaks.

Often, bottles containing OsO<sub>4</sub> solutions are stored within secondary containers,

such as larger glass bottles or metal tins to prevent OsO<sub>4</sub> vapors from escaping into the atmosphere. When this is the case, the bottom of the outer container should be ‘cushioned’ in some way, so as to avoid the inner bottle from breaking. Vermiculite is an excellent option as it acts as both cushion, to prevent abrasion, and absorbent in the case of spills.

All OsO<sub>4</sub> containing vessels, including those used for secondary containment, should be clearly labeled with the chemical name and the appropriate hazard signs.

Refrigerators containing OsO<sub>4</sub> should be locked in the absence of authorized personnel and should be clearly labeled with a caution sign such as “No Food or Beverage in this Refrigerator” or “Chemical Storage Only”.

## Ampoule Opening

### Straight walled Ampoule with scoring line



- Tap ampoule gently to accumulate  $\text{OsO}_4$  in the bottom of the ampoule
- Heat the tip of a glass rod over a flame and touch the hot tip to the scoring line
- The scoring line should now extend so as to form a complete ring around the middle of the ampoule
- Snap ampoule at the scoring line

### Straight walled Ampoule without scoring line



- Tap ampoule gently to accumulate  $\text{OsO}_4$  in the bottom of the ampoule
- Use a scoring knife to make a score mark in the middle of the ampoule and then proceed as above
- OR
- Hold the ampoule in one hand with the bottom on a flat surface
- Using a medium sized Philips screw driver, puncture the top of the ampoule

### Indented Ampoule



- Tap ampoule gently to accumulate  $\text{OsO}_4$  in the bottom of the ampoule
- Snap ampoule at indentation\*

\*There are many commercially available devices that are specifically designed to aid with the opening of ampoules and the prevention of sharps-related injuries

## Important

When opening glass ampoules, care must be taken to avoid the sharp edges and small glass shards that may form. The best way to do this is to add the sealed ampoule to a beaker or Erlenmeyer flask containing the volumetrically correct amount of distilled

water or appropriate buffer needed to make up a solution of desired concentration. With the ampoule at the bottom of the glass flask or beaker, use a glass rod to puncture or crush the ampoule and release the  $\text{OsO}_4$  into solution.

## $\text{OsO}_4$ Trouble Shooting

### $\text{OsO}_4$ adheres to sides/top of glass ampoule

This is a common problem with  $\text{OsO}_4$  – the inherently volatile compound tends to sublime within sealed ampoules, especially during transit, resulting in some of the crystals becoming ‘stuck’ on the inner glass walls of the ampoules. This problem is best solved by cooling the  $\text{OsO}_4$  to close to freezing or below, followed by firm tapping on a wooden block or surface. Cooling can be achieved in a number of ways:

1. Leave ampoule in a freezer for 10 minutes
2. Submerge ampoule in a small quantity of dry ice
3. Submerge ampoule in a small quantity of ice that has been premixed with a suitable salt
4. Dip ampoule in volatile solvent (e.g. Ethanol, Acetone) and then blow air onto the ampoule to evaporate the solvent

### $\text{OsO}_4$ in the ampoule appears as a solid mass and not as free flowing crystals

This phenomenon can also be attributed to the sublimation of  $\text{OsO}_4$  inside sealed

ampoules and should not be perceived as product non-conformance. The problem can be solved by gently heating the ampoules in a water bath until all the  $\text{OsO}_4$  is melted followed by cooling in dry ice and tapping on a wooden surface. This will cause the  $\text{OsO}_4$  to form small, free flowing crystals within the ampoules.

## Discoloration or darkening of outer packaging

During the packaging process, all care is taken to ensure that the glass ampoules are completely sealed and free of flaws, however in exceptional cases, an ampoule leak may occur. To prevent defective ampoules from reaching the end user, a screening period between final packaging and shipment of product is enforced. During this period, any leaking or defective ampoules are identified and discarded. In the rare event that discoloration is observed by the customer, the supplier should be immediately notified of the incident and the affected  $\text{OsO}_4$  should be removed to a fume hood before returning to the supplier.

## Dark spots/discoloration of $\text{OsO}_4$ crystals

$\text{OsO}_4$  crystals should be clear and have a bright to pale, straw-yellow color. The appearance of any black spots indicates that impurities are present, while a green to black discoloration is indicative of  $\text{OsO}_4$  reduction. The supplier should be immediately notified of either impurities or discoloration of the product and the  $\text{OsO}_4$  should be returned to the supplier.

## Dealing with OsO<sub>4</sub> Spills

Any OsO<sub>4</sub> spill must be treated as serious – clean up should be approached with caution and should only be attempted by individuals that have had the necessary training.

It is advisable for laboratories in which OsO<sub>4</sub> is regularly used to keep a spill kit on hand for emergencies.

These kits should contain:

- Sealable plastic bags
- A plastic scoop
- Hazardous chemical labels
- An adsorbent (cat litter is commonly used), presoaked in vegetable oil
- Aqueous sodium sulfite solution
- A list with the names and numbers personnel to contact in emergencies
- The name and telephone number of the nearest Hazmat team

In the case of small spills (10ml or less) that occur inside a certified fume hood, proceed as follows:

- Alert people in immediate vicinity of the incident
- Ensure that appropriate PPE is worn during clean up
- Cover spill with oil-soaked vegetable oil
- Use a scoop to transfer material into a sealable plastic bag
- Seal the above bag and place inside a second plastic bag

- Use sodium sulfite solution and then detergent to wash the spill area
- Carefully remove PPE and place inside outer plastic bag
- Seal above bag
- Label the bag with a hazardous chemicals label, which clearly identifies the contents as OsO<sub>4</sub>
- Arrange for the waste to be collected by a Hazmat team

In the case of larger spills or spills that occur outside of a certified fume hood, DO NOT attempt to clean up the spill:

- Alert people in the immediate vicinity to evacuate the area
- Close off the affected room/lab/area to isolate the spill
- Place an appropriate warning sign on the doors, e.g. 'Osmium Tetroxide Spill, DO NOT ENTER'
- Contact the nearest Hazmat team for clean up
- Notify emergency contact person(s) of the incident

In case of accidental exposure:

- In the case of inhalation of OsO<sub>4</sub> vapors, move victim to fresh air and immediately seek medical attention.
- Unconscious victims should be placed in the recovery position.
- If OsO<sub>4</sub> is spilled on skin or clothing, the affected area should

be rinsed with clean running water, under a safety shower, for at least 15 minutes. While washing, any contaminated clothing should be removed.

- When  $\text{OsO}_4$  comes into contact with the eyes, they should be held open and rinsed under running

water for several minutes. Please seek immediate medical attention after this.

- In case of accidental  $\text{OsO}_4$  ingestion, rinse mouth and drink plenty of water. DO NOT induce vomiting. Seek immediate medical attention.

## Disposing of $\text{OsO}_4$

DO NOT dispose of  $\text{OsO}_4$  solutions down laboratory sink or flush down a drain.

Spent  $\text{OsO}_4$  solutions should be neutralized after use. This can be done by adding vegetable oil or sodium sulfite to the solution. The solution should turn completely black. To test whether all the  $\text{OsO}_4$  has been neutralized, dip a piece of filter paper in vegetable oil and hold over the solution. Any blackening of the paper indicates that  $\text{OsO}_4$  is still present.

Store neutralized  $\text{OsO}_4$  in leak-proof waste containers that have been clearly labeled as containing  $\text{OsO}_4$ .

Pipette tips, gloves, ampoules and any packaging that have been contaminated with  $\text{OsO}_4$  should be stored in leak proof containers that have been labeled as hazardous waste.

Arrange for collection and disposal by certified Hazardous waste service.

Outer packaging that has not been contaminated with  $\text{OsO}_4$  may be recycled or disposed of as normal waste.

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