



Osmium Tetroxide

Information for the Public

What is osmium tetroxide?

Osmium tetroxide (otherwise known as osmic acid anhydride, osmium oxide, and osmium tetraoxide) is an extremely toxic substance that is a colorless to pale yellow or white crystalline solid with an acrid and unpleasant “chlorine-like” odor at room temperature. Since vapors can be created directly from the solid state at temperatures much lower than its boiling point, the importance of using osmium tetroxide in well-ventilated premises cannot be overstated due to its extremely high short-term toxicity. It has limited solubility in water and acts as a very strong and rapid oxidizer.

The general public was made aware of osmium tetroxide through a recently described plot to deploy this chemical in an “Improvised Explosive Device (IED)”;

 however, the suspects were not able to acquire the chemical before the plot was interrupted. It should be noted that the heating of this compound would result in decomposition of osmium tetroxide to osmium metal or osmium dioxide (both of which are much less toxic than the tetroxide form), so the likelihood of a successful attack with an IED containing osmium tetroxide appears suspect.

How is osmium tetroxide used?

Osmium tetroxide is primarily used as a staining agent for biological samples in the process known as “fixing.” Fixing allows very small structures to be seen under a electron microscope. This compound is also in the synthesis of certain organic compounds and as an industrial catalyst and/or oxidizing agent.

Occupational exposures to osmium tetroxide usually are associated with metal-working facilities that process copper and/or platinum; however, osmium is used in conjunction with electron microscopy and photography as well. In commercially available packages of 5 grams or more, osmium tetroxide is specially formulated to eliminate the acute vapor hazards and would not be useful in an IED.

How can people be exposed to osmium tetroxide?

- Breathing – Inhalation of vapor and/or aerosols of osmium tetroxide can cause adverse health effects. Gaseous osmium tetroxide can occur near industrial operations that roast, smelt, or refine copper. Leaving powdered osmium exposed to air in a room will slowly create osmium tetroxide, at room temperature. Similarly, osmium tetroxide vapor will readily be released from a liquid solution at room temperature.
- Eating/Drinking – Accidental ingestion of the compound itself can lead to adverse health effects. While food contamination would be possible if a solution of osmium tetroxide was used, this is not a likely route of exposure.
- Skin/Eye Contact – Vapors, liquids and aerosols can come into contact with the skin and/or eyes to cause adverse health effects. Liquid solutions used to dissolve platinum metals can create spray containing osmium compounds, including oxides.

How can osmium tetroxide affect my health?

The degree of reaction to exposure to any chemical depends on three main factors: the amount one is exposed to, the route of exposure (breathing, touching, etc.), and the length of time of the exposure.

- Acute/short-term: Osmium tetroxide is generally corrosive and can cause chemical burns to the skin, eyes, and respiratory tract. Acute inhalation exposure can lead to a burning sensation, tearing, cough, headache, wheezing, shortness of breath, pulmonary edema, and, ultimately, death at high concentrations. This edema can often be delayed by several hours after exposure. Prolonged medical observation may be necessary.
- Acute skin exposures can cause redness/rash, skin burns, pain, skin discoloration, and blisters. Black staining on the skin can result from conversion of osmium tetroxide to osmium dioxide (which is much less reactive and toxic than osmium tetroxide). This staining of the skin can also occur upon exposure to osmium tetroxide dissolved in water.
- Acute eye exposures can cause redness, pain, visual disturbances, severe tissue burns, severe conjunctivitis, and possible permanent loss of vision. The cornea can literally be stained black upon acute exposure.
- Acute ingestion exposure can cause abdominal cramps, burning sensation, vomiting, and even shock or collapse.
- Exposure to low levels (0.1 to 0.6 mg/m³) can cause tearing, vision disturbances (including reports of seeing “halos around lights”), headache, conjunctivitis, and cough in occupational settings.
- Chronic/long-term: Chronic low-level inhalation exposures can lead to insomnia, digestive disturbance, and distress to the pharynx (back of the throat) and larynx (voice box). Prolonged contact with skin can lead to dermatitis (inflammation of the skin). Mild kidney damage has been observed in animals with long-term exposures; however, persons with pre-existing kidney disease may be more susceptible to this effect.

- No information regarding carcinogenicity is available. Some animal evidence suggests that osmium tetroxide exposure could lead to reproductive health effects in males. There is also some evidence that osmium tetroxide can damage DNA (“genotoxic”).

What should I do if I have been exposed?

- If you think you have been exposed to a solution (liquid) or vapor of osmium tetroxide: rinse entire body and clothing with water, remove all contaminated clothing and wash your entire body again with soap and water. Clothing that would need to be pulled over the head should be cut off the body to avoid further contact with skin. Seek medical care as soon as possible.
- If you think you have swallowed osmium tetroxide, rinse out mouth with water. Do NOT drink anything. Seek medical care as soon as possible.
- If you think your eyes have been exposed to a liquid or vapor of osmium tetroxide, rinse eyes with plenty of water for at least 15 minutes. Remove contact lenses if easily possible. Seek medical care as soon as possible.

How is osmium tetroxide exposure treated?

Treatment involves removing the exposed individual from the source of exposure, removing osmium tetroxide from the clothing, skin, and exposed mucous membranes as soon as possible, and providing supportive medical care in a hospital setting. There is no antidote to osmium tetroxide poisoning.

How can I prevent or minimize my exposure?

- Under normal occupational conditions, wear the appropriate protective clothing and make sure that hazard and warning information is posted in the work area.
- Under accidental or intentional release conditions, leave the area where the osmium tetroxide was released. If outdoors, move upwind from the smell. If indoors, leave the building immediately. Avoid low-lying areas as vapor is heavier than air.

Where can I get more information?

- Local Health Departments. Call (517) 485-0660 or visit <http://www.malph.org/page.cfm/108/> on the Internet for your jurisdiction.
- The Michigan Department of Community Health “Toxics and Health Hotline” (1-800-648-6942)
- The Agency for Toxic Substances and Disease Registry (1-888-422-8737)
- The Centers for Disease Control & Prevention “Public Response Hotline” (1-888-246-2675)

**For immediate assistance, call the Poison Control Center hotline:
1-800-222-1222**