Spills, Deactivation, and Disposal of Glutaraldehyde

Spills

Prompt and appropriate attention to drips, splashes, and spills is important to reduce the potential for unnecessary exposure to glutaraldehyde, especially to vapor concentrations above the prescribed exposure limit value[1].

Avoid making contact with spilled material, taking care not to step in spills since glutaraldehyde will be absorbed by most shoes. When cleaning up a spill, always wear the correct protective equipment, consisting of splashproof monogoggles, or both safety glasses with side shields and a wraparound full-face shield, appropriate gloves[2], and protective clothing. A self-contained breathing apparatus or respirator and absorbents, may be necessary, depending on the size of the spill and the adequacy of ventilation.

Spill Containment Plan

A spill containment plan for glutaraldehyde should be in place and should include easy access to equipment for cleaning up a spill, as well as procedures for alerting personnel, avoiding glutaraldehyde contact, and, if necessary, evacuating non-essential personnel until the spill has been neutralized and disposed of. Type of ventilation, air turnover rate, the size and temperature of the room, and the quantity spilled are important considerations.

Cleanup of Spills

Small Spills

To clean up small spills, wear the correct protective equipment and cover the liquid with absorbent material. Collect and seal the material in polyethylene bags and place in a drum for transit to an approved disposal site.

Dirt that has absorbed the spilled material should also be collected and similarly disposed of.

The remaining spilled material may be rinsed away with water to reduce odor; however, it is important to ensure that the rinsate is discharged into a municipal or industrial sewer, not into a natural waterway.

Large Spills

Large spills that cause nasal and respiratory irritation indicate that the area should be evacuated and cleaned up by a trained team. The appropriate safety and governmental personnel should be notified immediately.

If tearing of the eyes and nasal or respiratory irritation occur with a spill, then the room ventilation is inadequate to handle the spill. The room should be vacated immediately until a team equipped to handle a larger spill is on the scene.

Personnel cleaning up a larger spill should be trained and equipped with a self-contained breathing apparatus, or, if not available, an officially approved or certified air-purifying respirator equipped with an organic vapor cartridge. They should also wear splash-proof monogoggles, or both safety glasses with side shields and a wraparound full-face shield, gloves, and clothing impervious to glutaraldehyde, including rubber boots or shoe protection.

Pour an appropriate deactivation compound (see below) into the spilled glutaraldehyde. Collect the neutralized liquid and, if appropriate, flush it down the drain with large amounts of fresh water.

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Depending on the quantity spilled, absorbents may be needed. Large spills should be contained and deactivated before disposal.

Although the methods listed below will deactivate glutaraldehyde, there may be other components present in a particular formulation that must also be considered before effective and safe cleanup is initiated. Please consult the manufacturer of the other chemical components in the formulation for further details and precautions.

Chemical Deactivation

If dilution to below 5 ppm active is not practical, glutaraldehyde can be deactivated chemically by adding a suitable amount of alkalinating or reducing agents. Two options are available, depending on the concentration of glutaraldehyde to be deactivated.

With Sodium Bisulfite

An effective chemical method that can be used to deactivate concentrations of glutaraldehyde (up to 5%) is by addition of sodium bisulfite (SBS). In order to assure rapid, complete inactivation, it is recommended that 2-3 parts (by weight) of SBS be added per part of active glutaraldehyde. Addition of 2-3 parts SBS will rapidly reduce the concentration of glutaraldehyde in solution to less than 2 ppm active within five minutes at room temperature. The remaining solution can then be disposed of by appropriate means.

The following table illustrates the amounts of SBS needed for different concentrations of glutaraldehyde:

Water Volume, gal (L)	Glutaraldehyde Active Level, ppm	SBS Required, oz (g)
100 (380)	20	0.53-0.8 (15-23)
500 (1900)	100	13.3-20 (380-570)
5 (19)	20,000 (2%)	26.7-40 (760-1140)

Note: SBS reacts readily with other aldehydes and ketones. If other aldehydes or ketones are present, more SBS may be necessary for complete deactivation. There may be other components present in your solution that will not be deactivated by SBS. For a complete summary of the chemistry and toxicology associated with SBS deactivation of glutaraldehyde, see footnote 3.

With Sodium Hydroxide (Caustic Soda)

Glutaraldehyde concentrations up to 2% active may be deactivated by the addition of aqueous sodium hydroxide (caustic soda). Adding a sufficient amount of sodium hydroxide solution to maintain a pH of 12 will reduce the concentration of glutaraldehyde to approximately 20 ppm or less within 8 hours at room temperature. Maintaining the pH at 12 or higher is critical, as a lower pH will result in a significantly slower deactivation of glutaraldehyde. The treated solutions, which now contain a low level of residual glutaraldehyde, should be returned to neutral pH by the careful addition of an inorganic acid (*e.g.*, hydrochloric acid) before disposal by appropriate means.

Disposal

Disposal of Concentrate

Glutaraldehyde-based solutions should not be discharged into lakes, streams, ponds, estuaries, oceans, or other waters unless in accordance with local regulatory procedures [*e.g.*, National Pollutant Discharge Elimination Systems (NPDES) permit]. Do not discharge effluent containing glutaraldehyde to sewer systems without previously notifying the local sewage treatment plant authority. For guidance, contact your Local Water Board, Regional Office of the Environmental Protection Agency, or appropriate regulatory authority.

In unusual circumstances, when you have large quantities of concentrated glutaraldehyde to dispose of (those containing greater than 5% active), high-temperature incineration is an acceptable practice. Under these conditions, glutaraldehyde burns cleanly to carbon dioxide and water.

Disposal of Diluted Product

Two environmentally acceptable methods exist for disposing of solutions of glutaraldehyde. The simpler method involves further dilution to an essentially nonmicrobiocidal concentration (less than 5 ppm

active) in order to allow the glutaraldehyde to biodegrade. The second procedure requires chemical inactivation prior to disposal (see Chemical Deactivation, page 3).

Bio-oxidation of Glutaraldehyde

In the laboratory, the potential rate at which a chemical can degrade is often measured by the Biochemical Oxygen Demand (BOD) test. This standard test involves exposing a test material to an unacclimated sewage sludge and measuring the oxygen demand of the system. Calculations of percent bio-oxidation are correlated to the amount of oxygen required to degrade the chemical completely to carbon dioxide and water. Glutaraldehyde exhibits a Chemical Oxygen Demand (COD) of 1.88 mg O_2, per mg active, as compared to a Theoretical Oxygen Demand (ThOD) of 1.92 mg O_2, per mg active. In a standard BOD test[4], more than 50% of glutaraldehyde is degraded in less than five days.

In tests against sewage microorganisms, the No Effect Concentration (NOEC) to domestic sewage bacteria in an OECD 209 respiratory inhibition study was 16 ppm.

Footnotes

1. For many substances, the exposure limit is expressed as a time-weighted average over an eight-hour working day (TWA_8). For others, it is expressed as a TWA_8 qualified by a short-term exposure limit (STEL), which is a 15-minute TWA that should not be exceeded at any time. The American Conference of Governmental Industrial Hygienist recommends that exposures above the TWA_8 up to the STEL should not be longer than 15 minutes and should not occur more than four times per day. There should be at least 60 minutes between successive exposures in this range. Where the exposure limit may be expressed as a ceiling limit, this value should not be exceeded at any time during the workday.

   The Dow Chemical Company has a formal review process to establish an exposure value to be applied to its workplaces; this is referred to as an Industrial Hygiene Guideline (IHG). IHGs are reviewed periodically to ensure that they provide adequate protection to the worker. This is a compliance limit, applicable worldwide within The Dow Chemical Company. This value must be used within any Dow Chemical plant worldwide in the absence of any regulatory limit or, if it is lower than applicable regulatory limits. Because glutaraldehyde vapor exposure limits are defined differently from country to country, The Dow Chemical Company recommends maintaining levels at or below the applicable requirements of your locale. In the absence of any requirements, The Dow Chemical Company currently recommends maintaining vapor exposure levels at or below 0.05 ppmv as a ceiling value.

2. It is important that the proper size, length, type, and quality of glove be worn when working with glutaraldehyde. Nitrile rubber and butyl rubber are suitable for use with up to 50% glutaraldehyde. While polyethylene and latex gloves are suitable for use with low concentrations of glutaraldehyde (*i.e.*, ≤ 3.4%), they are not recommended for uses with higher concentrations of glutaraldehyde (15-50%). Neoprene and polyvinyl chloride (PVC) gloves, although acceptable for other applications, are not recommended with glutaraldehyde because they retain or absorb glutaraldehyde. For more detailed information refer to: Jordan, S.L.P.; Stowers, M.F.; Trawick, E.G.; Theis, A.B., "Glutaraldehyde Permeation: Choosing the Proper Glove," *Am. J. Infect. Control*, 1996, 24: 67-69.

3. Jordan, S.L.P. *et al.,* 1996, "Inactivation of Glutaraldehyde by Reaction with Sodium Bisulfite," *J. Tox. Envir. Health,* 47: 299-309.

4. *Standard Methods for the Examination of Water and Waste Water,* 14th ed., American Public Health Assoc., 1976, Parts 507 and 508.

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