

ACRYLAMIDE

(For assistance, please contact EHS at (402) 472-4925, or visit our web site at <http://ehs.unl.edu/>)

This SOP provides specialized information for the use, handling, and storage of acrylamide, a suspected carcinogen. **As with any chemical, please read the Material Safety Data Sheet (MSDS) before use.**

Background

Acrylamide is a common research chemical used in laboratories as a cross linking (polymerizing) agent during gel chromatography and electrophoresis. Daily use of this chemical without manifesting symptoms of overexposure may lead to a false sense of security on the part of laboratory personnel. Acrylamide is toxic by all routes of exposure with the effects of overexposure often delayed from days to months, and in some cases, years. Therefore, laboratory workers must take precautions to prevent skin contact, inhalation, and accidental ingestion, even in small quantities.

Data concerning acrylamide poisonings in the laboratory has not been extensively studied. The most numerous sources of reports concerning poisonings resulting from overexposure have been associated with manufacturing or mining environments. In these industries, the most common routes of exposure leading to symptoms of toxicity have been the result of, in decreasing order frequency, skin contact, inhalation, and then ingestion. Injection, while not a common route of acrylamide poisoning in a laboratory or occupational setting, would be expected to effect toxicity at lower doses, based upon animal studies.

Affects of Overexposure

Acrylamide is known to attack the nervous system, and in particular the peripheral nervous system. The peripheral nervous system, also known as the sensory nervous system, involves the sense of touch and balance coordination necessary to carry out normal daily tasks such as walking, writing, and cooking. Early signs of acrylamide poisoning often include tingling in the fingers, numbness in the legs and feet, tenderness to the touch, excessive sweating of the feet and hands, bluish-red skin, peeling of the skin of the hands, and less often peeling of the feet. These symptoms may be followed quickly by others including muscle weakness of the hands and feet with the resultant loss of the ability to write or walk. Even later symptoms include weight

loss and drowsiness, weak or absent tendon reflexes, such as the knee jerk, muscular atrophy in the hand or thumb, and occasionally urinary and fecal retention.

Routes of Exposure

While the toxicity of many chemicals vary depending upon whether they are inhaled, absorbed through the skin, or ingested, the symptoms of overexposure to acrylamide appear to be the same regardless of the route of exposure. In addition, because the chemical readily absorbs through the skin, it is not “safer” to spill acrylamide on exposed skin than to breathe it.

Acute Verses Chronic Effects

In many cases, chemicals express both acute (short-term) and chronic (long-term) effects based upon the type of exposure. In studies reviewed for this SOP, the exact time between acute exposure and acute effects in humans was not known. The onset of symptoms was reported to vary from four weeks to 24 months or more. This makes the risk of over exposure to acrylamide particularly hazardous because an acute exposure may not yield symptoms of toxicity for several days to weeks after exposure, during which time there may be continued exposure. It is also difficult to determine whether resulting symptoms of poisoning are due to acute or chronic exposures. A further complication is that the symptoms of acute exposure parallel those of chronic exposure for many if not most symptoms.

It is prudent to maintain vigilance during the use of acrylamide and to take time to learn all of the symptoms of overexposure. This will help to mitigate the fact that there are virtually no warning properties and symptoms of acrylamide poisoning may be delayed. The following list of symptoms is provided in order of the most commonly reported symptoms from overexposure and whether the symptoms appeared earlier or later based upon reports reviewed from the National Institutes of Health:

Initial symptoms:

- Numbness, tingling, and tenderness to the touch.
- Skin and eye irritation.

Later symptoms (days or 1 to 2 weeks):

- Coldness of the hands and fingers.
- Coldness of the feet and toes (less often).
- Excessive sweating (concurrently or occasionally somewhat later).
- Bluish-red skin on the hands (concurrently or occasionally somewhat later).
- Peeling of the hands and less often the feet (concurrently or occasionally somewhat later).

Later symptoms:

- Fatigue.
- Marked weakness of the limb muscles.
- Fecal and urine retention (may be more related to ingestion).
- Changes in personality (may occur from large doses or ingestion).

Cancer Hazard:

Acrylamide is a probable human carcinogen. Repeated exposure to slightly higher amounts may induce multi-site cancers.

Reproductive Hazard:

Acrylamide has been reported to be a reproductive hazard based mainly upon animal studies which led to reproductive effects, including abortion, reduced fertility, and mutagenicity.

Methods to Control Exposure

Acrylamide use in the laboratory is considered a high risk and as such is included in the UNL Chemical Hygiene Plan as a restricted use chemical requiring notification and special use criteria. It has a low vapor pressure and does not usually form stable aerosols, thus the most probable route of exposure is skin absorption, though it is toxic by any route.

Acrylamide is commercially available in pre-mixed aqueous solutions or in powder form. In the powder form, Acrylamide is odorless and white in color. In its powder form, the monomer is extremely dangerous because the dust can easily become airborne and enter the respiratory system. In this regard, pre-mixed Acrylamide is safer to use.

Therefore, Researchers are strongly encouraged to purchase pre-made stock solutions or readymade gels. Toxicity and exposure potential decreases dramatically after Acrylamide has polymerized. However, since complete polymerization cannot be assured, exposure remains a concern. The following safety procedures should be followed by laboratory workers who handle Acrylamide.

Storage

- Keep containers tightly closed to prevent acrylamide from subliming and entering the atmosphere.
- Store in a cool place.
- Prevent contact with oxidizing materials, reducing agents, acids, bases, metals, UV light, and other contaminants.

Measuring Acrylamide Powders

While laboratory personnel are strongly encouraged to purchase aqueous stock solutions or pre-made gels, the following procedures are recommended if it is necessary to use acrylamide in powder form.

- Wear gloves, a lab coat, and goggles during measuring, weighing, and mixing operations. If there is a risk of splash, wear a full face shield. Ensure that the entire hand and arm area is covered. Do not allow a break in protective coverage at the wrist if coat and gloves do not overlap.
- Use a chemical fume hood to measure an amount of acrylamide into a pre-weighed, closable container. Tightly close container for transport.
- The closed container can then be moved safely from the hood to the balance to be weighed. If more or less material is needed, return the container to the hood and adjust the amount of material.

Pouring gels

- Since there is never complete polymerization, gels should be considered hazardous due to residual acrylamide monomer.
- After the gel is poured, allow residual acrylamide to polymerize in the flask.
- Polymerized gel can be loosened from the flask with a spatula then disposed of in the collection receptacle for pickup by EHS.
- Areas where gels are poured should be protected with a lab bench cover. Bench covers should be disposed via EHS upon contamination from spilling or after usage.

Post-electrophoresis

- Wear appropriate PPE (gloves, eye protection, lab coats) when dismantling electrophoresis apparatus.
- Gels that are stained with coomassie blue, and then rinsed in a solution containing less than 10% methanol, may be placed in a collection receptacle to dry. When the receptacle is full, the container should be tagged for EHS disposal.
- It is permissible to use the same receptacle for acrylamide and agarose gels, however, if gels are silver stained, they must be collected separately for EHS disposal.

Spill response

- **Small dry spill:** Scrape material into a clean, dry container and cover. Do not create an airborne dust. Clean spill area thoroughly with soap and water.
- **Small liquid spill:** Absorb liquid using vermiculite or Polyzorb from Spill Kit and place into containers for later disposal via EHS. Clean spill area thoroughly with soap and water. In case of a large spill outside of the fume hood: Notify others in the room of the spill. Evacuate the room and contact EHS (472-4925 or '0' for the campus operator after normal working hours). Post room with a warning notifying others of the spill to prevent unnecessary entry.

References: Information contained in this SOP was gathered from the following sources: CDC and National Institutes of Health, Howard Hughes Medical Institute, University of Melbourne, University of Delaware, Albert Einstein College of Medicine, and Northwestern University.