

# Safety Data Sheet

# Acrylamide

Division of Safety  
National Institutes  
of Health



## WARNING!

THIS COMPOUND IS TOXIC. IT IS READILY ABSORBED THROUGH THE SKIN AND RESPIRATORY AND INTESTINAL TRACTS AND TRANSPLACENTALLY. IT MAY CAUSE SEVERE IRRITATION OF THE SKIN AND EYES. AVOID FORMATION AND BREATHING OF AEROSOLS.

LABORATORY OPERATIONS SHOULD BE CONDUCTED IN A FUME HOOD, GLOVE BOX, OR VENTILATED CABINET.

AVOID SKIN CONTACT: IF EXPOSED, WASH WITH SOAP AND WATER.

FOR EYE EXPOSURE, IRRIGATE IMMEDIATELY WITH LARGE AMOUNTS OF WATER. FOR INGESTION, DRINK MILK OR WATER. FOR INHALATION, REMOVE VICTIM PROMPTLY TO CLEAN AIR. ADMINISTER RESCUE BREATHING IF NECESSARY. REFER TO PHYSICIAN.

IN CASE OF LABORATORY SPILL, WEAR PROTECTIVE CLOTHING DURING CLEANUP. AVOID SKIN CONTACT OR BREATHING OF AEROSOLS. USE ABSORBENT PAPER TO MOP UP SPILL. WASH DOWN AREA WITH WATER. DISPOSE OF WASTE SOLUTIONS AND MATERIALS APPROPRIATELY.

### A. Background

Acrylamide is a white crystalline solid, highly soluble in water and moderately soluble in some common organic solvents. It is toxic to the peripheral and perhaps the central nervous system and highly irritating on contact with skin and eyes. Acrylamide is an important industrial product as an intermediary in the manufacture of polymers and copolymers which are used as flocculants for waste and water treatment, in paper making, soil stabilization, and preparation of electrophoretic gels.

issued: 6/83

Prepared by the Environmental  
Control and Research Program

The proposed permissible exposure limit to acrylamide is 0.03 mg/m<sup>3</sup> as an 8-hour time weighted average (ACGIH, 1986).

A review of chemical, technological and biological properties of acrylamide may be consulted (McWilliams, 1978).

## B. Chemical and Physical Data

1. Chemical Abstract No.: 79-06-1
2. Synonyms: Acrylic acid amide; 2-propenamamide\*; propenoic acid amide.
3. Chemical formula: C<sub>3</sub>H<sub>5</sub>NO; CH<sub>2</sub> = CHCONH<sub>2</sub>; molecular weight: 71.08
4. Density: 1.123 g/cm<sup>3</sup> at 30°C.
5. Absorption spectroscopy: Data for ultraviolet, infrared, NMR and mass spectra have been tabulated (Grasselli and Ritchey, 1975). Maximum ultraviolet absorption is at 198 nm (Skelly and Husser, 1978).
6. Volatility: Vapor pressure is 0.007 mm Hg at 25°C, 0.033 mm Hg at 40°C and 0.07 mm Hg at 50°C. Graphs for vapor pressure of solid and liquid acrylamide in the range 10-150°C have been published (Carpenter and Davis, 1957).
7. Solubility: Solubility in g/100 ml solvent at 30°C is: water 215.5; methanol, 155; ethanol, 86.2; acetone 63.1; ethyl acetate 12.6; chloroform 2.66. Slightly soluble in non-polar aromatic and aliphatic solvents.
8. Description: White crystalline leaves; odorless.
9. Boiling point: 87°C at 2 mm Hg, 103°C at 5 mm Hg, 125°C at 25 mm Hg.  
Melting point: 84.5 ± 0.3°C.
10. Stability: Stable if kept in a cool dark place. Readily polymerizes under UV light and at elevated temperatures (polymerization becomes significant above 50°C, and is rapid, with heat evolution, at the melting point). The 50% aqueous solution, which is commonly used for commercial purposes, is usually stabilized by addition of cupric ion (25-30 ppm, air saturated), or antioxidants such as hydroquinone or tert-butylpyrocatechol.

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\*Chemical Abstracts index name from Vol. 76 to date.

11. Chemical reactivity: Acrylamide consists of an amide and a vinyl group. The amide group is hydrolyzed by acids or bases to form acrylic acid, or dehydrated to yield acrylonitrile. The vinyl group may be hydrogenated or halogenated, or yield Michael type addition compounds with alcohols or primary amines. The addition compound with sodium bisulfite is nontoxic and this reaction has been used for scavenging and detoxifying acrylamide residues.
12. Flash point: No data.
13. Autoignition temperature: No data.
14. Explosive limits in air: No data.

### Fire, Explosion and Reactivity Hazard

1. Use water, foam, carbon dioxide or dry chemical fire extinguishers. Fire-fighting personnel should wear protective clothing and air-supplied respirators with full face masks or chemical cartridge respirators.
2. There are no data on flammability of acrylamide and it is likely to be low. However, its polymerization at elevated temperatures may be explosive.
3. Conditions contributing to instability are high temperatures, UV light and presence of polymerization catalysts.
4. A hazardous decomposition product is the carcinogenic, flammable and toxic acrylonitrile.
5. Do not expose to open flames.

### Operational Procedures

The NIH Guidelines for the Laboratory Use of Chemical Carcinogens describe operational practices to be followed when potentially carcinogenic chemicals are used in NIH laboratories. The NIH Guidelines should be consulted to identify the proper use conditions required and specific controls to be implemented during normal and complex operations or manipulations involving acrylamide.

It should be emphasized that this data sheet and the NIH Guidelines are intended as starting points for the implementation of good laboratory practices when using this compound. The practices and procedures described in the following sections pertain to the National Institutes of Health and may not be universally applicable to other institutions. Administrators and/or researchers at other institutions should modify the following items as needed to reflect their individual management system and current occupational and environmental regulations.

1. Chemical inactivation: No validated method reported.
2. Decontamination: Turn off equipment that could be affected by acrylamide or the materials used for cleanup. If there is any uncertainty regarding the procedures to be followed for decontamination, call the NIH Fire Department (dial 116) for assistance. Use absorbent paper to mop up spill. Wipe off surfaces with water. Glassware should be rinsed (in a hood) with 10% NaOH, followed by soap and water. Animal cages should be washed with water.
3. Disposal: No waste streams containing acrylamide shall be disposed of in sinks or general refuse. Surplus acrylamide or chemical waste streams contaminated with acrylamide shall be handled as hazardous chemical waste and disposed of in accordance with the NIH chemical waste disposal system. Nonchemical waste (e.g., animal carcasses and bedding) containing acrylamide shall be handled and packaged for incineration in accordance with the NIH medical-pathological waste disposal system. Potentially infectious waste (e.g., tissue cultures) containing acrylamide shall be packaged for incineration, as above. Burnable waste (e.g., absorbent bench top liners) minimally contaminated with acrylamide shall be handled as potentially infectious waste and packaged for incineration, as above. Absorbent materials (e.g., associated with spill cleanup) grossly contaminated shall be handled in accordance with the chemical waste disposal system. Radioactive waste containing acrylamide shall be handled in accordance with the NIH radioactive waste disposal system.
4. Storage: Store solid acrylamide and its solutions in dark-colored, tightly closed containers, preferably under refrigeration.

#### Monitoring and Measurement Procedures Including Direct Field Measurements and Sampling for Subsequent Laboratory Analysis

1. Sampling: NIOSH (1976) recommends sampling of environmental air by means of a glass impinger, with distilled water as the collection medium. The method has been described in more detail, together with description of sample purification for use with polarographic methods of analysis (McLean et al., 1978).
2. Analysis: The NIOSH (1976) recommended method is one of differential pulse polarography as originally described by Betso and McLean (1976), with a detection limit of less than 1 g/ml. Wipe and impinger samples, obtained by the procedures of McLean et al. (1978) have also been analyzed by high performance liquid chromatography either directly and apparently without additional sample purification (Skelly and Husser, 1978), or after conversion to dibromopropionamide (Brown and Rhead, 1979). This lat

method appears to be more sensitive (it has been applied to urine samples) but requires many more steps, and recovery, while constant, is in the neighborhood of 70%. Other methods include spectrophotometry of the colored Schiff base formed between Ehrlich's reagent and the reaction product of acrylamide and diazomethane (Mattocks, 1968), electron capture gas chromatography (Croll and Simkins, 1972) and thin layer chromatography (Croll, 1971). Most of these methods were devised for the determination of acrylamide monomer in polyacrylamides, and with the exceptions noted above have not been adapted to biological samples.

### Biological Effects (Animal and Human)

1. Absorption: Acrylamide is readily absorbed and produces toxic effects by inhalation, ingestion and through the skin. It is a potent eye irritant but it is not known whether systemic effects are produced via the intraocular route. Acrylamide passes through the placenta but no embryo toxicity has been noted (Edwards, 1976)
2. Distribution: The radiolabel of acrylamide, whether labeled in the carbonyl (Spencer and Schaumburg, 1974a) or the vinyl group (Miller et al., 1982) is quickly distributed to all tissues following intravenous injection or feeding.
3. Metabolism and excretion: Much of the  $^{14}\text{C}$  label of orally or intravenously administered acrylamide is rapidly excreted in the urine. Elimination from most tissues of the rat is biphasic, with a terminal half time of about 8 days; 62% and 71% of intravenously administered label is excreted in the urine in 24 hours and 7 days respectively. Most of the acrylamide undergoes biotransformation since less than 2% is excreted unchanged. The major urinary excretion product, accounting for almost 50% of the administered dose is a conjugation product with glutathione, N-acetyl-S-(3-amino-3-oxypropyl)cysteine, together with smaller amounts of three as yet unidentified other metabolites (Miller et al., 1982). Fecal excretion is minimal (about 5%). It was shown previously (Hashimoto and Aldridge, 1970) that intravenous acrylamide in rats results in a great decrease in non-protein sulfhydryl concentration, particularly in liver but also significantly in nervous tissue.

That portion of the  $^{14}\text{C}$  label which is not excreted rapidly is bound rather firmly to tissue proteins, particularly to hemoglobin but also in brain. So far, these findings have not resulted in an explanation of the mechanism of neurotoxicity of acrylamide; for instance, several analogs of acrylamide exhibit very similar distribution or metabolic properties but much lower or no neurotoxicity (Edwards, 1975a, b).

4. Toxic effects: The acute oral LD50 is in the range of 150-180 mg/kg in the rat, guinea pig, and rabbit (McCollister et al., 1964). The cat seems to be the most sensitive species to the toxic effects of acrylamide but no quantitative data are available for this species.

The first human cases of acrylamide intoxication involved workers involved with transfer and handling of this material in solution or solid form (Auld and Bedwell, 1967; Graland and Patterson, 1967) and the data of these and subsequent authors have been reviewed (Spencer and Schaumburg, 1974a, 1975). Prolonged skin contact results in local dermatitis and rashes, followed by progressive peripheral neuropathy including unsteadiness, numbness of hands and feet followed by weakness of arms and legs. These effects have been attributed to a slow progressive retrograde degeneration ("dying back") of the peripheral nervous system. Removal of workers from exposure to acrylamide resulted in complete recovery, its length depending on extent and duration of exposure.

Animal data support the above clinical observations (McCollister et al., 1964). Acute exposures, regardless of route and dose, result in hypotension, incoordination, behavioral changes and convulsions. Death is probably due to laryngeal spasm, however if the dose is not fatal recovery is usually quick and complete (Spencer and Schaumburg, 1974b). The "dying back" phenomenon has been confirmed histologically in rats (Fullerton and Barnes, 1966), cats (Prineas, 1969), and baboons (Hopkins, 1970) and appears to be a Wallerian type of degeneration affecting the distal ends of the largest diameter fibers. As in man, complete recovery results if the dose was not fatal. Central nervous system involvement has been suspected in some cases but not definitely proved.

Acrylamide solutions are a strong eye irritant, producing conjunctival irritation and corneal injury from which animals recovered within 24 hours (McCollister et al., 1964). Effects on visual acuity and other parameters of vision in macaque monkeys have also been noted in chronic feeding studies (Merigan et al., 1982).

5. Carcinogenic effects: There have been no reports concerning carcinogenicity of acrylamide.
6. Mutagenic and teratogenic effects: Acrylamide is not mutagenic in a variety of Salmonella strains, with or without activation (Lijinsky and Andrews, 1980). Chromosome aberrations and a decrease in mitotic cells have been noted in mice following single intraperitoneal injections of acrylamide (Shirashi, 1978).

### Emergency Treatment

1. Skin and eye exposure: For skin exposure, remove contaminated clothing and wash skin with soap and water. For eye exposure, irrigate immediately with copious quantities of running water for at least 15 minutes.
2. Ingestion: Drink plenty of water or milk.

3. Inhalation: Remove victim promptly to clean air. Administer rescue breathing if necessary.
4. Refer to physician.

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