Acrylonitrile

Updated: November 2018

CAS number 107-13-1

Acrylonitrile is a volatile, flammable, water-soluble liquid at room temperature. Acrylonitrile has a pungent, onion- or garlic-like odor.

It can be dissolved in water and evaporates quickly [ATSDR].

The vapors are explosive, with cyanide gas being produced.

Acrylonitrile may be found in the soil, water, or air near industrial sites where it is made, or at hazardous waste sites where it has been disposed of. Because acrylonitrile evaporates easily, most of it is released to the air from facilities where it is produced and used. Acrylonitrile can enter groundwater by filtering through the soil, but it is not commonly found in groundwater [ATSDR].

Usage and exposure

The large majority of acrylonitrile in Canada is used as a feedstock or chemical aid in the production of nitrilebutadiene rubber and in acrylonitrile-butadiene-styrene and styrene-acrylonitrile polymers. Estimated world capacity in 1993 was about 4 million tonnes. Major areas of production are the European Union (>1.25 million tonnes per year), the USA (approximately 1.5 million tonnes per year), and Japan (approximately 0.6 million tonnes per year) [WHO].

Acrylonitrile is released into the environment primarily from chemical production and the chemical and plastic products industries [WHO].

Occupational exposure to acrylonitrile occurs during production and its use in the manufacture of other products [WHO].

Acrylonitrile is primarily used in the manufacture of acrylic and modacrylic fibers. It is also used as a raw material in the manufacture of plastics (acrylonitrile-butadiene-styrene and styrene-acrylonitrile resins), adiponitrile, acrylamide, and nitrile rubbers and barrier resins [EPA].

Acrylonitrile may be released to the ambient air during its manufacture and use [EPA].

Occupational exposures to acrylonitrile occur in its production and use in the preparation of fibers, resins and other products. It is present in cigarette smoke and has been detected rarely and at low levels in ambient air and water [IARC].

Routs of exposure

Inhalation, skin absorption, ingestion, skin and/or eye contact [CDC].

Human exposure to acrylonitrile appears to be primarily occupational, via inhalation [EPA].

The primary routes of potential exposure in the occupational environment are inhalation and dermal [WHO].

Target organs

Eyes, skin, cardiovascular system, liver, kidneys, central nervous system.

Metabolism

Acute animal tests in rats, mice, rabbits, and guinea pigs have demonstrated acrylonitrile to have high acute toxicity from inhalation and high to extreme acute toxicity from oral or dermal exposure (EPA).

Acrylonitrile is rapidly absorbed via all routes of exposure and distributed throughout examined tissues. There is little potential for significant accumulation in any organ, with most of the compound being excreted primarily as metabolites in the urine within the first 24–48 h following administration [WHO].

Health hazards

Acute effects

In case reports of acute intoxication, effects on the central nervous system characteristic of cyanide poisoning and effects on the liver, manifested as increased enzyme levels in the blood, have been observed. There have also been reports that acrylonitrile is a skin irritant and skin sensitizer, the latter based on patch testing of workers [WHO].

Workers exposed via inhalation to high levels of acrylonitrile for less than an hour experienced mucous membrane irritation, headaches, nausea, feelings of apprehension and nervous irritability; low grade anemia, leukocytosis, kidney irritation, and mild jaundice were also observed in the workers, with these effects subsiding with the ending of exposure. Symptoms associated with acrylonitrile poisoning include limb weakness,

labored and irregular breathing, dizziness and impaired judgment, cyanosis, nausea, collapse, and convulsions [EPA].

Acute dermal exposure may cause severe burns to the skin in humans [EPA].

IARC reported toxic effects of acrylonitrile in humans. A 22-year-old chemist, who was exposed to acrylonitrile vapors, developed headache, vertigo, vomiting, tremors, uncoordinated movements and convulsions One day after exposure, slight liver enlargement and congestion of the oral pharynx, but no disorders of the central nervous system, were noted. After four days, no kidney, liver, cardiac or respiratory abnormalities were detected [IARC].

Workers exposed to 'mild' concentrations of acrylonitrile in synthetic rubber manufacture developed nausea, vomiting, weakness, nasal irritation and an 'oppressive feeling' in the upper respiratory tract [IARC].

Headache, fatigue and diarrhea were observed in some cases, and mild jaundice lasting for several days and accompanied by liver tenderness and low-grade anemia in a few others [IARC].

It was reported of skin damage resulting from occupational contact with acrylonitrile. A burning sensation developed within 5 min to 24 h followed by a reddening of the area, which often blistered after one day. Development of allergic dermatitis is possible [IARC].

Chronic effects

In one study, headaches, fatigue, nausea, and weakness were frequently reported in chronically (long-term) exposed workers [EPA].

Complaints of poor health, headache, decreased work capacity, poor sleep, irritability, chest pains, poor appetite and skin irritation (during the first months of employment only) came from workers employed in the manufacture of acrylonitrile (IARC).

There are no data for any significant abnormality in liver function tests related to acrylonitrile chronic exposure (IARC).

No information is available on the reproductive or developmental effects of acrylonitrile in humans (EPA).

Depression, lability of autonomic functions (lowered arterial pressure, labile pulse, diffuse dermographia, increased sweating, change in orthostatic reflex) were also observed in workers involved in acrylonitrile production (IARC).

No data were available for reproductive and developmental effect (IARC).

The potential carcinogenicity of acrylonitrile in occupationally exposed populations has been investigated in several epidemiological studies. There is inadequate evidence in humans for the carcinogenicity of acrylonitrile. There is sufficient evidence in experimental animals for the carcinogenicity of acrylonitrile. Acrylonitrile is possibly carcinogenic to humans (Group 2B).

References

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