INEOS Nitriles

hydrogen cyanide

Emergency Response and Environmental Data for Hydrogen Cyanide

Initial Spill Response

The immediate response to any release of hydrogen cyanide should be to isolate the area and then to protect those downwind of the spill. Please access the following link to the US DOT *Emergency Response Guidebook Table of Initial Isolation and Protective Action Distances* referring to ID number 1051 for specific instructions:

http://hazmat.dot.gov/pubs/erg/greenpgs.htm

General response guidelines can also be found in the US DOT *Emergency Response Guidebook* by accessing the following link to Guide 117:

http://hazmat.dot.gov/pubs/erg/g117.pdf

Physicochemical Information

Common Name: Hydrogen Cyanide [HCN]

Physical State: Colorless gas shipped under pressure as a liquid

Odor: Faint odor of bitter almond smelled in the concentration range of 1-5 ppm

Specific Gravity/Density: 0.688 (water = 1.0)

Vapor Density: 0.932 (air =1.0)

Vapor Pressure: 610 mm Hg at 20° C

Water Solubility: Completely soluble in water

Evaporation Rate: >1 (water = 1.0)

Flash Point: 0° F (-18° C)

Flammability limits: 6 - 41%

General Information

Hydrogen cyanide is a extremely toxic and flammable compound. Inhalation of vapors and skin contact must be avoided. Exposure to vapor concentrations greater 50 ppm for 30 minutes or skin contact can result in cyanide type poisoning in humans. Exposed individuals must obtain immediate medical treatment.

In any spill situation, the immediate release area and a downwind isolation zone should be established. Vapor generation will be very rapid and vapors can travel a considerable distance. Vapors are easily ignitable at ambient temperature conditions. Remove all sources of ignition.

Containers of hydrogen cyanide in or near a fire can BLEVE. Fire combustion products may be highly toxic and include uncombusted cyanides. Due to the extreme toxicity of hydrogen cyanide vapor, fire fighters should evaluate whether to extinguish fires involving a hydrogen cyanide container/vessel or to allow burning out. Dry chemical, alcohol foam and carbon dioxide are recommended materials for fire fighting.

Hydrogen cyanide is a monomer and is inhibited with sulfuric, phosphoric or glycolic acid to prevent polymerization. Violent polymerization with release of heat and pressure build up may occur when HCN is exposed to temperatures greater than 122° F, fire conditions, strong oxidizers or alkaline materials.

Teflon and butyl rubber are preferred materials to provide protection against skin contact. Supplied air breathing apparatus should be used until monitoring dictates a lower level of protection. Fully encapsulating vapor protecting suits (Hazmat Level A protection) should be used in the immediate release area or when vapor concentrations are unknown.

Effects of Releases to Water

Hydrogen cyanide is miscible in water. Spills will quickly dissolve into the water column causing a reaction and liberating heat. HCN is highly volatile (vapor pressure of 610 mm Hg. @ 20° C) and can volatilize from water into the atmosphere creating potential inhalation concerns in the immediate spill and downwind areas.

At pH less than 9.2, most of the free cyanide in water will exist as hydrogen cyanide. Cyanide can react in water with metals typically present (e.g. K, Na, Fe) to form complexes. Some of these complexes, such as iron and copper cyanide, are very stable and others, such as zinc cyanide, decompose quite readily.

Hydrogen cyanide is highly toxic to freshwater fish. Although aquatic toxicity is highly species and habitat dependent, fish kills will generally occur in the concentration range of 50-100 parts per billion (ppb). Extended exposures to concentrations in the low ppb range are toxic to certain organisms including minnows, bluegill and perch. HCN is considered moderately toxic to invertebrates with kills occurring in the 1-100 ppm range.

Volatilization is the primary removal mechanism from water. Cyanide, at very low concentration, will slowly biodegrade in both fresh and salt water. However, degradation data in water are very limited. The formation of both insoluble and soluble metal complexes would also be significant in salt water. Hydrolysis and photolysis are not expected to be significant removal pathways.

Hydrogen cyanide spilled into water is not expected to adsorb to sediments or suspended particulates. The formation of more stable, insoluble metal complexes may occur in fresh water.

Hydrogen cyanide has a very low bioconcentration factor (BCF<1) and it is not expected to bioaccumulate in aquatic organisms.

The USEPA short term (1-10 days) Drinking Water Health Advisory for cyanide is 0.22 mg/l. The lifetime USEPA Drinking Water Health Advisory for cyanide is 0.154 mg/l.

Mitigation Measures for Releases to Water

In the event of a hydrogen cyanide release, downstream water users and sewer and water treatment operators should be notified that a toxic, volatile chemical has been released into the water and uptake could damage boilers, industrial equipment and treatment processes.

They should be instructed to cease water/sewer uptake, monitor for contamination and consider supplying impacted water users with alternate supplies of fresh water.

Hydrogen cyanide should be expected to go into solution very rapidly depending on the receiving water mixing zones, wave action etc. The use of containment and recovery materials such as booms, spill pillows etc. will not be effective.

Containment dikes, diversion ditches and temporary impoundment's can be erected in low flow streams to contain contaminated water for subsequent treatment.

Recovered contaminated water can be treated by thermal, chemical or wet-air oxidative processes. Alkaline chlorination and ozonation are effective in treating most metal-cyanide complexes. Biological treatment and ion exchange are effective on dilute wastewaters.

Hydrogen cyanide can be removed from water by aeration or sparging techniques. However, this will result in airborne vapor emissions that could create exposure hazards to people in the immediate area or downwind of the release site.

Killed fish and other animals should be collected and inventoried for subsequent resource damage assessment and disposal. A monitoring program shuld be established to track concentrations and impact to receiving waters.

Effects of Releases to Air

Hydrogen cyanide will rapidly volatilize from spill surfaces, soils and water into the atmosphere creating a rapid and serious inhalation hazard in the immediate spill area.

Vapors are very flammable, lighter than air and can travel considerable distances creating exposure, fire and explosion hazard.

Vapors are very irritating to the eyes, skin and respiratory tract and can cause toxic and lethal effects via inhalation and skin absorption.

The odor threshold for many individuals is 1-5 ppm which is below a toxic level, thus giving relatively good warning properties to potentially exposed individuals.

The AIHA Emergency Response Planning Guidelines (ERPG) levels for hydrogen cyanide are as follows:

- ERPG-3: 25 ppm
- ERPG-2: 10 ppm
- ERPG-1: NA

HCN vapors are very stable in air and can be transported considerable distances downwind. The estimated atmospheric half-life is over one year.

Hydrogen cyanide will very slowly degrade in the atmosphere via reaction with photochemically generated hydroxyl radicals. The estimated half-life is 334 days. Since HCN is very soluble, wet deposition is the most probable removal mechanism. HCN is expected to be resistant to direct photolysis.

Mitigation Measures for Releases to Air

The need to protect individuals in the immediate release area is critical as is the need to protect individuals in downwind areas from airborne vapors. Vapors are stable in air and can travel considerable distances. Shelter-in-place instructions or evacuation of affected publics should be considered as conditions warrant. Conditions affecting public protection decisions include meteorological conditions, mitigation measures employed, timing and duration of release, release rate and proximity of unprotected individuals to release area.

If possible, hydrogen cyanide fires should be allowed to burn out since the combustion products pose less of a hazard than HCN vapors.

Water fog or spray can be applied to vapors or fumes to help reduce downwind impact. Note that a water stream sprayed directly onto an hydrogen cyanide pool can liberate heat, spread contamination and accelerate vapor formation.

Alcohol foam, (preferably AFFF/ATC) can be applied to the spill surface and will substantially reduce vapor release. If possible a 6% foam concentration should be applied continuously to prevent foam breakdown.

Note that both water fog and foam application will create contaminated run-off. The establishment of diversion ditches, dikes or other barriers can be used to contain contaminated water run-off for subsequent collection or disposal. Plug rugs, plumbers putty, tarps and sand or other equipment can be used to cover sewers and drains in the immediate spill and run-off areas. Direct skin contact with contaminated water or materials should be avoided.

Effects of Releases to Soil

Hydrogen cyanide should be expected to rapidly volatilize from soil into the atmosphere creating potential inhalation concerns in the immediate spill area. Contact with the spill pool or contaminated debris should be avoided.

Hydrogen cyanide adsorption to soils and organic sediments will be insignificant.

Volatilization will be the primary removal mechanism from soils, especially in acidic soils.

Due to its solubility and insignificant adsorption to soils, released hydrogen cyanide is expected to have a fairly high mobility in soils with a pH < 9.2. Spills and contaminated run-off, therefore, must be removed to avoid potential migration and contamination to groundwater. In basic soils, HCN mobility would be restricted with the formation of alkali metal salts and metallocyanide complexes.

Low concentrations of hydrogen cyanide in soils are expected to undergo biodegradation to ammonia and carbon dioxide. Higher concentrations in soil are not expected to easily biodegrade due to hydrogen cyanide's toxic effect on microorganisms.

Mitigation Measures for Releases to Soil

The size of spill area should be minimized as vapor evolution is proportional to pool size. Dikes, barriers or run-off ditches should be built to contain released hydrogen cyanide.

If possible, impervious plastic sheeting or tarps should be placed underneath the release to contain and minimize spill to soil. [Note that hydrogen cyanide is very flammable and that plastic sheeting is known to discharge static electricity].

Alcohol foam, (preferably AFFF/ATC) can be applied to the spill surface and will substantially reduce vapor release. Note that the initial application of foam and water will temporarily increase vapor evolution. If possible, use a 6% foam concentration and continue to apply as foam breaks down.

Note that both water fog and foam application will create contaminated run-off. The establishment of diversion ditches, dikes or other barriers can be used to contain contaminated water run-off for subsequent collection or disposal. Use plug rugs, plumbers putty, tarp and sand or other equipment to cover sewers and drains in the immediate spill and run-off areas.

Remove spilled hydrogen cyanide contaminated water and soil as soon as possible to minimize infiltration into soils and groundwater.

Absorbent materials such as commercial spill sorbents, spill pads, vermiculite, ground corncob, and clay, sand or saw dust can be used to remove small spills. All contaminated absorbents must be containerized for subsequent proper treatment and/or disposal.

Contaminated soil and debris can be removed by mechanical means such as bulldozers, loaders or shovels. Care must be taken to ensure that operators are wearing appropriate personal protective equipment and that flammable vapors that can be ignited by motorized removal equipment are not present. Also, all equipment employed during the cleanup must be decontaminated or properly disposed.

Small residual concentrations of hydrogen cyanide in soils may be treated via bioremediation or application of a dilute neutralizing agent such as sodium bisulfite. However, consultation with local environmental authorities is recommended prior to using these methods.

Regulatory Information
The product and uses described herein may require global product registrations and notifications for chemical inventory listings, or for use in food contact or medical devices. For further information, visit http://techservice.innovene.com.

Health and Safety Information
The product described herein may require precautions in handling and use because of toxicity, flammability, or other consideration. The available product health and safety information for this material is contained in the Material Safety Data Sheet (MSDS) that may be obtained by calling +1-866-363-2454 (Toll Free-North America), or at http://techservice.innovene.com. Before using any material, a customer is advised to consult the MSDS for the product under consideration for use.

The Material Safety Data Sheet for this product contains shipping descriptions and should be consulted, before transportation, as a reference in determining the proper shipping description. If the material shipped by INEOS Nitriles is altered or modified, different shipping descriptions may apply and the MSDS of the original material should not be used.

For additional information, on samples, pricing and availability, please contact:

INEOS USA LLC
INEOS Customer Service Center
Marina View Building
2600 South Shore Boulevard
Ste. 250
League City, Texas 77573
USA
Toll-free: +1-866-363-2454

INEOS Europe Ltd
Clayhill,
Beechen lane,
Lyndhurst, SO43 7DD
+44 (0)2380 287265

Phone Numbers
Please use specific country number
depending from where you call:

Belgium/Netherlands	+32 (0)2 711 97 00
France	+33 (0)1 55 1741 85
Germany	+49 (0)69 5007 0188
Ireland	+353 (0)1 40732 74
UK	+44 (0)207 026 8321
Rest of the World	+44 (0)207 026 8322
FAX	+49 (0)221 3555 7528

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