

ATSDR Record of Activity

ROUTING:

E. Murray B. Fowler

J. Holler H. Hansen

File

UID #: RAN2Date: 4/24/2008Time: 1432am _ pm XSite Name: Vermont Mills Property SiteCity: BenningtonCnty: BenningtonState: VT

CERCLIS #: _____

Cost Recovery #: 10EQRegion: 01Site Status (1) NPL X Non-NPL
(2) Emergency ResponseRCRA Non-Site specific Federal
Remedial X Other:

Activities

Incoming Call
Outgoing Call
Conference Call
Incoming MailPublic Meeting
Other Meeting
Data Review
Other :X Health Consult
Health Referral
Written ResponseSite Visit
Info Provided
Training

Requestor and Affiliation: (1) Catherine Young, EPA OSC

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1-EPA

6-COUNTY HLTH

11-POISON CTR

16-DOE

21-INTL

26-ARMY

31-ATSDR

2-USCG

7-CITY HLTH

12-PRIV CITZ

17-NOAA

22-CITZ GROUP

27-NAVY

3-OTHER FED

8-HOSPITAL

13-OTHER

18-OTHR STATE

23-ELECT. OFF

28-AIR FORCE

4-STATE ENV

9-LAW ENFORCE

14-UNKNOWN

19-OTHR COUNTY

24-PRIV. CO

29-DEF LOG AGCY

5-STATE HLT

10-FIRE DEPT

15-DOD

20-OTHR CITY

25-NEWS MEDIA

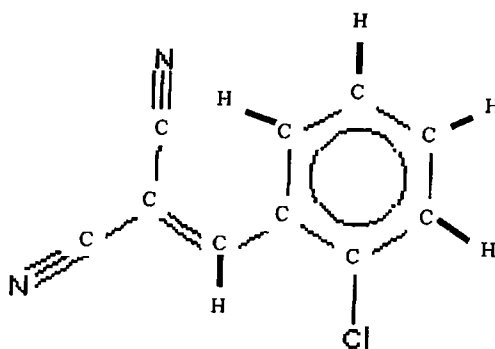
30-NRC

Program Areas

Health Assessment
Petition Assessment
X Emergency Response
X Health ConsultationHealth Studies
Health Surveillnc
Disease Registry
Exposr RegistryTox Info-profile
Tox Info-Nonprofil
Subst-Spec Resch
Health EducationWorker Hlth
Admin
OtherNarrative Summary:

After reviewing the previous AROA (Dated 4/23/2008), the OSC requested additional information based on her concern that thermal decomposition products of CS-1 that may cause harm to the occupants of the mill and the surrounding community. U.S. EPA requested that ATSDR amend the previous AROA to include these topics. Instead, ATSDR has opted to develop a second consultation on this issue.

When addressing thermal decomposition of chemicals, it is necessary to develop an understanding of the chemical structure. The chemical structure for CS is available on line <http://webbook.nist.gov/>. (NIST, 2005) The molecular formula is $C_{10}H_5ClN_2$ and the structure is shown below.



CS-1 is a formulation containing 5% hydrophobic silica aerogel to protect the material during storage. (WHO, 2004).

In conjunction with potential explosions dispersing CS into the community as described in the previous consultation, the preceding or concurrent fire would also convert CS into products of thermal decomposition. CS has a flashpoint of 197°C (387°F). (Hoenig, 2007) This means CS-1 will not ignite easily but it will burn. When heated to decomposition, CS emits hydrogen chloride, a mixture of oxides of nitrogen, and various cyanide compounds. (Lewis, 1996) The references contain a more detailed breakdown of the types of compounds formed during the combustion of CS. (Kluchinsky et al, 2002; Kluchinsky et al, 2002a; Smith et al, 2002).

Action Required/Recommendations/Info Provided:

When a product as complex as CS undergoes uncontrolled combustion, the dynamics of the combustion process can produce a varying mixture of a number of compounds at varying concentrations. For every molecule of CS that burns, potentially two molecules of a cyanide compound would be formed. When CS burns, cyanide or nitrile compounds would tend to predominate as the chemical degradation products in the smoke with hydrogen cyanide apparently being the most common single substance of this class. Therefore, ATSDR recommends that hydrogen cyanide be used as an indicator chemical for the presence of all cyanide containing breakdown products.

Many forms of cyanide, such as hydrogen cyanide gas, are themselves flammable and may be consumed in a fire. This would tend to reduce the amount of cyanide in the emissions, but produce nitrogen oxides. The presence of nitrogen oxides in the smoke would tend to indicate a more complete combustion process. The actual form of nitrogen oxide formed would depend on the dynamics of combustion in the fire, but ATSDR recommends that nitrogen dioxide be used as an indicator chemical for the class. Hydrogen chloride gas also seems to become a significant proportion of the pollutants in the smoke under most conditions. Finally, like most organic compounds, a fire involving CS is likely to produce dense black smoke with large amounts of particulate matter.

The thermal breakdown compounds of CS are respiratory irritants and would tend to compound the effect of any CS that is also released. EPA has established a reference concentration based on a lifetime exposure to hydrogen cyanide of 3 ppb. (ATSDR, 2006) For comparison to the other compounds formed in a fire, hydrogen chloride has an EPA reference concentration of 10 ppb (EPA, 1995); and nitrogen dioxide has an ambient air quality standard of 53 ppb, averaged over a year. (EPA, 1985) These values represent concentrations considered safe for long-term exposure. In the presence of fine particulate matter, the adverse effects on humans by acid gases such as these breakdown products have been increased. Based on this, the most toxic of the breakdown products of CS would probably be the cyanides.

Exposure to small amounts of cyanide can be harmful. Exposure to high levels of cyanide even for a short time harms the brain and heart and can cause coma and death. Some of the first indications of cyanide poisoning are rapid, deep breathing and shortness of breath, followed by convulsions (seizures) and loss of consciousness. Skin contact with hydrogen cyanide or cyanide salts can irritate and produce sores. Workers who breathed in amounts of hydrogen cyanide as low as 6–10 ppm over a period of time developed breathing difficulties, chest pain, vomiting, blood changes, headaches, and enlargement of the thyroid gland. (ATSDR, 2006)

Based on this, ATSDR recommends that any plume from a fire be monitored for particulate matter, hydrogen cyanide, nitrogen dioxide, and hydrogen chloride. Most fires do not burn long enough to pose a long-term health effect. However, the chemical thermal breakdown products of CS have Acute Exposure Guideline Levels (AEGLs) available at www.epa.gov/oppt/aegl/pubs. AEGLs are developed by a group chaired by the US EPA and including membership of various groups across industry and government. The details are explained at the website; however, AEGL level 1 values represent concentrations at which most people will experience no health effects other than transitory irritation. The AEGL-1 for 8 hour exposures for hydrogen chloride is 1.8 ppm; for hydrogen cyanide is 1 ppm; and, for nitrogen dioxide is 0.5 ppm. (EPA, 2008)

Generally, ATSDR recommends protective measures for the community be considered when the concentrations at the point of exposure (e.g., closest residence downwind or adjacent business suites in the building) reaches these AEGL-1 levels. For particulates (PM_{10}), protective measures are recommended by ATSDR at levels above $150 \mu g/m^3$ ($0.15 mg/m^3$) (EPA, 1987). Protective measures in this instance may include evacuation, shelter-in-place, or plume suppression of the smoke from the fire.

In the event of a potential explosion and fire involving the CS-1, toxic acid gases such as cyanide-based compounds, hydrogen chloride, and oxides of nitrogen may be formed and released into the community. Particulate matter may increase the threat of these substances alone. This type of event would increase the adverse impact on public health over the release of the tear gas by itself. This is especially true given the poor condition of fire suppression systems in portions of the property described in the previous consultation. The previous consultation also noted the presence of many residents in the immediate vicinity with pre-existing conditions that would make them more susceptible to the effects of a fire or make it more difficult for them to escape the smoke from a fire. The other businesses in the Vermont Mill complex include retail establishments and medical offices where the occupants may be expected to have similar pre-existing conditions.

Conclusions

In the event of a fire, the emissions from the building due to the burning of CS-1 would likely be more harmful to the occupants of the building and residents in the nearby community than a release of CS-1 alone. To the extent that the occupants and residents are either more susceptible or less able to escape the smoke from the fire, the effects of a fire on their health could be significantly worse. This combination of increased risk during a fire and increase susceptibility poses a potential health threat to the community with possibly significant effects on the population in and around the Vermont Mills Property.

Recommendations

While the CS-1 material is stored at the Vermont Mills Property, a contingency plan should be developed to address protective measures for the occupants and residents near the site. If ambient air concentrations at the point of exposure for either occupants of the property or residents in the neighboring community reach or exceed the AEGL-1 8 hour concentrations, protective measures should be implemented. ATSDR recommends that provisions be made in the community to allow air monitoring for cyanides in the event of a fire at the Vermont Mills Property.

If containers of CS-1 in storage are suspected of being damaged, consideration should be given to periodically conducting cyanide monitoring around the suspect containers until the condition of the containers is verified or the containers are rendered safe.



Signature: Richard A. Nickle

Date: 4/30/2008

Enclosures: Yes () No (); MIS entered: Yes () No ()

cc: ATSDR Region
ATSDR DRO

References

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Wilcox and Barton. 2008. Letter to Ms. Catherine Young, US EPA, dated March 26, 2008 containing a comprehensive inventory of Suite 1 of the Vermont Mill.