Health Consultation

LANXESS, INC., FACILITY
(AIR EMISSIONS)
ADDYSTON, HAMILTON COUNTY, OHIO

EPA FACILITY ID: OHD004233003

SEPTEMBER 5, 2007

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

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HEALTH CONSULTATION

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Prepared By:

Ohio Department of Health
Health Assessment Section
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

BACKGROUND AND STATEMENT OF ISSUES

Site Information

The Ohio Department of Health (ODH) Health Assessment Section (HAS) and the Ohio Environmental Protection Agency (Ohio EPA) Division of Air Pollution Control were asked by the Hamilton County General Health District to evaluate the public health threat posed by the unintentional releases of the chemicals acrylonitrile, styrene, and 1,3 butadiene to the environment from the Lanxess, Inc. facility in Addyston, Ohio.

The company, located at 356 Three Rivers Parkway in Addyston, Ohio, operates various continuous plastic polymerization units that use acrylonitrile, 1,3-butadiene, and styrene (ABS) to make plastic products. These processes routinely release the above chemicals into the air, which included three accidental releases of these chemicals into the environment during late 2004 and early 2005.

The primary public health concern was the potential exposure of children at the nearby Meredith Hitchens Elementary School to these chemicals during these events. In the report, released on May 20, 2005, ODH and Ohio EPA estimated the concentrations of these chemicals and recommended ambient air monitoring near the facility.

DISCUSSION

The Events

These releases were associated with three incidents at the Lanxess facility that occurred October 2-4, 2004; December 15, 2004; and February 23, 2005. The exposures were based on modeling, compared to health-based standards for acute exposure, and reported on May 20, 2005. All three of these chemical releases represent a potential for "acute" exposures to these chemicals; short-term exposures lasting on the order of several minutes up to nearly two days. All of the chemicals of concern, acrylonitrile, styrene, and 1,3 butadiene, are volatile organic compounds (VOCs) – liquids that readily vaporize upon exposure to the air. All three chemicals have a short life span upon release to the atmosphere, breaking down to other chemicals over the course of hours (1,3 butadiene) or 1-2 days (acrylonitrile, styrene).

1. In the October, 2004 incident 1,122 lbs of acrylonitrile, 387 lbs of styrene, and 34 lbs of 1,3-butadiene were estimated to have been released to the air at the plant over a two-day period. Estimated concentrations of the chemicals of concern at the facility fence-line included acrylonitrile at 0.7 parts per million (ppm), 0.13 ppm styrene, and 0.02 ppm 1,3-butadiene (see Table 1).

2. The December 15, 2004 event involved the release of 700 lbs of acrylonitrile over an estimated 8-minute time period. Modeled concentrations at the property fence-line were 13.5 ppm and 8.9 ppm at the Meredith Hitchens Elementary School, 1640 feet from the site of the release.

3. The February 23, 2005 incident involved the release of 750 lbs of 1,3-butadiene over a 2½ hour time period. Estimated concentrations of 1,3-butadiene at the closest fence-line (820 feet away) were 2.8 ppm.

Potential Exposure Evaluation

The potential exposure pathway was inhalation – breathing in of vapors released into the air by the plant facility, and the potentially exposed population included children and residents near the facility. During the chemical release from October 2 through October 4, 2004 (a weekend), Addyston residents were celebrating Oktoberfest at the Meredith Hitchens Elementary School located across the street from the plant. The release was detected by visual observations by area personnel – no measurements were taken, no public warnings were issued, and no exposures occurred according to Lanxess. The December 15, 2004 incident occurred between 3:48 PM to 3:56 PM on a Wednesday. The facility conducted field sampling along the fence lines of the plant and the reported: "No detectable levels of Arylonitrile were found." However, it is not known at what time this sampling was performed. In this case, the Mayor of Addyston, the Hitchens School principal and the Chief of the Cleves Fire Department were informed by phone. The February 23, 2005 release of butadiene occurred on Wednesday at about 4:30 PM and was detected at the production unit by area monitoring equipment. Lanxess did not conduct any additional monitoring, but identified no exposures and notified the municipal school official and local mayor by phone.

All three identified chemical incidents approximated acute exposures. Any potential adverse health effects would likely include short-lived, reversible symptoms that would disappear upon cessation of the exposure (dissipation of the chemical vapors) or physical removal of the individual from the exposure (leaving the area).

Estimated concentrations of these chemicals at the facility's fence-line have been reconstructed via modeling carried out by the Hamilton County Department of Environmental Services. The model used real-time meteorological data (recorded at the time of each incident at an on-site met station) and estimates of the total amounts of each chemical released in each event (provided by the company).

It is important to stress in discussions of these data that these results are estimates based on modeling using the best available data. They do not represent actual recorded measures of chemical concentrations at the facility property line.

Health Evaluation

<u>Acrylonitrile</u>

Acute Health Effects:
The U.S. EPA has classified acrylonitrile as an "**Extremely Hazardous Substance.**" Acute exposure to acrylonitrile via the inhalation route at concentrations greater than 16

ppm can lead to nose and throat irritation, breathing difficulties, nausea, dizziness, weakness, headaches, and convulsions. This concentration is close to that at which can be smelled in air (about 21 ppm). Symptoms typically disappear when exposure is stopped (ATSDR Toxicological Profile for Acrylonitrile).

Chronic Health Effects:
The National Toxicology Program (NTP) Report on Carcinogens, 11th Edition states "Acrylonitrile is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity in experimental animals." It also states "An increased risk of cancer of the lung was observed in U. S. textile workers exposed to acrylonitrile and observed for 20 years or more." The International Agency for Research on Cancer (IARC) lists acrylonitrile as *possibly carcinogenic to humans* (Group 2B).

Styrene

Acute Health Effects:
Styrene is less toxic than acrylonitrile but results in similar temporary adverse health effects when people breathe in styrene vapors at somewhat higher levels (100 ppm). These include depression, concentration problems, weakness, fatigue, and nausea plus possible eye, nose, and throat irritation (ATSDR ToxFaqs for Styrene).

Chronic Health Effects:
Health effects for people breathing styrene for long periods of time are not known, except for limited information on the harmful effects on the nervous system in occupationally exposed workers. Long-term animal exposures to high levels of styrene indicate damage to the liver, but this effect has not been seen in people. IARC has determined that styrene is *possibly carcinogenic to humans* (Group 2B).

1,3-Butadiene

Acute Health Effects:
Like styrene, 1,3-butadiene is not considered to be an "Extremely Hazardous Substance." Short term exposure to high levels of 1,3-butadiene causes eye, nose, and throat irritation. Breathing very high levels (>1,000 ppm) of this chemical for a short period of time can cause central nervous system damage, blurred vision, nausea, fatique, headache, decreased blood pressure and pulse rate, and unconsciousness (ATSDR ToxFaqs for 1,3-butadiene).

Chronic Health Effects:
The NTP currently lists 1,3-butadiene as *known to be a human carcinogen*, and IARC lists 1,3-butadiene as *probably carcinogenic to humans* (Group 2A). Occupational studies of industry workers found an increased risk for lymphomas and leukemia.

It is important to note that the development of cancer is usually associated with long-term, chronic exposures (>10 years) to comparatively high levels of these chemicals in

occupational settings. These short-term exposure events are unlikely to lead to any lasting chronic adverse health effects.

Health-based Standards and Guidelines for Exposures

The Occupational Safety and Health Administration (OSHA) has established a permissible exposure limit (PEL) of 2 ppm for acrylonitrile in workplace air over an 8-hour exposure and a 40-hour work week and a ceiling value of 10 ppm, as determined over a sampling period of fifteen (15) minutes. The Agency for Toxic Substances and Disease Registry (ATSDR) has a minimal risk level (MRL) of 0.1 ppm (100 ppb) for acrylonitrile by the inhalation route and acute (less than or equal to 14 days) duration. MRLs are based only on non-carcinogenic effects and are derived from a no-observed-adverse-effect level (NOAEL) or a lowest-observed-adverse-effect level (LOAEL) and are intended to assist in determining the safety of communities near hazardous waste sites.

For 1,3-butadiene, OSHA has established a permissible exposure limit (PEL) of 1 ppm in workplace air for an 8-hour exposure over a 40-hour work week and a short-term exposure limit (STEL) of 5 ppm. For styrene, OSHA has set an 8-hour time-weighted average (TWA) concentration of 100 ppm as a PEL, a ceiling of 200 ppm, and a 5-minute maximum peak in any 3-hour period of 600 ppm during an 8-hour shift.

Review of the literature has indicated that Emergency Response Planning Guidelines (ERPGs) developed by the American Industrial Hygiene Association (AIHA) are the best available health criteria for evaluating the health significance of accidental releases. This set of exposure limits is divided into three categories representing exposure to increasing concentrations of specific chemicals:

ERPG-1: The maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing other than mild, short-term health effects or the detection of a clearly defined objectionable odor.

ERPG-2: The maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms.

ERPG-3: The maximum concentration in air below which it is believed nearly all individuals could be exposed to up to one hour without experiencing or developing life-threatening health effects.

Table 1 compares the estimated concentrations of the chemicals of concern at the facility property line for each of the three chemical release events.

As can be seen from this table, the estimated concentrations of these chemicals at the facility's fence-line were significantly below the ERPG-1 values for these chemicals except for the acrylonitrile concentration calculated for the fence-line following the

December 15, 2004 event. This modeled concentration exceeded the ERPG-1 value (mild short-lived reversible health impacts) for this chemical (13.5 vs. 10.0 ppm) but was significantly below the ERPG-2 value for acrylonitrile (13.5 vs. 35 ppm) associated with more serious, irreversible health impacts. The modeled exposure level for the school property during the December 15 event was 8.9 ppm, below the ERPG-1 value. As such, it is not expected that these three releases resulted in any lasting adverse health effects in area residents, including the children at the school.

It is important to point out again that these results are based on computer modeling and are not actual data. The impacts were calculated using meteorological data conditions at the time of release as supplied by Lanxess.

Table 1
Release of Chemicals to the air from the Lanxess, Inc. facility (2004-2005), Addyston, Ohio

October 2-4, 2004
1,122 lbs acrylonitrile
387 lbs styrene
34 lbs 1,3-butadiene
49-hour period (2+ days)

Chemical	Modeled Concentration at Plant Fence-line (ppm)	ERPG-1 Standard (ppm)
Acrylonitrile	0.70	10.0
Styrene	0.13	50.0
1,3-Butadiene	0.02	10.0

ppm = parts per million
ERPG = Emergency Response Planning Guidelines

December 15, 2004
700 lbs acrylonitrile
8-minute release

Chemical	Modeled Concentration at Plant Fence-line (ppm)	Modeled Concentration at nearby school (ppm)	ERPG-1 Standard (ppm)
Acrylonitrile	13.5	8.9	10.0

ppm = parts per million
ERPG = Emergency Response Planning Guidelines

February 23, 2005
750 lbs 1,3-butadiene
2.5 hour release

Chemical	Modeled Concentration at Plant Fence-line (ppm)	ERPG-1 Standard (ppm)
1,3-Butadiene	2.8	10.0

ppm = parts per million
ERPG = Emergency Response Planning Guidelines

Child Health Issues

A public health concern was raised because children could be potentially exposed at this site. Children can be at a greater risk of developing illness due to exposure to hazardous chemicals because of their smaller stature and developing body systems. Children are likely to breathe more air and consume more food and water per body weight than are adults. Children are also likely to have more opportunity to come into contact with environmental pollutants due to being closer to the ground surface and taking part in activities on the ground such as, crawling, sitting, and lying down on the ground.

CONCLUSIONS

Three unintentional chemical release events at the Lanxess, Inc. facility in Addyston, Ohio from October 2004 to February 2005 led to the discharge of process chemicals to the ambient air in proximity to nearby residential communities, including an adjacent elementary school. Of primary public health concern is the release of acrylonitrile, a chemical considered to be an "Extremely Hazardous Substance," in two of the three events.

In one of these events, the December 15, 2004 incident, modeled concentrations at the plant fence-line slightly exceeded health-based standards for acute exposure to acrylonitrile. This release, based on these modeling results, could have resulted in the development of mild, reversible symptoms (nose & throat irritations, headaches, nausea, dizziness) in exposed individuals at the plant property line. However, similar modeled concentrations for the school property for this event were below levels that would be expected to result in any adverse health effects, even the reversible symptoms listed above.

While these three spill events at the Lanxess, Inc. facility were not likely to have significantly impacted the health of area residents, including children at the Hitchens School, the nature of the chemicals released and the occurrence of three of these spill events in a six-month period were of major concern to the Ohio Department of Health and the Ohio EPA. The potential exposure to area residents was categorized as a *Indeterminate Public Health Hazard.* Additional data would be needed to determine the actual ambient air concentrations of these chemicals in the school vicinity.

RECOMMENDATIONS

The following actions were recommended to be taken:

1) The Ohio EPA, Division of Air Pollution Control (DAPC) and the Hamilton County Department of Environmental Services (HCDOES) should work with the Lanxess, Inc. to review current production processes, process safeguards, and contingency plans to reduce or eliminate the likelihood of additional releases to the community.

2) Ohio EPA DAPC and HCDOES should install an ambient air monitor in the adjacent community, especially at or in the vicinity of the nearby Hitchens Elementary School in order measure the actual concentrations of these chemicals in the ambient air.

PUBLIC HEALTH ACTIONS

Completed Actions

1) The Ohio EPA collected ambient air samples from the rooftop of the Meredith Hitchens Elementarry School across the street from Lanxess beginning in May, 2005.

2) In December of 2005, the Ohio EPA completed a report, which indicated that long-term exposure to levels of volatile organic compounds (VOCs) measured in the air near Lanxess Corporation in Addyston, Ohio posed an unacceptable health risk.

3) The Three Rivers School District permanently closed the Meredith Hitchens Elementary School across the street from the plant. The 370 students at the school were transferred to other schools in the district.

4) In December of 2005, the ODH was requested by the Hamilton County General Health District to provide a community cancer assessment for the Village of Addyston, Ohio. The cancer assessment was released on May 25, 2006 and revealed significantly higher than expected numbers of cancer cases for the 55 observed cancers combined, lung and bronchus cancer and colon and rectum cancer. No cancers were reported among children or young adults ages 0 to 29 during the study period (1996-2003).

5) The Ohio EPA issued orders to Lanxess to reduce the levels of volatile organic compounds (VOCs) measured in air near the facility in Addyston, Ohio on December 5, 2005. Subsequent orders to reduce air emissions were issued on June 21, 2006; November 7, 2006; and March 13, 2007.

PREPARERS OF THE REPORT

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U.S. DOL CFR OSHA Standards 1910.1000 Table Z-2 - Styrene 1969.

CERTIFICATION

This Lanxess, Inc Facility (Air Emissions) Health Consultation was prepared by the Ohio Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun. Editorial review was completed by the Cooperative Agreement Partner.

Technical Project Officer, CAT, CAPEB, DHAC, ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health consultation and concurs with the findings.

Team Lead, Cooperative Agreement Team, CAPEB, DHAC, ATSDR