

Industry Perspective Of An Air Toxics Study: Ambient Toluene Diisocyanate Concentrations From Flexible Polyurethane Foam Manufacturing

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Presentation Highlights

➤ Part 1: Background

- What is Toluene diisocyanate (TDI)?
- Some history (TDI and Community Health)
- Critique of the Intervention
- The Hickory Springs Study
- Recommendations

➤ Part 2: 2007 TDI monitoring study

- ATSDR Sampling Protocol (Appendix A)
- Hickory Springs Monitoring Objectives
- Monitoring Setup
- Differences from Protocol
- Field Issues
- Results

What is Toluene Diisocyanate (TDI)?

- TDI is one of the isocyanates most commonly used in the manufacture of polyurethane foams
- TDI is used as a catalyst with water to react with a polyether
- TDI is consumed in the chemical reaction and not released from the finished polyurethane foam
- Known to cause occupational asthma (*U.S. foam plants do not have any cases of TDI-related occupational asthma*)
- TDI exists in two isomers:
 - **2,4-TDI** (CAS: 584-84-9), and
 - **2,6-TDI** (CAS: 91-08-7)
- 2,4-TDI is produced in the pure state, but TDI is often used as “80/20” and “65/35” mixtures of the 2,4 and 2,6 isomers respectively

What is Toluene Diisocyanate (TDI)?

- TDI is regulated under NCDENR's Air Toxics Program

Pollutant Name	CAS Number	HAP	TAP
Toluene diisocyanate, 2,4-	584-84-9	Y	Y
Toluene diisocyanate, 2,6-isomers	91-08-7	--	Y

- 2,4-TDI and 2,6-isomers
North Carolina Toxic Air Pollutant
Acceptable Ambient Level = 0.0002 mg/m³ (0.03 ppb)
24-hr ave. period
- 2,4-TDI
Federal Hazardous Air Pollutant
(2,6-TDI is not)

Background - TDI and Community Health

- Trinity American Corporation (TAC), Glenola, NC
 - Residents near TAC complained of odor and health affects
 - Resulted in a community assessment and health intervention study of TDI emissions by state and federal agencies. Lead by the U.S. Department of Health and Human Services, Agency for Toxic Substances Disease Registry (ATSDR)
 - Ambient TDI concentrations and resident blood samples (TDI antibody) data were collected
- Result of Intervention
 - State Health Director issued a public nuisance order in September 1997 directing the TAC facility to cease all manufacturing operations
 - Lowered TDI NCTAP AAL concentration (currently the lowest in U.S.)

Critique of the Intervention

- The American Chemistry Council's Diisocyanates Panel funded a critical investigation of the ATSDR intervention
 - American Industrial Hygiene Association Journal:
"Community Exposure Assessment and Intervention Effectiveness at Trinity American Corporation, Glenola, North Carolina." September/October 2001
 - Steven P. Levine, University of Michigan, Dept. Of Environmental Health Sciences, Ann Arbor, MI
 - Charles F. Redinger, Redinger and Associates, San Rafael, CA
 - William P. Robert, BASF Corp., Wyandotte, MI

Critique of the Intervention

- Case Study - Summary of Conclusions:
 - Public health hazard claims did not follow the ATSDR's own Public Health Assessment Guidance Manual for making such claims
 - Odors were the community's biggest complaint. No attempt to address non-TDI, non-methylene chloride odors from Trinity or other community source(s)
 - Lack of complete understanding of all potential community sources of contaminants prior to intervention
 - No demonstration or confirmation from sampling by either ATSDR or TAC consultants that fence-line TDI concentration presented a public health risk or violated NC ambient air standards
 - Lack of a complete environmental exposure assessment (facility equipment, modes of operation, meteorological conditions, etc.)
 - Decisions need to be data-driven and linked between exposure and plant operations before allegations of health effects are used for decision making

The New Studies

- In 2003 - 2005, ATSDR developed Study Protocol with industry input and revisions
- October 2005 ATSDR/NCDHHS: *Protocol Environmental Exposure to Toluene Diisocyanate and Respiratory Health Effects* (Draft)
- Sites selected based on:
 - Facility EPA Toxic Release Inventory data (1998 – 2004)
 - Proximity of residents
 - Size of population potentially affected

The New Studies

PROTOCOL OBJECTIVES

- Process Specific
 - Identify and characterize populations in target and comparison areas
 - Recruit adult participants residing in both areas
 - Assess participants' potential for occupational or other exposures to diisocyanates

- Public health/exposure outcome
 - Assess respiratory health of participants with questionnaires
 - Assess presence of diisocyanate antibodies through blood samples
 - Air sampling of TDI in target and comparison areas
 - Assess the relationship between residents' respiratory health outcomes in target and comparison areas

The New Studies

INDUSTRY CONCERNS

- Study did not include an initial health survey – Any complaints?
- The ATSDR protocol (draft and final) cited the 1997 ATSDR public health advisory. No reference to AIHAJ article or address of article conclusions
- Only revision to include an unexposed comparison group
- No meteorological correlation
- All five of the targeted facilities are in compliance with issued air permits (and lower TDI limits)
- A number of scientific papers question the value and accuracy of the blood test that will be used
- No way to relate findings from the health interviews, to air monitoring or blood tests
- Lack of action would leave the industry vulnerable. More plant closures?

The New Studies

INDUSTRY ACTION

- No objections to the reasons for conducting the study
- Request to improve the scientific approach of the study
- Made ATSDR aware that the industry would be involved
- Requested for the need of active discussions with the ATSDR and NCDHSS
- Requested that the community be engaged
- Requested sound scientific approach open to peer review
- Requested information on who, where, when to conduct parallel monitoring
- Industry involvement appeared to delay issuing of the final protocol document (published April 2007)

ATSDR Study at Hickory Springs

- Hickory Springs – Conover Complex, Conover, Catawba County, NC
- First facility investigated by ATSDR under the protocol (draft/final)
- Company installed over a \$20,000 meteorological weather station at the facility
- Performed five weeks of field monitoring at two off-site locations
- Significant time and money (internal and external) spent preparing and executing parallel monitoring
- No resident health data collected (only ambient air sampling)

Recommendations

- Get involved
- What is behind the study?
- Support from an industry association preferable
- What are the possible outcomes?
- Prepare for changes: manufacturing process, raw materials, add-on control, etc.
- To the extent possible, develop defensible, independent data and conclusions by third parties

2007 Monitoring Study

- **Outline of the TDI monitoring study**
 - ATSDR Sampling Protocol (Appendix A)
 - Hickory Springs Monitoring Objectives
 - Monitoring Setup
 - Differences from Protocol
 - Field Issues
 - Results

ATSDR Sampling Protocol – Appendix A

- ATSDR primary responsibility
- Support from NIOSH, EPA, NCDHHS, NCDAQ (Air Toxics Protection Branch)
- Communities within ¼-mile of facility
- Six weeks of monitoring at residential properties
- Time-weighted sampling using Honeywell (Zellweger) Analytical Single Point Monitor (SPM)
- TDI 2 ppb to 60 ppb, 620 cc/min
- Not intended to verify diisocyanate concentration
- If SPM detects 2 ppb, 8-hr pump triggered NIOSH Method 5525 (filter only)
- If SPM detects 4 ppb, 15-min pump triggered parallel NIOSH Method 5525
- SPMs checked daily, data downloaded every week
- Procedures included for data QA/QC, calibration, training, lab operation, documentation
- No meteorological data collection (local or NWS)

Hickory Springs Monitoring Objective

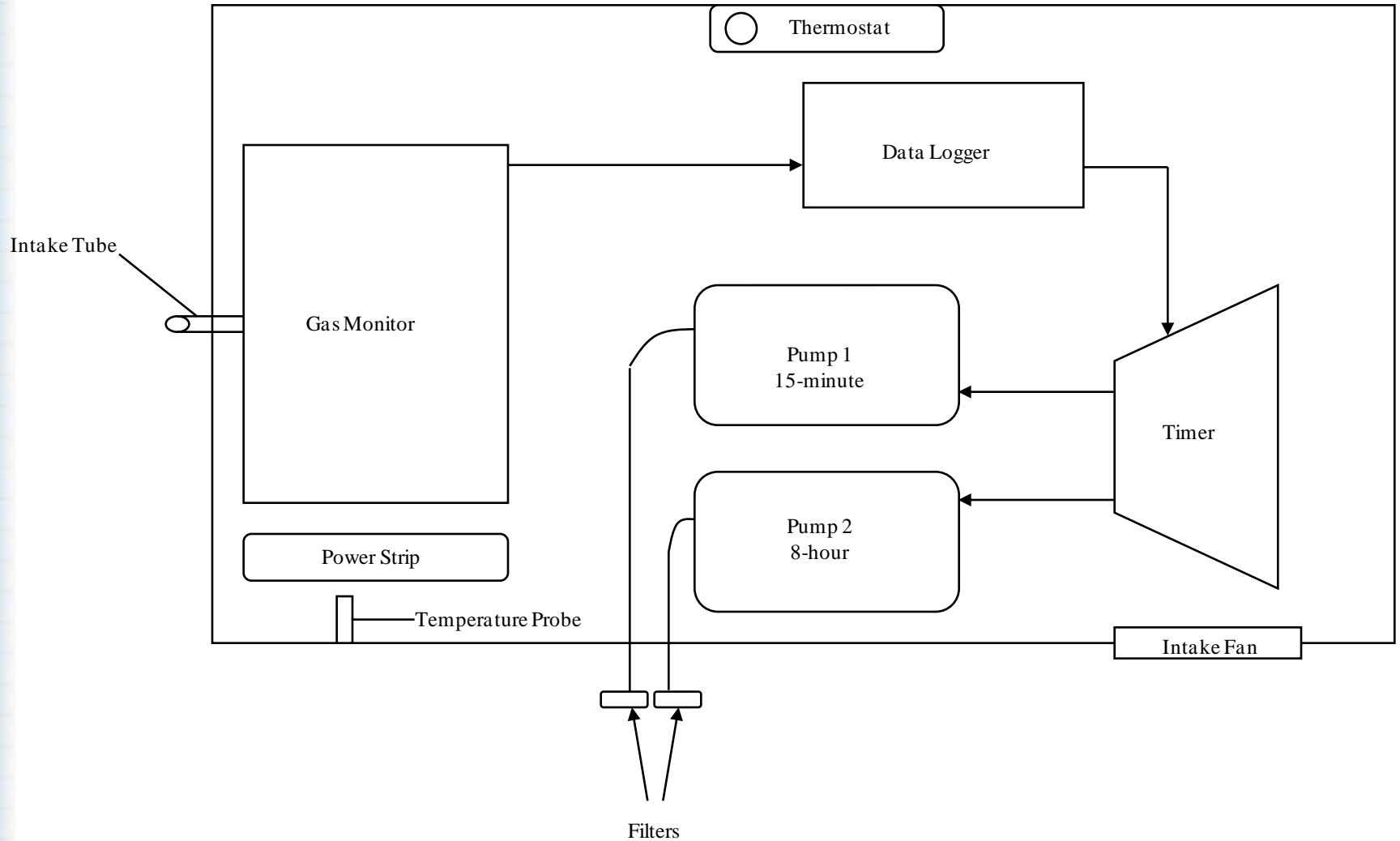
- Mirror the ATSDR protocol
- Locate monitoring sites near ATSDR sites
- Secure Equipment
- Collect facility meteorological data

- Limitations/Issues
 - ATSDR monitoring locations not made available

Monitoring Setup



Monitoring Setup



Monitoring Setup



Differences From Protocol

- Different pumps (rubber diaphragm vs. carbon vane)
- Pump flow rate calibrated daily
- Container temperature monitored to maintain within operating range for the equipment
- Data downloaded each day
- Response verified on SPM daily
- Method 5525 filters changed daily
- Multiple visits each day to monitor equipment operation
- Frequent daily analysis of meteorological conditions
- Only two monitoring locations
- Equipment in containers (moisture resistant)

Field Issues

- Temperature. Limited operating temperature range of SPM required heat (light bulb) and ventilation fans
- Electronic noise triggering pumps (2 ppm LDL)
- Combustion source interference
- SPM light sensitivity
- NIOSH modified Method 5525
- Laboratory analysis (DataChem is the only accredited laboratory that can run the LC/MS for the modified NIOSH Method 5525).

Results

- Hickory Springs
 - February 5 - 9, 2007
 - May 21 - June 1, 2007
 - June 11 – June 22, 2007
- Three other foam manufacturers monitored
- 12 weeks of field sampling total
- 17 filters to lab for modified NIOSH Method 5525 analysis

Results

During the 12 weeks of monitoring,
no samples met or exceeded the testing protocol
concentration of 2 ppb.

Questions?

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