NIOSH Overview: Spray Polyurethane Foam Processes

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Who is NIOSH?

- The National Institute for Occupational Safety and Health
- Created under the OSHAct of 1970
- Mission – ensure safety and health at work for all people through research and prevention.
  - Responsible for conducting occupational safety and health research.
  - Education and Training.
- To provide leadership in research to prevent work-related illness, injury, disability, and death
Division of Applied Research & Technology Engineering & Physical Hazards Branch

- Engineers, Industrial Hygienists, Physicists, other disciplines
- Identify and evaluate occupational exposures
- Develop and evaluate engineering controls for preventing or reducing exposures
- Disseminate information on hazards, exposures, and control solutions to industry and professionals
NIOSH Alert on Truck Bed-Liners Applicable to all SPF Operations

Contains Recommendations for:
- Workers
- Employers
- Future Research
- Engineering controls
- Exposure monitoring
- Respiratory protection
- Medical monitoring
- Surveillance
- Decontamination
Why NIOSH issued Alert

- Reports of occupational asthma – detailed in NIOSH Alert.
- Isocyanates – can cause occupational asthma
- Workers with asthmatic symptoms from isocyanate exposure often continue to have symptoms even after exposures have ended
- Affected workers often have to leave their jobs to prevent progression of respiratory symptoms
NIOSH Assessment of Spray Polyurethane Products Industries

- Comprehensive study of the spray polyurethane truck bed-liner (TBL) process (2003-2006)
- Preliminary assessment of the Spray Polyurethane Foam (SPF) insulation process - 4 sites (Aug. 2009)
- Review of industry information on the SPF process
- Concluded that based on the similarities these two spray polyurethane processes (TBL and SPF) are essentially the same (i.e. same chemicals and equipment)
Importance of worker issues

- Worker exposures not always considered in developing “green” products and practices
- Workers/applicators generally have higher exposures compared to homeowners or consumers
- Controls and training to reduce worker exposures generally likely to reduce exposures for homeowners
- A truly comprehensive approach to sustainability and green practices needs to include occupational safety and health aspects
Exposures – Spray Application

- Vapor, mist, particulates (isocyanates, amines) can migrate to other rooms or floors
Exposures – Trimming Foam

- Cutting, scraping foam generates dust
SPF Standard Operating Procedures

- Hazard Communication and Training
- Wear Personal Protective Equipment (PPE) - sprayer and helper.
  - Full-Face Supplied-Air Respirator (SAR)
  - chemical protective clothing (i.e. disposable coveralls with a hood and chemical protective gloves).
- Limit access to spray area.
  - Only trained workers with proper PPE.
**SPF Standard Operating Procedures**

- Isolate process to prevent chemical migration to other areas to ensure others are not exposed.
- Provide adequate ventilation to remove chemicals.
  - Filter and exhaust to unoccupied area.
  - Prevent access to exhaust area.
- Do not re-enter spray area without appropriate PPE.
  - Need to determine appropriate time period.
Challenges for SPF industries

- Develop engineering control strategies to protect all workers during all phases of the operations.
  - Preparation
  - Spraying
  - Trimming
  - Clean-up.
- Controls need to be adaptable to a wide variety of applications and foam densities.
  - Indoor and outdoor
  - New construction and retrofits
  - Residential (attic retrofits)
  - Commercial
  - ½-pound (low density), 2-lb. (medium), and 3-lb. (high) foams
Evidence of Exposures in Adjacent Areas

Information from an industry research study:

- Isocyanate vapors drifted throughout building after application of SPF within 20 minutes\(^1\)
  - Mostly lower floors
  - Exposure levels above the PEL in adjacent areas
  - More than 20 feet away from applicator
- Also found in truck trailer\(^1\)

\(^1\) B. Karlovick, Bayer MaterialScience, July 16, 2009
Challenges for SPF industries

- Develop strategies to isolate (enclose) process.
  - Contain and control chemicals generated.
  - Prevent migration of chemicals to other areas.

- Develop ventilation system for enclosures.
  - Reduce airborne chemicals including MDI.
  - Air supply and exhaust needed.
  - Exhaust to unoccupied location.

- Determine appropriate time periods for re-enter into sprayed areas without PPE.
  - Dependent on ventilation rate and SPF curing time.
Potential Controls used at SPF Sites

- Explore ways to isolate (enclose) process.
  - Used plastic sheeting to cover wall studs.
  - Used metal grating to control expansion of foam.
  - Potential advantages – reduced chemical usage; chemical vapors and aerosols likely trapped behind plastic film resulting in lower airborne chemical concentrations.

Panel system
Controls used at SPF Sites

- Use air movers to exchange air in the spray zone.
  - Reduce airborne chemical concentrations.
  - Air supply and exhaust needed.
  - Filter and exhaust to unoccupied location.
General Guidelines

- Enclose the spray zone as much as possible
- Supply air (active or passive) at one end of spray zone
- Direct airflow through spray zone from clean to contaminated
- Filter and exhaust air at opposite end of spray zone
- Create negative pressure within the enclosure
Location of Air Supply and Exhaust

- Work place variability prevents a one size fits all approach.
- Identify “typical” work place scenarios where possible and provide related design guidance.
- For all other situations, provide clear and simple information on basic design considerations so applicators can set up their own systems (similar to the auto refinish “Breathe Easy” factsheet).
- Example design considerations are illustrated in the following slides.
Prototype SPF Spraying Booth Front View
Prototype SPF Spraying Booth
Left View
Prototype SPF Spraying Booth
Right View
Prototype SPF Spraying Booth
Inside View
## Prototype SPF Spraying Booth Cost

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC 1.25” diameter, schedule 40, pipe</td>
<td>$175</td>
</tr>
<tr>
<td>PVC Fittings</td>
<td>$300</td>
</tr>
<tr>
<td>6 mil Clear Polyethylene Sheeting</td>
<td>$100</td>
</tr>
<tr>
<td>Poly-Hangers</td>
<td>$140</td>
</tr>
<tr>
<td>Foam Pipe Insulation</td>
<td>$30</td>
</tr>
<tr>
<td>Duct collar</td>
<td>$10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$755</strong></td>
</tr>
</tbody>
</table>
Additional Location Issues

- Make-up air for single fan systems
- Location of exhausts (away from occupied areas)
- Height of exhaust (i.e., should exhaust be located at floor level)
- Other activities (e.g., mixing areas)
- Outdoor applications (wind direction, neighboring locations)
Other Job site considerations

- Confined spaces
- Emergency and medical planning
  - Monitoring employees health
Cleanup

- Make certain workers handling contaminated surfaces use appropriate PPE
- Dispose of all hazardous materials properly
Communication and training is key to safe use and handling of SPF

Employers should develop a workplace strategy for jobsites prior to initiating work

With widespread use of SPF to retrofit buildings for energy conservation, the those involved need to ensure SPF installation is carried out in a safe manner to protect workers, helpers, building occupants, and consumers
Contact Information

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OSHA Considerations

Janet Cater
Health Scientist
Directorate Standards
and Guidance
OSHA Considerations

**Green Jobs** - jobs that help to improve the environment

- Workers in the green industries may face hazards that are commonly known in workplaces

- Employers are responsible for making the workplace a safe place
Weatherization

• Green building practices
  – Various types of weatherization products
    • Fiberglass
    • Cellulose
    • Spray Styrofoam
    • Spray polyurethane foam

• All have potential benefits

• All have potential hazards
  – Any chemical can be hazardous if used improperly
  – Most chemicals can be handled safely
OSHA Applicable Standards

• **Hazard Communication** - 29 CFR 1910.1200; 1915.1200; 1917.28; 1918.90; and 1926.59

• **Respiratory Protection** - 29 CFR 1910.134

• **Personal Protective Equipment** - 29 CFR 1910 Part I, 1926.95

• **Ventilation** - 29 CFR 1910.94; 1915.51; 1918.94; 1926.57
OSHA Applicable Standards

• 3 PELS for isocyanates
  – 29 CFR 1910 subpart Z (Air contaminants)
    • Ceiling limits
      – 140 ug/m^3 TDI
      – 200 ug/m^3 MDI
      – 50 ug/m^3 MIC

• General duty clause
OSHA Applicable Standards

• **Hazard Communication** - 29 CFR 1910.1200; 1915.1200; 1917.28; 1918.90; and 1926.59
• **Respiratory Protection** - 29 CFR 1910.134
• **Personal Protective Equipment** - 29 CFR 1910 Part I, 1926.95
• **Ventilation** - 29 CFR 1910.94; 1915.51; 1918.94; 1926.57
OSHA Applicable Standards

- Confined space
- Electrical
- Falls
- Fire/explosion
- Flammable liquids
- Medical and First Aid
Employer Responsibilities

- Full Hazard Communication
- Provide worker training
- Appropriate Exposure Control System
  - Appropriate PPE for **ALL** exposed workers
  - Adequate and appropriate containment and/or ventilation
Hazard Communication

• Communicate all hazards via:
  – MSDS
  – Labeling of all hazardous substances
  – Warning signs
Hazard Communication - MSDS

• Material Safety Data Sheets
  – Integral part of communication strategy
  – Must be readily available to all affected workers
  – Must be comprehensive
Hazard Communication - MSDS

MSDS should contain the following:

- Identify known hazards and exposure routes
  - Includes skin and other relevant health effects beyond asthma
- Identify appropriate first-aid and medical measures
- Identify appropriate exposure controls and PPE (skin and respiratory)
- Address need for adequate containment and ventilation
  - Includes use of filters (bed-liner guidance)
  - Generation of dust – may contain isocyanates (ongoing research area)

UNITED STATES DEPARTMENT OF LABOR
Hazard Communication – New Communication Rule

  - Others apply for construction; maritime; long shore
- **New** - Global Harmonization System (GHS)
  - Proposed rulemaking
    - For MSDS
      - ANSI 400 standard
      - 16 Section format
        » Already in use with current standard
  - Comment period has ended
  - Public hearings ongoing
Training

• Employers need to train workers on:
  – Hazards associated with use of **ALL** hazardous chemicals including Isocyanates and other SPF ingredients
  – Proper control measures
  – Proper use of PPE
  – Protecting those in adjacent areas
  – Appropriate ventilation
#1 - 1 1/4 PVC 3 WAY L = 2
#2 - 1 1/4 PVC 4 WAY LT = 3
#3 - 1 1/4 PVC TEE = 1
#4 - 1 1/4 PVC CRoss = 1
#5 - 1 1/4 PVC 45° ELBOW = 0
#6 - 1 1/4 PVC CASTER INSERT = 1
#7 - CASTER = 1
#8 - 1 1/4 PVC 5 WAY CROSS = 1
#9 - PVC PIPE 1 1/4 X 53 1/4° = 4
#10 - PVC PIPE 1 1/4 X 58° = 0
#11 - PVC PIPE 1 1/4 X 39 3/8° = 4
#12 - PVC PIPE 1 1/4 X 17° = 0
#13 - PVC PIPE 1 1/4 X 3 1/4° = 0
#14 - PVC PIPE 1 1/4 X 61° = 0
#15 - PVC PIPE 1 1/4 X 67 7/8° = 0
#16 - PVC PIPE 1 1/4 X 4° = 0
#17 - PVC PIPE 1 1/4 X 11 7/8° = 4
#18 - PVC PIPE 1 1/4 X 46 3/8° = 2
#19 - PVC PIPE 1 1/4 X 109° = 0
#20 - PVC PIPE 1 1/4 X 5 1/16° = 2
#21 - 1 1/4 90° ELBOW = 2

LEFT ELEV REV #1 2-3-11
#1 - 1 1/4 PVC 3 WAY L = 0  
#2 - 1 1/4 PVC 4 WAY LT = 1  
#3 - 1 1/4 PVC TEE = 1  
#4 - 1 1/4 PVC CROSS = 2  
#5 - 1 1/4 PVC 45° ELBOW = 0  
#6 - 1 1/4 PVC CASTER INSERT = 2  
#7 - CASTER = 2  
#8 - 1 1/4 PVC 5 WAY CROSS = 0  
#9 - PVC PIPE 1 1/4 X 53 1/4° = 4  
#10 - PVC PIPE 1 1/4 X 58° = 0  
#11 - PVC PIPE 1 1/4 X 39 3/8° = 4  
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RIGHT ELEV REV #1  2-3-11