MANUFACTURERS
SUPPORTING SPRAY FOAM
CONTRACTING COMMUNITY:
UPDATE FROM CPI AND SFC

LEE SALAMONE, ACC CENTER FOR THE POLYURETHANES
INDUSTRY
MANUFACTURERS SUPPORTING THE SPRAY POLYURETHANE FOAM VALUE CHAIN

- CPI is the voice of the polyurethane industry in North America
- Supports manufacturers of polyurethanes and materials to make polyurethanes
- Works collaboratively with downstream users and their customers
- Focus on advocacy, product stewardship, research and industry promotion
INDUSTRY-LED PRODUCT STEWARDSHIP

**PRIMARY GOAL**

*To increase understanding of safe installation practices regarding use, handling and disposal of spray polyurethane foam.*
INDUSTRY-LED PRODUCT STEWARDSHIP: THREE-PRONGED APPROACH

Program focuses on practices and communications that can help to minimize potential for exposure of workers and building occupants to spray foam chemicals.

- **Worker Performance and Training** – develop a health and safety training program for professional SPF applicators.

- **Outreach** - Educate DIY’ers, consumers and the building/construction sector about best practices on key issues including informing the selection of a contractor; different types of SPF products; health and safety considerations for DIY’ers and consumers during and after product installation.

- **Research** - Develop research and support testing programs to develop a better understanding of potential exposure to chemical components for workers applying SPF and potential consumer/occupant exposure to SPF emissions.
UPDATE ON CPI’S SPRAY POLYURETHANE CHEMICAL HEALTH AND SAFETY TRAINING PROGRAMS FOR HIGH-PRESSURE AND LOW-PRESSURE PRODUCTS

BILL ROBERT, BASF
WORKER TRAINING AND PERFORMANCE

• Posters
• Guidance
• Training
• Website
CPI SPF HEALTH AND SAFETY TRAINING PROGRAMS

High-pressure product training launched in December 2010

• The program provides health and safety information for SPF contractors, applicators or helpers who work with two-component high-pressure SPF systems.

• More than 6,000 have accessed the training program either online or in an instructor-led capacity.

• This program was recently upgraded and translated to Spanish.

Low-pressure product training launched in December 2012

• Development of training was supported by grant funding from OSHA

• The Low-Pressure Training provides information for weatherization professionals, applicators or helpers who work with one-component SPF or two-component, low-pressure SPF kits for sealing and insulating. Low-pressure SPF kits and insulating foam sealant, also called "foam in a can," are often used by weatherization and insulation professionals for their excellent heat resistance and air-sealing properties.

• This program is available in English and Spanish
Working Safely with Low-Pressure Spray Polyurethane Foam Insulation Online DVD

This video provides general guidance for professionals on how to apply low-pressure spray polyurethane foam. It is intended as a supplement to other job safety information already available such as specialized training, Material Safety Data Sheets (MSDS), product label information and other materials.

The video is available to view or download at www.spraypolyurethane.org.
Recently completed: Guidance for Selecting a Contractor for the Installation of SPF in School Building, Fire Safety Guidance and Guidance for Images Showing SPF Application

Continue outreach and education on training program and information available on SPF website www.spraypolyurethane.org

Continue to promote available health and safety information at industry events
STATUS OF CPI SPF HEALTH AND SAFETY RESEARCH PROJECTS

RICK WOOD, AIR PRODUCTS
CPI SPF RESEARCH PROJECTS

- Evaluate Potential Worker Exposure During SPF Application
  - SPF Ventilation Study

- Evaluate SPF Chemical Emissions After SPF Application
  - Indoor Air Quality
VENTILATION RESEARCH PROJECT

Purpose
• Evaluate the impact of changes in ventilation rates on concentrations of SPF chemical vapor and particulate emitted during application.

Project Consists of 3 Phases
• Phase 1 - Develop and test three generic formulations.
• Phase 2 - Air monitoring during application of the generic formulations under controlled environmental conditions to measure chemical emissions.
• Phase 3 - Air monitoring in the field to measure chemical emissions during SPF application.
PHASE 1

• Three generic formulations were developed:
  • Low density open cell formulation
  • Medium density closed cell formulation
  • Low pressure 2-component kit formulation

• The formulations represent typical commercial systems; however, do not reveal confidential information of actual formulations on the market/in use.

• Generic formulations are being used in both the CPI Ventilation and Emissions studies.
<table>
<thead>
<tr>
<th>Low density - open cell</th>
<th>Medium density - closed cell</th>
<th>Low pressure - Kit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A-side</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100% pMDI</td>
<td>100% pMDI</td>
<td>92.5% pMDI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blowing Agent HFC-134a (7.5%)</td>
</tr>
<tr>
<td><strong>B-side</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polyether polyl (Triol) 34%</td>
<td>Aromatic Polyester Polyol (36.39%)</td>
<td>Polyester Polyol (23%)</td>
</tr>
<tr>
<td></td>
<td>Aromatic Amino Polyether Polyol (33.61%)</td>
<td>Polyether Polyol (23%)</td>
</tr>
<tr>
<td>NPE Emulsifier (11.9%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blowing agent</td>
<td>Blowing agent</td>
<td></td>
</tr>
<tr>
<td>Water 20%</td>
<td>HFC-245a (6.97%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water (2.53%)</td>
<td></td>
</tr>
<tr>
<td>Fire Retardant</td>
<td>Fire Retardant</td>
<td></td>
</tr>
<tr>
<td>Tris-(1-chloro-2-propyl) phosphate (TCPP) (25.2%)</td>
<td>Tris-(1-chloro-2-propyl) phosphate TCPP (15.91%)</td>
<td>Tris-(1-chloro-2-propyl) phosphate TCPP (30%)</td>
</tr>
<tr>
<td>Silicone Surfactant (1.0%)</td>
<td>Silicone Surfactant (1.0%)</td>
<td>Silicone Surfactant (2%)</td>
</tr>
<tr>
<td>Catalyst</td>
<td>Catalyst</td>
<td>Catalyst (5%)</td>
</tr>
<tr>
<td>Bis (2-Dimethylaminoethyl) ether (0.9%) (BDMAEE)</td>
<td>Bis (2-Dimethylaminoethyl) ether (0.7%) (BDMAEE)</td>
<td>Pentamethyldiethylene triamine (PMDETA)</td>
</tr>
<tr>
<td>Tetramethyliminobispropylamine (3.0%) (TMBPA)</td>
<td>Bis (dimethylaminopropyl) methylamine (2.59%) (DAPA)</td>
<td>(Ethylhexanoic, 2-, potassium salt/Oxybisethanol, 2,2’)</td>
</tr>
<tr>
<td>N,N,N-Trimethylaminoethylethanolamine (4.0%) (TMAEEA)</td>
<td>N,N,N-Trimethylaminoethylethanolamine (0.3%) (TMAEEA)</td>
<td></td>
</tr>
</tbody>
</table>
PHASE 2 TEST PROTOCOL

• Personal and area air sampling conducted as generic SPF formulations are applied to a substrate.

• Air sampling conducted in a ventilated spray room under specified air exchange rates and environmental conditions.

• Low and medium density formulations sprayed using standard industry high pressure equipment. Low pressure kit formulations to be sprayed using manufacturer-supplied equipment.

• Applicator sprays a maximum of 12 inserts during a 15 to 20 min test period for each generic formulation
PHASE 2
VENTILATED SPRAY ROOM

- Approximately 8 ft x 8ft x 8ft
- Make-up air introduced on one side of the room and exhausted through a filter bank on the opposite wall of the room.
- Air flow is perpendicular to the spray
- Ventilation rate - 86 cfm or 10.4 Air Changes per Hour (ACH) selected for first series of air sampling
- SPF spray substrate consists of three 2x4 inch studs, 7 feet in height, spaced 16 inches apart, providing 2 cavities lined with cardboard inserts.
PHASE 2 – TESTING

Area samples located to approximate worker’s breathing zone, in an area behind the applicator.

Area Samples collected during SPF application and post application.
Ventilated Spray Room

Spray Room

Airlock

Breathing Air

Spray Room Area

25’

22’

Spray Machine

Polyol

Iso drum

Substrate

Area Samples

Applicator

Air Flow

7’9”

8’2” High

7’9”

4’6”

6’

Courtesy of Air Products and Chemicals, Inc.
PHASE 2 – AIR SAMPLING RESULTS AT 10.4 ACH AIR EXCHANGE RATE

1. Three generic SPF formulations were sprayed for 15 min with 10.4 air changes per hour of general ventilation perpendicular to the spray.

2. One set of stationary samples collected 30 minutes after the completion of the spray session for a period of 1 hour (post spray sample) while ventilation continued to operate at 10 ACH operating and sprayed inserts remained in the room.

3. Personal and stationary samples were collected for MDI, pMDI, amine catalyst, blowing agent, and fire retardant.
METHYLENE BISPHENYL ISOCYANATE (MDI)

Concentration (ppm)

- OSHA Ceiling Limit = 0.02 ppm
- ACGIH TLV-TWA = 0.005 ppm

2,4-MDI

4,4-MDI

Applicator Area Post Spray Applicator Area Post Spray Applicator Area Post Spray Low Pressure Kit

Medium Density Low Density
POLYMERIC METHYLENE BISPHENYL ISOCYANATE (P-MDI)

Concentration - mg/m³

- Applicator
- Area
- Post Spray

Medium Density
Low Density
Low Pressure Kit

p-MDI
AMINE CATALYSTS

Concentration - ppm

- BDMAEE
- TMAEEA
- DAPA
- TMIPA
- PMDETA

Medium Density
Low Density
Low Pressure Kit

Applicator  Area  Post-Spray  Applicator  Area  Post-Spray  Applicator  Area  Post-Spray
BIS(2-DIMETHYLAMINOETHYL)ETHER (BDMAEE)

Concentration (ppm)

<table>
<thead>
<tr>
<th>Applicator</th>
<th>Area</th>
<th>Post-Spray</th>
<th>Applicator</th>
<th>Area</th>
<th>Post-Spray</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium Density</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Density</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ACGIH TLV-STE = 0.15 ppm
ACGIH TLV-TWA = 0.05 ppm
TCPP – FIRE RETARDANT

Concentration - ppm

TCPP

Medium Density
Low Density
Low Pressure Kit

Applicator
Area
Post Spray
Applicator
Area
Post Spray
Applicator
Area
Post Spray

0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
BLOWING AGENTS
HIGH PRESSURE MEDIUM DENSITY (HFC-245FA)

Concentration - ppm

Applicator | Area | Post Spray

Medium Density

AIHA WEEL = 300 ppm

HFC-245fa
BLOWING AGENTS –
LOW PRESSURE KIT HFC -134A

![Graph showing concentration levels of HFC-134a in Applicator, Area, and Post Spray. The AIHA WEEL is set at 1000 ppm.](image-url)
PATH FORWARD

• During the application of the three generic SPF formulations at a ventilation rate of 10.4 ACH:
  ▪ Occupational exposure limits were exceeded for personal and area samples, therefore OSHA regulations would require respiratory protection for those spraying generic SPF formulations or for those working in the vicinity of the SPF application under equivalent conditions.

• Task Force will evaluate findings and consider whether to propose further Phase 2 testing.

• CPI will prepare interim reports summarizing combined monitoring results for generic medium density, low density, and kit formulations at specified air exchange rates as the project continues.
PRODUCT EMISSION TESTING
EMISSIONS TASK FORCE OBJECTIVE

Develop methods for SPF standardization that can be used by manufactures to evaluate potential emissions released from SPF insulation samples

Participate in research to support the development of SPF product emissions standards through ASTM Sub-committee D22.05 on Indoor Air Quality
ASTM SUBCOMMITTEE D22.05 ON INDOOR AIR TASK GROUP ON SPF EMISSIONS

Task Group Members Include:
- Industry/CPI
- Regulatory (US EPA, CPSC, etc.)
- Instrument Vendors
- Consultants
- Air Quality Testing Labs
- Certification Programs
- Other Stakeholders

Technical Contact
- John Sebroski, Bayer MaterialScience LLC
PROPOSED ASTM WORK ITEMS

Develop several standard practices / test methods:

- Standard Practice for Development of Generic SPF Formulations
- Standard Practice for Spraying, Sampling, Packaging, and Test Specimen Preparation of Spray Polyurethane Foam (SPF) Insulation Samples for Environmental Chamber Emissions Testing
  - ASTM Work Item WK30960
- Standard Test Method for Measuring SPF Chemical Emissions with Thermal Desorption Tubes and GC/MS
  - ASTM Work Item WK40292
- Standard Test Method for Measuring MDI using LC MS/MS During Chamber Testing/IAQ Studies
- Standard Practice or Method for Estimating SPF Emissions using Micro-scale Test Chambers
  - ASTM Work Item WK40293
SUMMARY OF SPF EMISSIONS RESEARCH

1. Developed thermal desorption GC/MS analytical method for measuring potential SPF emissions
SUMMARY OF SPF EMISSIONS RESEARCH

2. Established baseline conditions and sample preparation techniques for measuring SPF emissions with micro-scale test chambers
SUMMARY OF SPF EMISSIONS RESEARCH

3. Conducted SPF insulation holding time and packaging study using generic SPF formulations; ASTM draft standard practice
SUMMARY OF SPF EMISSIONS RESEARCH

4. Evaluated wall adhesion effects of semi-volatile compounds (e.g. amine catalysts, flame retardant, MDI) in conventional test chambers; recoveries improved with micro-scale chambers
CURRENT ACTIVITIES

- ASTM D22 on Air Quality Ballot, January 2013
  - Standard Practice for Spraying, Sampling, Packaging, and Test Specimen Preparation of Spray Polyurethane Foam (SPF) Insulation Samples for Environmental Chamber Emissions Testing
- Collaboration with US EPA, Office of Research and Development
  - Ongoing meetings and discussion to identify collaboration opportunities
- 2013 Research Projects
  - CPI to further develop analytical test methods; optimize recovery of flame retardant and amine catalysts using micro-scale test chambers
  - International Isocyanate Institute (III) to evaluate prototype of test chambers optimized for MDI emissions
NEXT STEPS

ASTM Ballot Item
- Standard Practice for Spraying, Packaging and Test Specimen Preparation of SPF Insulation for Testing of Emissions Using Environmental Chambers

New Work Items at ASTM D22.05 on Indoor Air
- Standard Test Method for Measuring SPF Chemical Emissions with Thermal Desorption Tubes and GC/MS
- Standard Practice for using Micro Chamber to Measure SPF Emissions

Research to support development of ASTM standards
- Environmental Test Chamber Optimization of SVOCs (Amine Catalysts, Flame Retardant and MDI)
- Optimize Thermal Desorption GC/MS Method
- Validation Study Plans
SPRAY FOAM COALITION

• Formed at CPI in 2010 as a forum for manufacturers of spray foam systems and their suppliers
• Champion the use of spray polyurethane foam
• Promote its economic, environmental and societal benefits
• Provide a forum to help shape public policy on issues critical to the industry
• Support the safe manufacture, transport, and application of spray polyurethane foam
RESEARCH AND TESTING PROJECTS

- Improvements to Acceptance Criteria for Spray Foam (AC 377 and others)
- Modeling of Unvented Attics – appropriate credit given for unvented attics
- Developed Document on Best Practices for Installing Spray Foam
- Thermal Specimen Preparation
- Ventilation Best Practices Document
SPRAY FOAM COALITION WEBSITE
www.WhySprayFoam.org

- Case Studies/White Papers
- Get the Facts flyers
- Support for Contractor Certification and CPI Product Stewardship
- Business Statistics
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