SPF Chemistry Makes It A Safe Product

2018 SPFA Convention & Expo Workshop

Presented by

George R. Thompson, Ph.D. and Brian Fogg, M.S.

CCS
Chemical Compliance Systems, Inc.

“Anticipating the Unanticipatable”
ANTITRUST POLICY STATEMENT FOR SPRAY POLYURETHANE FOAM ALLIANCE MEETINGS

• It is and shall remain the policy of the Spray Polyurethane Foam Alliance ("SPFA"), and it is the continuing responsibility of every SPFA member company, SPFA meeting or event participant, as well as SPFA staff and leadership to comply in all respects with federal and state antitrust laws. No activity or discussion at any SPFA meeting or other function may be engaged in for the purpose of bringing about any understanding or agreement among members to (1) raise, lower or stabilize prices; (2) regulate production; (3) allocate markets; (4) encourage boycotts; (5) foster unfair or deceptive trade practices; (6) assist in monopolization; or (7) in any way violate or give the appearance of violating federal or state antitrust laws.

• Any concerns or questions regarding the meaning or applicability of this policy, as well as any concerns regarding activities or discussions at SPFA meetings should be promptly brought to the attention of SPFA’s Executive Director and/or its legal counsel.
Pre-Workshop Quiz

1. How many of you represent manufacturers?

2. How many of you represent installers?

3. How many of you have some background in chemistry?
Toxicology – The Regulatory Science of Poisons
SPF Chemistry Lawsuit Experiences

Case-Specific *Toxicological Root Cause Analysis Elements*

- 4 Expert Witness Cases - Defendants
- 1.5 Summary Judgment Wins
- 2.5 Settled Wins
- All Based Upon Detailed Chemistry Risk Assessments
- All Cases Started by Installation Complaint
“Safe” – Dictionary Definitions

1. “free from harm or risk” – different?
2. “secure from threat or danger, harm, or loss”
3. “affording safety or security from danger, risk, or difficulty”
4. “not likely to take risks; cautious”
5. “successful in reaching base in baseball without being put out”
HAZARD – estimated/measured adverse effect from a chemical under specific conditions

TOXIC – deleterious to man &/or other organisms

POISON – any agent capable of producing a deleterious biological response (every known chemical)

RISK – probability an adverse effect will occur under specified conditions, influenced by
  • Exposure amount, frequency, duration
  • Exposure route (inhalation, ingestion, dermal)
  • Effect severity/usage conditions

RISK = f (Hazard ● Exposure)

HAZARD ASSESSMENT (Chemical) – experimentally identify deleterious effects:
  Health, Environmental, Safety

RISK ASSESSMENT – characterization of potential adverse effects under specified usage and exposure conditions
  • Identify hazards
  • Evaluate exposure elements & conditions
  • Eliminate or control the hazards
Paracelsus – The Father of Toxicology
(1493-1541)

“All Ding sind Gift, und nichts ohn Gift, allein die Dosis macht, das ein Ding kein Gift ist”

All things are poisons, and nothing is without poison; only the dose permits something not to be poisonous.

“Substances considered toxic are harmless in small doses, and conversely, an ordinarily harmless substance can be deadly if over-consumed”

“Poisons’ were not necessarily something negative...poisons could have beneficial medical effects”
[toxicology vs. pharmacology]

The Dose Makes the Poison
Hazard Assessments vs. Risk Assessments

<table>
<thead>
<tr>
<th>HAZARD of CONCERN</th>
<th>RISK MODIFICATION STRATEGIES</th>
<th>RESULTANT BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medicines/Vaccines</td>
<td>Dosages, Frequency, Duration</td>
<td>Prevent/Cure Diseases</td>
</tr>
<tr>
<td>Food Constituents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potatoes – Arsenic/Bromine/Nickel</td>
<td>Small concentrations, Vary Diet</td>
<td>Nutrition/Health</td>
</tr>
<tr>
<td>Mushrooms, Duck, Pears, Cauliflower - Formaldehyde</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tea – Fluoride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle Fuel Flammability</td>
<td>Engineering Controls</td>
<td>Efficient Transportation</td>
</tr>
<tr>
<td>Product/Process Chemicals</td>
<td>Exposure Minimization Engineering Controls</td>
<td>Diverse Product Availability</td>
</tr>
</tbody>
</table>

All chemicals are hazardous, but prudent management & use can eliminate the risks.
Continuous Data Compilation Since 1985

- $\geq 80,000,000$ Data Elements
- 280,000 Chemicals
- $>29,000$ Chemicals with 44 EHS Endpoints
- 1,250 Fracking Chemicals
- 1,100 Munition Chemicals
- 1,000 Cosmetic Chemicals
- 200 Spray Polyurethane Foam Chemicals
- $\geq 1,500,000$ Product SDSs
- $>10,000$ Manufacturers
- 1,000 Public Data Sources
- $>800$ Chemical Regulatory Lists
“GREENER” CHEMICAL SCORING PROCESS

Chemicals – Products – Processes – Wastestreams

Significance of each sub-score can be individually weighted

FINAL GREENER CHEMICAL GRADE
(0 - 100%)

ECOLOGICAL SCORE
(0-100%)

Water Score

Air Score

Soil Score

HEALTH SCORE
(0-100%)

Acute Health Score

Chronic Health Score

SAFETY SCORE
(0-100%)

Fire Score

Special Score

Reactivity Score

44 ENDPOINTS IN THE NSF/GCI/ANSI 355-2011 NATIONAL STANDARD
# GreenSuite® Scoring Hierarchy Descriptors

<table>
<thead>
<tr>
<th>Green Score</th>
<th>Alpha Score</th>
<th>Text Descriptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>97 - 100</td>
<td>A+</td>
<td>Highly Probable Non-Risk</td>
</tr>
<tr>
<td>93 - 96</td>
<td>A</td>
<td>Very Probable Non-Risk</td>
</tr>
<tr>
<td>90 - 92</td>
<td>A-</td>
<td>Probable Non-Risk</td>
</tr>
<tr>
<td>87 - 89</td>
<td>B+</td>
<td>Reasonable Non-Risk</td>
</tr>
<tr>
<td>83 - 86</td>
<td>B</td>
<td>Possible Non-Risk</td>
</tr>
<tr>
<td>80 - 82</td>
<td>B-</td>
<td>Cautious Non-Risk</td>
</tr>
<tr>
<td>77 - 79</td>
<td>C+</td>
<td>Minimal Risk</td>
</tr>
<tr>
<td>73 - 76</td>
<td>C</td>
<td>Slight Risk</td>
</tr>
<tr>
<td>70 – 72</td>
<td>C-</td>
<td>Moderate Risk</td>
</tr>
<tr>
<td>65 – 69</td>
<td>D</td>
<td>Serious Risk</td>
</tr>
<tr>
<td>&lt; 65</td>
<td>F</td>
<td>Extreme Risk</td>
</tr>
</tbody>
</table>
Enhanced GreenSuite®

“One tool cannot do it all!”

Enhanced GreenSuite® Data Entry Screen

1. Product Stewards & Toxicologists
   - RCR Chemical (Exposure Scenario Options)
2. Process Engineering
   - Process Engineering (G-PEAS) (24 Criteria - Customer)
3. Research/Development Procurement/Acquisitions

Chemical (GC-DDS) (44 Criteria - CCS)

Green Supply Chain (GSC-ACS) (44 Criteria – CCS)

Product (GP-CAS) (44 Criteria - CCS) [Design/Evaluate]

Process (G-PACS) (44 Criteria - CCS) [Design/Evaluate]

Green Chemistry Student Tutorial (GC-STM) (44 Criteria CCS)

Waste Stream (G-WACS) (44 Criteria - CCS) [Evaluate/Design]

Manufacturer & Supplier “Family Tree” (44 Criteria – CCS)

[ 10 Optional Hazard & Risk Assessments ]
# GreenSuite®

## Lifecycle Alternative Assessments

<table>
<thead>
<tr>
<th>Design</th>
<th>New Constituents</th>
<th>Manufacturing Precursor Materials</th>
<th>Finished Manufactured Product</th>
<th>Transportation &amp; Storage</th>
<th>Usage Emissions</th>
<th>Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Screening Test Data Requirements]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[Product Specific]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[Product Specific]</td>
</tr>
</tbody>
</table>

- **Chemical Module**
- **Product Module (Design)**
- **Supplier “Family Tree” System**
- **Process Module/Chemicals**
- **Process Module/Engineering**
- **Product Module (Evaluate)**
- **Waste Module**
# Spray Polyurethane Foam (SPF) Chemistry

<table>
<thead>
<tr>
<th>Side A</th>
<th>+</th>
<th>Side B</th>
<th>-----&gt;</th>
<th>Curing SPF</th>
<th>-----&gt;</th>
<th>Cured SPF “Article”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Isocyanate Blend</strong> + <strong>Polyol Blend</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>SPF</strong></td>
<td></td>
<td><strong>SPF (+ CO₂)</strong></td>
</tr>
</tbody>
</table>

### Reacts 100%
- **Isocyanate chemicals**
- Polyols React 100%
- Polyols (20-70%)
- Amine/Metal Catalysts (0.1-5%)
- Flame Retardants, Reactive (5-8%)
- Flame Retardants, Nonreactive (10-30%)
- Surfactants (<1%)
- Blowing Agent, Reactive – Water (17-20%)
- Blowing Agent, Nonreactive (8-14%)
- Antimicrobial (<0.5%)

### Isocyanate Blend
- **Amine/Metal Catalysts (Intact) – Low VP**
- **Flame Retardants, Nonreactive (Intact) – V. Low VP**
- **Surfactants (Intact) – Extremely Low VP**
- **Blowing Agent, Nonreactive (Intact) – High VP**
- **Antimicrobial (Intact) – V. Low VP**
- **Urea – Low VP**

### Polyol Blend
- SPF (+ CO₂)
- SPF (Solid) – No Free Isocyanate
- Residual Glycols – V. Low VP
- Amine/Metal Catalysts (Intact) – Low VP
- Bound 100% to SPF
- Flame Retardants, Nonreactive (Intact) – V. Low VP
- Surfactants (Intact) – Extremely Low VP
- Blowing Agent Reacts 100% to Form CO₂
- Blowing Agent, Nonreactive (Intact) – High VP
- Antimicrobial (Intact) – V. Low VP

The cured SPF ‘article’ contains low residue levels of Catalysts, Nonreactive Flame Retardants, Surfactants, and Antimicrobials, but **None of these readily evaporate due to their very low to extremely low Vapor Pressures (VP).** If the Side B formulas contained a Nonreactive Blowing Agent, this material will evaporate quickly from the surface of the SPF due to its high VP (i.e., during the curing time), with the reminder locked within the matrix of the SPF. During the curing process, residual SPF constituent continue to react until the freeze – out temperature is reached as a result of heat dissipation.
Isocyanate Chemical Structures

\[
R\-\text{N}\equiv\text{C}\equiv\text{O}
\]

Isocyanate Ion

P-toluenesulfonyl isocyanate
4083-64-1
Green Scores:  74  77  83  63

4,4' Diphenylmethane diisocyanate (MSDI)
CAS #: 101-68-8
Green Scores:  65  59  51  85
<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>CAS #</th>
<th>Green Grade</th>
<th>Ecological</th>
<th>Health</th>
<th>Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hexamethylene diisocyanate</td>
<td>28182-81-2</td>
<td>89</td>
<td>84</td>
<td>87</td>
<td>97</td>
</tr>
<tr>
<td>P-Toluenesulfonyl isocyanate</td>
<td>4083-64-1</td>
<td>74</td>
<td>77</td>
<td>83</td>
<td>63</td>
</tr>
<tr>
<td>Polymethylene polyphenylisocyanate</td>
<td>9016-87-9</td>
<td>72</td>
<td>70</td>
<td>59</td>
<td>85</td>
</tr>
<tr>
<td>Methylene bisphenyl isocyanate</td>
<td>26447-40-5</td>
<td>68</td>
<td>59</td>
<td>60</td>
<td>85</td>
</tr>
<tr>
<td>Methylenediphenyl diisocyanate</td>
<td>101-68-8</td>
<td>65</td>
<td>59</td>
<td>51</td>
<td>85</td>
</tr>
<tr>
<td>Toluene-2-diisocyanate</td>
<td>584-84-9</td>
<td>64</td>
<td>69</td>
<td>47</td>
<td>77</td>
</tr>
<tr>
<td>Isophorone diisocyanate</td>
<td>4098-71-9</td>
<td>63</td>
<td>65</td>
<td>54</td>
<td>72</td>
</tr>
</tbody>
</table>
Primary Isocyanate Health Hazards
(Two Lowest Health Scores: TDI = 47 & MDI = 51)

- **Acute Health Hazards** (Scores = 30 & 30)
  - IDLH = 0 & 0
  - STEL/Ceiling = 0 & 5
  - Inhal LC50 = 2 & 7
  - Skin Irrit. = 25 & 80
  - Eye Irrit. = 0 & 25

- **Chronic Health Hazards** (Scores = 64 & 73)
  - Carcinogenicity = 50 & 90
  - Sensitizer = 0 & 0
  - TLV = 0 & 9

Scores < 65 in Red

CPI recommends full personal protective equipment to prevent skin, eye & inhalation exposure
<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>CAS #</th>
<th>Green Grade</th>
<th>Ecological</th>
<th>Health</th>
<th>Safety</th>
<th>Vapor Press. (mmHg)</th>
<th>Density (g/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water/Air</td>
<td>7732-18-5/---</td>
<td>100/---</td>
<td>100/---</td>
<td>100/---</td>
<td>100/---</td>
<td>23.8</td>
<td>1.225 E-3</td>
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<tr>
<td>Hexamethylene diisocyanate</td>
<td>28182-81-2</td>
<td>89</td>
<td>84</td>
<td>87</td>
<td>97</td>
<td>1 E-3</td>
<td>1.14</td>
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<tr>
<td>P-Toluenesulfonyl isocyanate</td>
<td>4083-64-1</td>
<td>74</td>
<td>77</td>
<td>83</td>
<td>63</td>
<td>9.44 E-5</td>
<td>1.29</td>
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<tr>
<td>Polymethylene polyphenylisocyanate</td>
<td>9016-87-9</td>
<td>72</td>
<td>70</td>
<td>59</td>
<td>85</td>
<td>5.4 E-13</td>
<td>1.23</td>
</tr>
<tr>
<td>Methylene bisphenyl isocyanate</td>
<td>26447-40-5</td>
<td>68</td>
<td>59</td>
<td>60</td>
<td>85</td>
<td>4.8 E-5</td>
<td>1.24</td>
</tr>
<tr>
<td>Methylenedi diphenyl diisocyanate</td>
<td>101-68-8</td>
<td>65</td>
<td>59</td>
<td>51</td>
<td>85</td>
<td>1.89 E-4</td>
<td>1.23</td>
</tr>
<tr>
<td>Toluene-2-diisocyanate</td>
<td>584-84-9</td>
<td>64</td>
<td>69</td>
<td>47</td>
<td>77</td>
<td>2.38 E-2</td>
<td>1.22</td>
</tr>
<tr>
<td>Isophorone diisocyanate</td>
<td>4098-71-9</td>
<td>63</td>
<td>65</td>
<td>54</td>
<td>72</td>
<td>3.0 E-4</td>
<td>1.06</td>
</tr>
</tbody>
</table>
Isocyanate Chemical Reactions in Polyurethanes

- \( R-NCO \)
- \( RNH_2 + CO_2 \)
- \( RNHCONHR \)
- \( UREA \)
- \( H_2O \)
- \( RNHCONHR' \)
- \( UREA \)
- \( RNCO \)
- \( OCN-R-N=C=N-RNCO \)
- \( CARBODIIMIDE \)
- \( R'OH \)
- \( URETHANE \)
- \( R-NCO \)
- \( ALOPHANATE \)
- \( R-NCO \)
- \( URETONAMINE \)
- \( R-NCO \)
- \( RHNCOOR' \)
- \( URETHANE \)
- \( R-NCO \)
- \( DIMER \)
- \( TRIMER \)
- \( R'-COOH \)
- \( R'=COO \)
- \( RNHCONHR' \)
- \( UREA \)
- \( R'-OH \)
- \( R'=OH \)
- \( R'-HN_2 \)
- \( R'-HN_2 \)
- \( RHNCOOR' \)
- \( AMIDE \)
- \( RHHCOR' + CO_2 \)
## Side B – Polyol Blend GreenSuite® Hazard Assessment Comparisons (15-30 CAS #s)

<table>
<thead>
<tr>
<th>Chemicals</th>
<th>Conc. (%)</th>
<th>Green Grade</th>
<th>Ecological</th>
<th>Health</th>
<th>Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blowing, Reactive (1)</td>
<td>1</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Blowing, Nonreactive (1)</td>
<td>9</td>
<td>86</td>
<td>77</td>
<td>91</td>
<td>92</td>
</tr>
<tr>
<td>Polyether Polyols (3)</td>
<td>0.8-15.2</td>
<td>85-88</td>
<td>75-84</td>
<td>78-90</td>
<td>92</td>
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<tr>
<td>Polyol, Sucrose (1)</td>
<td>6</td>
<td>85</td>
<td>74</td>
<td>89</td>
<td>92</td>
</tr>
<tr>
<td>Polyol, Aromatic (1)</td>
<td>39</td>
<td>86</td>
<td>78</td>
<td>89</td>
<td>92</td>
</tr>
<tr>
<td>Flame Retardant (2)</td>
<td>6-17</td>
<td>87</td>
<td>77</td>
<td>91</td>
<td>92</td>
</tr>
<tr>
<td>Surfactant (3)</td>
<td>0.03-4.8</td>
<td>79-86</td>
<td>74-81</td>
<td>70-86</td>
<td>92</td>
</tr>
<tr>
<td>Catalyst, Metal (6)</td>
<td>0.002-5.6</td>
<td>37,77-86</td>
<td>53, 62, 76-78</td>
<td>26, 61, 84-89</td>
<td>30, 83-92</td>
</tr>
<tr>
<td>Catalyst, Amine (7)</td>
<td>0.2-0.8</td>
<td>71-83</td>
<td>68-73</td>
<td>50, 55, 81-88</td>
<td>83-92</td>
</tr>
</tbody>
</table>
# Curing/Cured SPF Constituent Risk Assessments

(11/9 CAS #s)

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Conc. (%)</th>
<th>Ranking</th>
<th>Green Grade</th>
<th>Ecological</th>
<th>Health</th>
<th>Safety</th>
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</thead>
<tbody>
<tr>
<td>Polyurethane Foam (SPF)</td>
<td>78</td>
<td>1</td>
<td>95</td>
<td>95</td>
<td>92</td>
<td>97</td>
</tr>
<tr>
<td>Polyl-1</td>
<td>0.04</td>
<td>2</td>
<td>89</td>
<td>83</td>
<td>86</td>
<td>97</td>
</tr>
<tr>
<td>Surfactant</td>
<td>0.36</td>
<td>3</td>
<td>88</td>
<td>78</td>
<td>89</td>
<td>97</td>
</tr>
<tr>
<td>Catalyst, Metal</td>
<td>5</td>
<td>4</td>
<td>88</td>
<td>77</td>
<td>91</td>
<td>97</td>
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<td>Flame Retardant, NR</td>
<td>4</td>
<td>5</td>
<td>88</td>
<td>76</td>
<td>91</td>
<td>97</td>
</tr>
<tr>
<td>Blowing Agent</td>
<td>3.1</td>
<td>6</td>
<td>86</td>
<td>73</td>
<td>85</td>
<td>100</td>
</tr>
<tr>
<td>Catalyst, Amine-1</td>
<td>1</td>
<td>7</td>
<td>83</td>
<td>78</td>
<td>74</td>
<td>97</td>
</tr>
<tr>
<td>Reaction Product-1</td>
<td>7.3</td>
<td>8</td>
<td>82</td>
<td>69</td>
<td>77</td>
<td>100</td>
</tr>
<tr>
<td>Catalyst, Amine-2</td>
<td>1</td>
<td>9</td>
<td>81</td>
<td>68</td>
<td>86</td>
<td>88</td>
</tr>
<tr>
<td>Catalyst, Amine-3</td>
<td>0.05</td>
<td>10</td>
<td>77</td>
<td>66</td>
<td>84</td>
<td>82</td>
</tr>
<tr>
<td>Catalyst, Amine-4</td>
<td>0.2</td>
<td>11</td>
<td>72</td>
<td>74</td>
<td>52</td>
<td>90</td>
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</table>
## CPI Published SPF Air Sampling Test Results

<table>
<thead>
<tr>
<th>ACH Time</th>
<th>Med Dens/HP [CC] (ppm)</th>
<th>Low Dens/HP [OC] (ppm)</th>
<th>Low Press Kit [CC] (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A Side</td>
<td>B Side</td>
<td>A Side</td>
</tr>
<tr>
<td></td>
<td>MDI (2)</td>
<td>Am. Cat.</td>
<td>TCPP</td>
</tr>
<tr>
<td>~10 Applic</td>
<td>0.025  8.0  0.32  300</td>
<td>0.014  1.0  0.15</td>
<td>0.0002  1.8  0.04</td>
</tr>
<tr>
<td>1 hr</td>
<td>0  0.02  0.003  1.0</td>
<td>0  0.065  0.0017</td>
<td>0  0.01  0.001</td>
</tr>
<tr>
<td>2 hr</td>
<td>0  0.005  0.0013  0.5</td>
<td>0  0.05  0.0015</td>
<td>0  0.003  0.0013</td>
</tr>
<tr>
<td>~2 3 hr</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 hr</td>
<td>0  0.007  0.001  0.9</td>
<td>0  0.07  0.0018</td>
<td>0  0.005  0.0017</td>
</tr>
<tr>
<td>8 hr</td>
<td>--  0.006  0.001  0.8</td>
<td>--  0.09  0.0023</td>
<td>--  0.006  0.002</td>
</tr>
<tr>
<td>12 hr</td>
<td>--  0.005  0.001  0.5</td>
<td>--  0.08  0.002</td>
<td>--  0.014  0.0015</td>
</tr>
</tbody>
</table>

**MDI OEL = 0.005 ppm; Amine Cat. OEL = 0.05 ppm; TCPP No OEL; HFC OEL = 300-1000 ppm**

In 5 lawsuits: MDI never detected; common VOCs & surfactants ID; TCPP very low levels in 1/8 poor tests

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**CCS-22**
Decreasing SPF Systems Relative Risk
### Spray Polyurethane Foam (SPF) Chemistry

<table>
<thead>
<tr>
<th>Side A + Side B</th>
<th>Curing SPF</th>
<th>Cured SPF “Article”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isocyanate Blend + Polyol Blend</td>
<td>SPF (+ CO₂)</td>
<td>SPF (+ CO₂)</td>
</tr>
<tr>
<td>Reacts 100%</td>
<td>SPF (Solid) – No Free Isocyanate</td>
<td>SPF (Solid) – No Free Isocyanate</td>
</tr>
<tr>
<td>Polyols React 100%</td>
<td>SPF (Solid) – No Free Isocyanate</td>
<td>SPF (Solid) – No Free Isocyanate</td>
</tr>
<tr>
<td>Amine/Metal Catalysts 50% Dilution</td>
<td>Residual Glycols – V. Low VP</td>
<td>Amine/Metal Catalysts (Intact) – V. Low VP</td>
</tr>
<tr>
<td>Flame Retard., Nonreactive 50% Dilution</td>
<td>Amine/Metal Catalysts (Intact) – Low VP</td>
<td>Flame Retard., Nonreactive (Intact) – V. Low VP</td>
</tr>
<tr>
<td>Blowing Agent, Nonreactive 50% Dilution</td>
<td>Bound 100% to SPF</td>
<td>Surfactants (Intact) – Extremely Low VP</td>
</tr>
<tr>
<td>Antimicrobial 50% Dilution</td>
<td>Flame Retard., Nonreactive (Intact) – V. Low VP</td>
<td>Blowing Agent, Nonreactive (Intact)</td>
</tr>
<tr>
<td>Amine/Metal Catalysts (Intact) – Low VP</td>
<td>Surfactants (Intact) – Extremely Low VP</td>
<td>High VP</td>
</tr>
<tr>
<td>Antimicrobial (Intact) – V. Low VP</td>
<td>Surfactants (Intact) – Extremely Low VP</td>
<td>Antimicrobial (Intact) – V. Low VP</td>
</tr>
<tr>
<td>Urea – Low VP</td>
<td>Blowing Agent, Nonreactive (Intact)</td>
<td></td>
</tr>
<tr>
<td>High VP</td>
<td>Antimicrobial (Intact)</td>
<td></td>
</tr>
</tbody>
</table>

### Safety Precautions

- Full PPE required during installation
- All occupants vacated during & 24-48 hours after
- Ventilate to outside during installation
- Maintain vacancy for 24-48 hours after install
- Aggressively ventilate to outside during curing
- Document thorough final project inspection
- Walk through with customer
OSHA Hazard Communication Standard (HazCom)

- Aligned with UN Global Harmonization System (GHS) 2012

- Classified Potential Chemical Hazards, including A & B Side constituents

- Employee Communication of Potential Chemical Hazards & Protections
  - Written Hazard Communication Plan (WHCP)
  - List of Chemical Hazards Present
  - Container Labeling – Workplace & Shipped
  - Safety Data Sheets (SDSs)
  - Employee Training Program
OSHA Safety Data Sheet (SDS) Elements

1. Product Identification – Chemical/Mixture
2. Hazard(s) Identification
3. Product Hazardous Composition
4. First Aid Measures
5. Fire Fighting Procedures
6. Accident Release Measures
7. Handling and Storage
8. Exposure Controls/PPE
9. Physical/Chemical Properties
10. Stability/Reactivity
11. Toxicological Information
12. Ecological
13. Disposal Consideration
14. Transportation Information
15. Regulatory Information
16. Other Information (Prep Date/Last Revision)
Exposure Prevention Strategies

• **OSHA Hazard Communication required employee training**
  - Written Hazard Communication Program
  - Product & chemical Safety Data Sheet (SDS) review
  - Product hazard awareness training
  - Container labeling
  - Exposure prevention strategies & equipment
  - Personal Protective Equipment (PPE) requirements

• **Installer certification with SPF manufacturer**

• **Worksite preparation procedures**
  - Ventilation during & 24-48 hours after installation
  - Airflow barriers & site protection coverings
  - Restricted access placards – outside, inside

• **Building vacancy 24-48 hours post installation**
  - Humans & pets
  - Written & signed documentation of this requirement
Toxic Substances Control Act Amendments - Overview

- **New Risk-Based Safety Standard**
  - Must Consider Risks to Susceptible “Highly” Exposed Populations.

- **Risk Assessment Priorities**
  - High = unreasonable risk due to potential chemical hazard and route of exposure
  - Low = the chemical use does not meet high-priority standard.

- **High Priority Designation Triggers Assessment Completion Deadline**

- **Chemical Assessment Prioritization (11/29/2016) – First 10 Chemical Risk Assessments**
  - 1, 4 Dioxane
  - 1, Bromopropane
  - Asbestos
  - Carbon Tetrachloride
  - Cyclic Aliphatic Bromide Cluster
  - Methylene Chloride
  - N-Methylpyrrolidone
  - Pigment Violet 29
  - Tetrachloethyene=Perchlroethylene
  - Tetrichloroethylene

- **Scoping Document / Chemical Within 6 Months**
  - Hazards
  - Conditions of Use
  - Susceptible Subpopulations
  - Exposures

- **3-Year Risk Assessment Completion Deadline**

- **If Unreasonable Risk, 2-Year Mitigation Deadline**

- **By 12/31/2019 - 20 Chemical Risk Assessment Continuously Ongoing**
Safe SPF - Conclusions

- **SPF is safe for consumers, but potentially hazardous for workers**
  - SPF chemistry protects the customer when properly installed
  - PPE and best business practices keep workers safe from SPF constituents

- **A Side is very hazardous (Health Scores = 47-60) – Risk is controllable**
  - Full body PPE & air supply
  - Rapidly reactive – binds to anything/everything
  - Heavier than air – settles quickly
  - Isocyanates undetectable within < 1 hour; don’t evaporate
  - Isocyanates **not** in cured SPF

- **B Side is much less hazardous (Health Scores mostly 70-100)**
  - Protected by full body PPE & air supply
  - Zero to minimal residues in cured SPF – diluted 50%
  - Predominant polyols minimal hazards, mostly/entirely reacted

- **SPF system initial hazards essentially gone in properly cured SPF**
  - Isocyanate 100% reacted
  - B Side constituents diluted 50%
  - Proper chemistry during installation & curing is key
Safe SPF - Recommendations

- Manufacturers develop SPF complete system risk assessments
  - Evaluate A Side, B Side, Curing SPF, & Cured SPF
  - Use proprietary reports for internal constituent alternative assessments & sales literature
  - Provide nonproprietary reports to distributors & installers
  - Train product development chemists regarding “green” chemistry, i.e., hazards & risks
  - Add “green” chemistry SPF system awareness to installer certification program
  - Distribute SDSs for entire SPF system – A Side, B Side, Curing SPF & Cured SPF – to customers
  - Maintain liability insurance in case of lawsuits

- Installers request manufacturer nonproprietary SPF system risk assessment reports & SDSs
  - Reject potential customers with asthma, known chemical sensitivities, or COPD
  - Train & test installers & sales staff regarding constituent hazards & formulation risks
  - Maintain SDSs for all SPF system components
  - Inspect/grade/evaluate completed SPF projects - with pictures
  - Maintain detailed records for each SPF project – specific process, issues, equipment
  - Annually monitor installer health
  - Maintain liability insurance in case of lawsuits
GreenSuite® SPF Hazard & Risk Assessments – Free Webinar

Wednesday, February 21, 2018 1:30 – 3:00 pm (ET)

- SPF Manufacturers, Distributors, Installers, & Attorneys
- Management, Sales Staff, Legal & Employee Hazard & Risk Awareness
- SPF Chemists Converted to “Green” Chemists
- Sales Staff Proprietary Product Awareness with Nonproprietary Report Resource
- Installer increased awareness improves customer satisfaction & Reduces Risks
- Management & Legal Awareness Improves Business & Minimizes Lawsuit Risks
- Demonstration – Quantitative Chemical Hazard Assessments in Seconds
- Demonstration – Quantitative SPF Formulation Risk Assessments in Seconds

Pre-Registration = georgethompson@chemply.com

Or, See Me at the CCS Booth
Thank You

Questions/Comments to:

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“Anticipating the Unanticipatable”