

Environmental and Health Considerations in Selecting Insulation

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Outline

- “ Insulation type and market share
- “ Fiberglass Insulation . E&H issues
- “ Foamed Plastic Insulation . E&H issues
- “ Cellulose Insulation . E&H issues

True or False?

Fiberglass insulation used to have formaldehyde in it, but no longer does.

False



True or False?

Fiberglass insulation contains
some added chemical flame
retardants.

False



True or False?

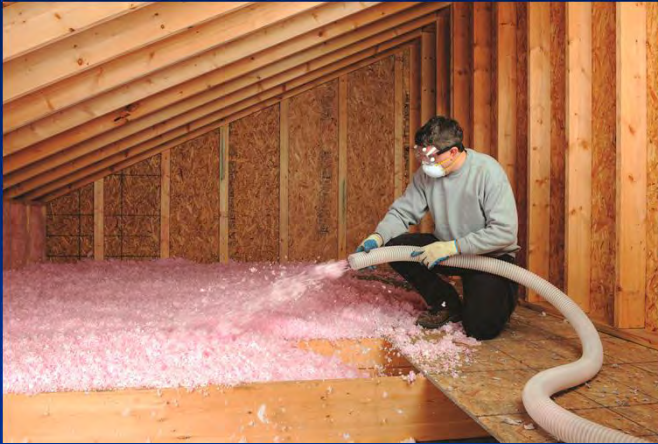
Fiberglass insulation contains chemical binders that commonly comprise about 15% of the total weight of the finished product.

True !



Insulation Type	Percent sales U.S. 2009
Fiberglass	51
Foamed Plastic (EPS, XPS, SPF)	44
Cellulose	2
Reflective/Radiant	2
Mineral Wool	1

Fiberglass Insulation



PROPINK® L77 Loosefill Insulation –
Photo Courtesy Owens Corning

Made of glass fibers and resin binders (commonly 20-40% recycled glass, remainder is silica sand)



Spider® Insulation – Photo Courtesy of Johns Mansville



Unfaced Fiberglass Roll Insulation –
courtesy Johns Mansville

Glass Wool Fibers and Cancer

- “ In 2001, the International Agency for Research on Cancer (IARC) downgraded the classification of glass wool fibers from Group 2B (possible carcinogen) to Group 3 (not classifiable as to carcinogenicity in humans)
- “ **2011, National Toxicology Program (NTP):** Reasonably anticipated to be a human carcinogen (Certain Glass Wool Fibers (Inhalable)) However, available data suggest that indoor air concentrations do not increase significantly after installation of fiberglass insulation

Fiberglass Insulation Resin Systems

Urea-Formaldehyde → Phenol-Formaldehyde
and Urea-extended
Phenol Formaldehyde → Acrylic Thermoset

Resins comprise 4-16% of fiberglass
insulation products, by weight!

Emissions from Fiberglass Insulation with Phenol-formaldehyde Binders

Wall Assemblies in Test Chambers



Unfaced fiberglass insulation



Unfaced fiberglass insulation behind unprepared dry wall

Source: **Formaldehyde and Total Volatile Organic Compound Emissions from Thermal Insulation Products** (2004), Charles W. Axten, Assoc. of nonwoven Fabrics Industry
http://www.inda.org/cgi-bin/biblio_reader.cgi?cmd=expand&id=1574?thermal-bond

Formaldehyde emissions from fiberglass insulation with phenol formaldehyde binder

Table 1- Formaldehyde emissions and modeled concentrations for office buildings reported by Axten

AQS Sample	Sample description			Formaldehyde emissions factors $\mu\text{g}/\text{m}^2 \cdot \text{hr}$ - number of hours					Modeled concentration - ppb			
									Green Guard	CA 01350		
ID	Insulation material	Vapor barrier	Emitting face	24	48	168	744	1392	7 days	7 days	14 days	58* days
11642-020AA	Unfaced Fiber Glass	None	None	51.1	41.2	28.9	32	25.4	25.9	18.9	9.6	16.6
11642-030AA	Unfaced Fiber Glass	None	Unprepared Drywall	28.9	28.9	29.6	31.1	33	25	18.2	17.1	20.3
11642-040 AA	Unfaced Fiber Glass	None	Drywall Prep w/GG cert Primer&Latex	27.8	24.4	20.3	21.1	not reported	18.3	13.3	9.3	13.8
11642-050AA	Kraft faced Fiber Glass	None	Unprepared Drywall	25.8	21.5	20.9	24.5	32.1	19.2	14	10	21.5
1164207 0AA	Kraft faced Fiber Glass	None	Drywall Prep w/GG cert Primer&Latex	28.7	26.2	19.9	18.2	17.3	17.8	13	8.5	11.3
11642-080 AB	Unfaced Fiber Glass	Poly secured to studs	Unprepared Drywall	17.8	14.1	13.1	25.6	21.8	11.7	8.6	6.2	14.3
1164209 0 AB	Unfaced Fiber Glass	Poly secured to studs	Drywall Prep w/GG cert Primer&Latex	18.9	16.2	13.4	18.4	14.9	12	8.8	5.9	9.8

* 58 day CA 01350 modeling results are calculated from Axtel 7 day and 58 day emission factors and 7 day modeling results

Source: Healthy Building News <http://www.healthybuilding.net/healthcare/Fiberglass-insulation-formaldehyde-emissions-090116.pdf>

Emissions from Fiberglass Insulation with Phenol-formaldehyde Binders

- “ Modeled concentrations for office buildings as reported by Axten were 10-22 ppb
- “ CA 01350 office ventilation rate is 0.68 ach, residential ventilation rate is 0.23 ach
- “ Due to higher loading factors in houses (more square footage of insulation per unit volume) the final modeled concentration will be even higher (about 4 times higher)
- “ OEHHA CREL for formaldehyde in residences will be 9 ppb after 1/1/12!

Environmentally Preferable Fiberglass and Cellulose Insulation



Environmentally Preferable Fiberglass and Cellulose Insulation Products

What Makes these Products Preferable?

To Improve Indoor Air Quality

Over the next few years, insulation will be added to thousands of California homes to make them more comfortable and energy efficient. When selecting insulation products, it's important to consider not just energy efficiency but also how the product will affect the home's indoor air quality.

Insulation materials occupy a large volume of space inside a home's walls, floors, and attic or roof area. Some insulation products emit harmful chemicals such as formaldehyde. When the air pressure changes between the inside and outside of buildings, air and chemicals emitted from insulation can move through walls, floors and ceilings and pass into the home—a process known as infiltration.



Green Insulation. Full Conformance

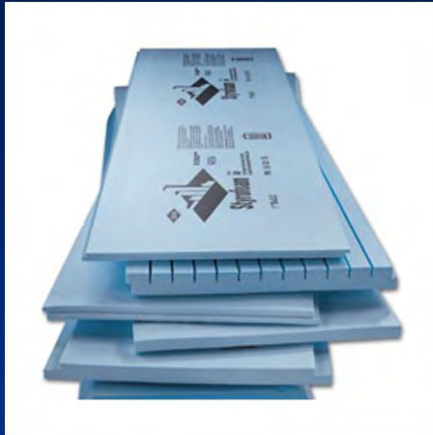
Manufacturer/ Product Type	Product Name	30% PC	Ultra- Low VOC
Johns Manville/ fiberglass batts	Unfaced and Faced (kraft, MR) Batts and Rolls, ComfortTherm® Batts and Rolls, Easy Fit® Unfaced and Kraft-Faced Batts	✓	✓
Johns Manville/ blown-in fiberglass	Attic Protector®, ClimatePro®, Spider®	✓	✓
Owens Corning/ blown-in fiberglass	PROPINK® L77 Loosefill Insulation, PROPINK Complete® Blown-in Wall System using PROPINK® L77 Loosefill Insulation, AttiCat® Expanding Blown-In PINK FIBERGLAS	✓	✓

Green Insulation.

Partial Conformance

Manufacturer/ Product Type	Product Name	30% PC	Ultra- Low VOC
Owens Corning/ fiberglass batts	PINK FIBERGLAS [®] Insulation Unfaced and Faced (kraft, foil, flame spread 25) Batts and Rolls	✓	
CertainTeed/ fiberglass batts	Sustainable Insulation [®] Unfaced And Kraft-faced Batts & Rolls		✓
GreenFiber/ blown-in cellulose	Natural Fiber Insulation	✓	

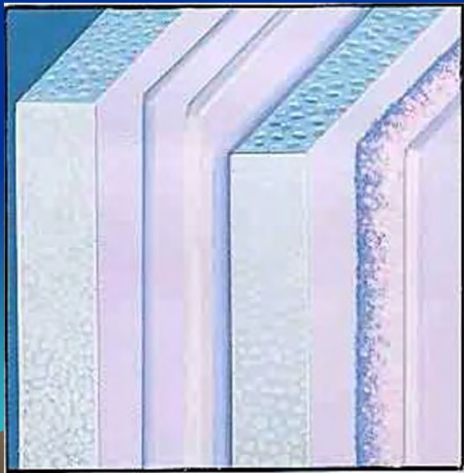
Foamed Plastic Insulation



Rigid Extruded Polystyrene Board (XPS)



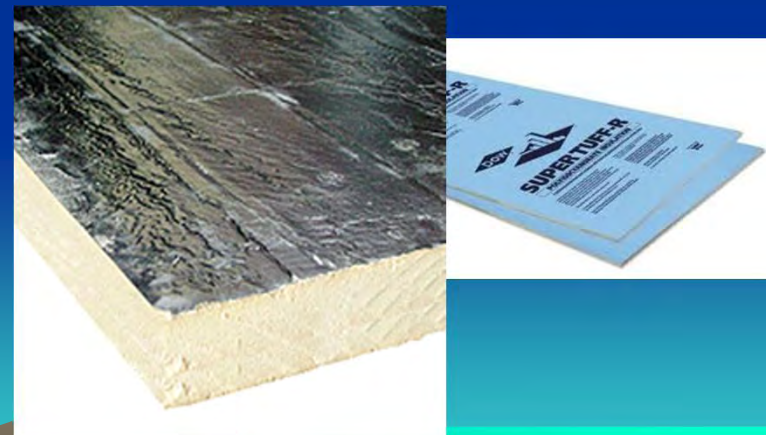
Spray Polyurethane Foam (SPF)



Expanded Polystyrene Foam Board (EPS)



Polyisocyanurate Rigid Foam Board



Spray Polyurethane Foam Insulation – What Is It?

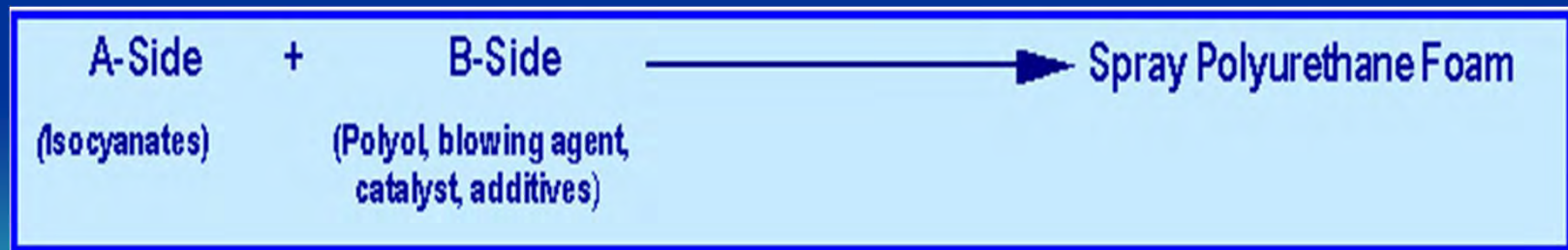
“ Expanding Foam Insulation

“ Widely used in homes to save energy costs



SPF Insulation - What's In It?

- “ Made by mixing 2 chemical parts
- “ Part A = Isocyanates
- “ Part B = Polyol + additives
- “ Chemical Reaction Occurs



SPF Insulation Exposure

Who Is At Risk?

“ Anyone exposed to liquids, vapors, dust, aerosols during installation

- . Installers
- . People in home during installation
- . People in home after installation?

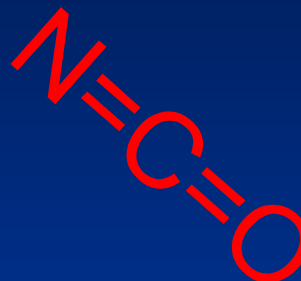


SPF Insulation

Chemicals of Concern

" Isocyanates

- . MDI, TDI



" Part B additives

- . Flame retardants
- . Amine containing catalysts
- . Solvent additives

" Aldehyde degradation products

Isocyanate Toxicity

“ Isocyanates

- . Skin, eye, lung irritation
- . Difficulty breathing
- . Asthma
- . Sensitization

“ More a concern for installers than residents

Isocyanates



Part B Additives-Toxicity

“ Flame Retardants

- . Persistent, bioaccumulative

“ Catalysts containing Amines

- . irritants, vision effects
- . Fishy odors

“ Solvent Additives

- . Irritants, headaches, dizziness

Degradation Products- Toxicity

“ Aldehyde Compounds

- . irritants
- . difficulty breathing

“ Other degradation products?

Building Occupants- Health Complaints

- “ Residual odors: fishy smell, chemical smell, metallic “taste”
- “ Respiratory irritation
- “ Asthma
- “ Chemical sensitivity

More research is needed

Exposures – Spray Application

“ Vapor, mist, particulates (isocyanates, amines) can migrate to other rooms or floors



Evidence of Isocyanate Exposures in Adjacent Areas

Information from Bayer:

- . Isocyanate vapors drifted throughout building after application of SPF w/i 20 minutes
 - ” Mostly lower floors
- . Exposure levels above the PEL in adjacent areas
 - ” More than 20 feet away from applicator
- . Also found in truck trailer



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Exposures – Trimming Foam

” Cutting, scraping foam that is not fully cured generates dust that may contain isocyanates



Appropriate Exposure Control - Proper Use of PPE

- “ Primary worker (spray applicator):
 - . Full saran-coated body cover (no exposed skin)
 - . Gloves, over-boots
 - . Appropriate respirator with full face mask
- “ Helpers (need to evaluate on case-by-case basis)
 - . Full skin protection and gloves (no skin exposed)
 - . Full face mask
- “ Adjacent workers
- “ Train **ALL** workers



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Appropriate Exposure Control - Ventilation Considerations

- “ Ventilation crucial for worker safety
- “ Only vent to outside using approved filter
 - . Protect workers or passers-by outside
 - . Similar methods can be adapted from measures used in truck bed-liner industry



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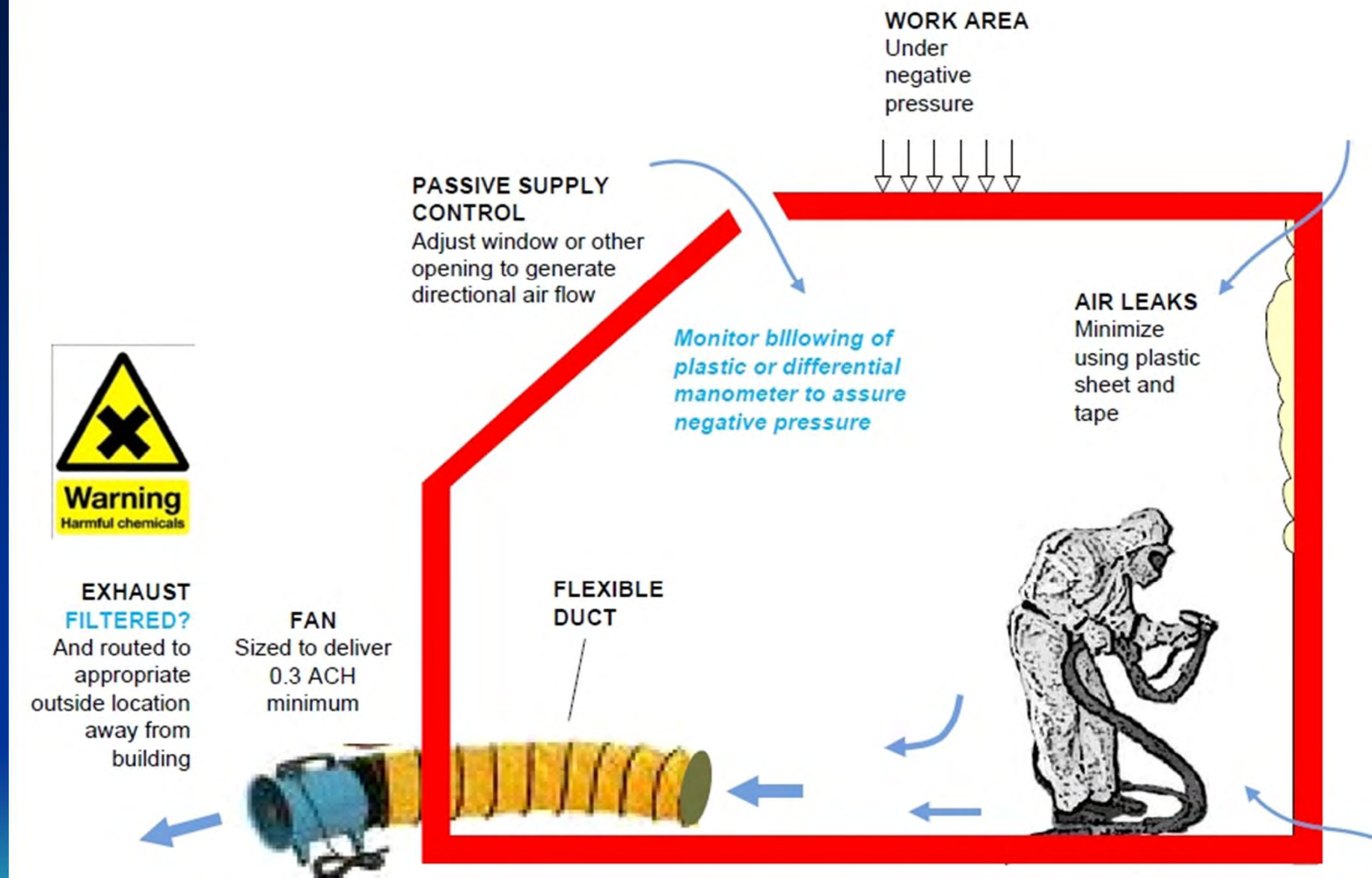
Controls used at SPF sites

Use air movers to exchange air in the spray zone

- Reduce airborne chemical concentrations
- Air supply and exhaust needed
- Exhaust to unoccupied location



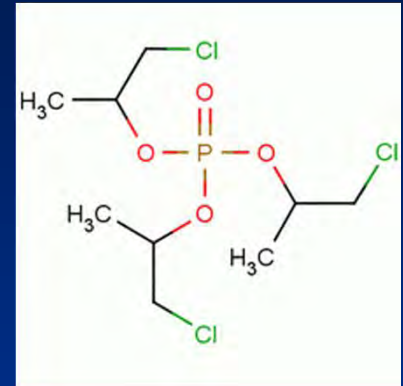
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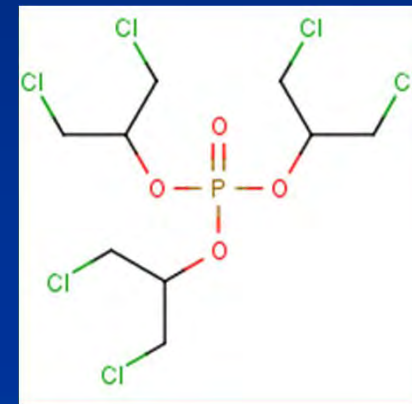
Source: Health and Safety Product Stewardship Workbook for High-Pressure Application of Spray Polyurethane Foam (copyright: American Chemistry Council) www.spraypolyurethane.org

Flame Retardants Typically Used in SPF

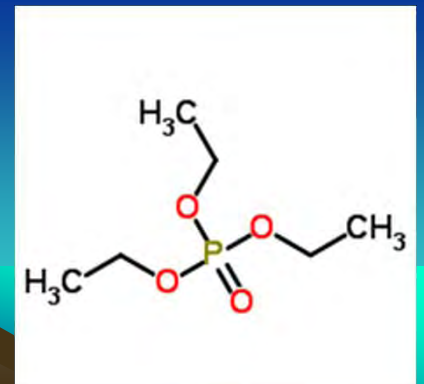
TCPP (tris (1-chloro-2-propyl) phosphate)



TDCPP (tris(1,3-dichloro-2-propyl) phosphate).



TEP (triethyl phosphate)



Source: Spray Polyurethane Foam Association

Toxicity of SPF Flame Retardants

- “ TCPP . limited toxicity in mammals, but long-term exposure effects unknown. Toxic to aquatic organisms.
- “ TDCPP - On October 12, 2011 TDCPP was added to California's Proposition 65 list of cancer-causing chemicals. TDCPP also has reproductive, developmental, systemic and genotoxic effects. ^
- “ TEP thought to be relatively safe

^Source: USEPA DfE Program

Emissions from Heating or Burning SPF

Examples of “Hot Work”

- Welding
- Heating of polyurethane foam while working on pipes
- Heating MDI-based glues
- Soldering
- Treatment with a heat gun
- Cutting with torches or hot wire
- Hot scissors
- Grinding
- Sawing

Chemicals Emitted

- ” Carbon dioxide
- ” Carbon monoxide
- ” Nitrogen oxides
- ” Hydrogen cyanide
- ” Isocyanates
- ” Amines

House Fire - Dioxins



SPF Recommendations

- “ Avoid inhalation, skin/eye contact with SPF chemicals
- “ Do not install while residents/pets are present
- “ Follow re-occupancy wait times
- “ Report odors or health symptoms
- “ Known isocyanate sensitization: do not use SPF insulation.

The Federal SPF Workgroup

- " EPA
- " OSHA
- " NIOSH
- " CPSC
- " FTC



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Is SPF “Green”?

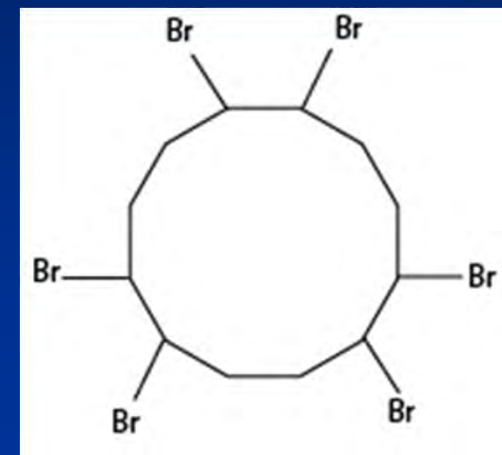


- “ Using SPF can reduce energy consumption
- “ Many polyols are plant derived
- “ Does “green” Include:
 - . Contains highly toxic isocyanates?



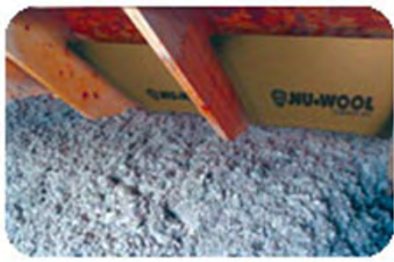
Flame Retardant Chemical of Concern in XPS and EPS: HBCD

- “ Hexabromocyclododecane (HBCD) is a persistent, bioaccumulative and toxic compound (PBT).
- “ Potential human health concerns based on animal test results indicating potential reproductive, developmental and neurological effects
- “ Found in dust, sewage sludge, breast milk, body fluids, wildlife and environment.



Hexabromocyclododecane

HBCD is 0.7% by weight in XPS and 2.5% in EPS



Cellulose Insulation



- “ Newspaper treated with sodium borate, boric acid, or ammonium sulfate
- “ In 2006, NTP and NIOSH concluded that there was little evidence of lower respiratory system health conditions associated with CI exposure based on acute studies, but toxicity to chronic exposure can not be ruled out. CI should continue to be regarded as a nuisance dust and workers should wear masks to prevent inhalation exposure.

Source: National Toxicology Program <http://ntp.niehs.nih.gov/?objectid=58BE4A0E-F1F6-975E-72E7FA7644178104>

True or False?

After the installation of fiberglass insulation, indoor concentrations of glass fibers are known to increase significantly.

False

True or False?

Flame retardant chemicals in foamed plastic products are reacted into the polymer matrix.

False



True or False?

Good quality dust masks should always be worn when applying both fiberglass and cellulose insulation.

True



True or False?

Fiberglass fibers are not
carcinogenic.

False

2011 NTP: Certain Glass Wool Fibers (Inhalable) are
Reasonably anticipated to be a human carcinogen

All of the following types of
foamed plastic insulation are
being made and sold in the U.S.
today

- “ Extruded Polystyrene (EPS)
- “ Expanded Polystyrene (XPS)
- “ Polyisocyanurate Insulation
- “ Urea Formaldehyde Foam Insulation (UFFI)
- “ Spray Polyurethane Foam (SPF)



False??

Thank you

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Where to Get More Information

- “ EPA’s DfE SPF website at http://www.epa.gov/dfe/pubs/projects/spf/spray_polyurethane_foam.html
- “ NIOSH Alert on Spray-on Truck Bed Lining Operations at <http://www.cdc.gov/niosh/docs/2006-149/default.html>
- “ OSHA’s isocyanates website at <http://www.osha.gov/SLTC/isocyanates/index.html>
- “ American Chemistry Council- Center for the Polyurethanes Industry website at <http://www.spraypolyurethane.org/>
- “ Spray Polyurethane Foam Alliance’s website at <http://www.sprayfoam.org/>
- “ OSHA’s Green Jobs Hazards website at <http://www.osha.gov/dep/greenjobs/index.html>

Where to Get More Information

- “ Green Building Advisor’s website at <http://www.greenbuildingadvisor.com/green-basics/spray-foam-insulation-open-and-closed-cell>
- “ Green Building Advisor’s article on “Spray Foam Jobs with Lingering Odor Problems” at <http://www.greenbuildingadvisor.com/blogs/dept/musings/spray-foam-jobs-lingering-odor-problems>
- “ Healthy Building News: <http://www.healthybuilding.net/index.html>
- “ Green Science Policy Institute: <http://greensciencepolicy.org/>