• Who is CPI?
• 2009 - Enhanced Product Stewardship Program
• 2010 - Next Stage of Spray Polyurethane Foam Product Stewardship Program
• Summary
ACC Center for the Polyurethanes Industry

CPI - largest group servicing the polyurethanes industry.

ACC’s Plastics Division - lead organization for plastics resin producers.
**CPI Mission**

- CPI is the voice of the PU industry in North America
- CPI promotes the sustainable growth of the PU industry in cooperation with user groups.
- CPI coordinates on key industry activities with PU trade associations across the globe.
Broad Product Stewardship Programs

- Guidance documents / videos
- Training programs
- RCAP
- Truck Bed Liners
Setting the Stage…

- Rapidly growing SPF market
- Driven by energy use reduction
• Launched in 2009 by both SPFA and CPI, together
• Has both a worker focus and a consumer / building occupant focus
• Initial worker focus (2009) – improve understanding with high pressure workers: hazard communications; good workplace practices
Video: Safe Handling of MDI

links
MDI Video - Safe Handling of Diphenylmethane Diisocyanate Introduction
MDI Video - Part One - Hazard Communications
MDI Video - Part Two - Drum and Intermediate Bulk Container Handling
MDI Video - Part Three - Tank Container Transfers
MDI Video - Part Four - Cargo Tank Trailer Transfers
MDI Video - Part Five - Rail Tank Car Transfers
MDI Video - Part Six - Emergency Response

www.spraypolyurethane.com
Launched August 31, 2009

SPF Health and Safety Website

www.spraypolyurethane.com
CPI-SPFA
Spray Polyurethane Foam
Technical Discussion

Jim Chapman
Bayer MaterialScience LLC
Overview

• SPF Systems

• Cure and Re-Entry Times

• Existing Product Testing Capabilities

• Ventilation
• **Basic Categories:**
  – High-Pressure SPF systems
    • 2-component systems
  – Low-Pressure SPF systems
    • 2-component kits
    • 1-component foam products
**SPF Delivery Systems**

- **Containers**
  - **Refillable Cylinders:**
    - 2-component, Low-P only
  - **Single-use Drums / Cylinders:**
    - 2-component only, High- & Low-P
  - **Pressurized Cans / Single-use cylinders:**
    - 1-component only
SPF Delivery Modes

• Spray
  – 2-component only, high & low pressure
  – Product application: insulation, coating

• Stream / Bead
  – 1-component & 2-component, low pressure only
  – Product application: adhesive, sealant
<table>
<thead>
<tr>
<th>Time, sec</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>System sprayed- temp 130 F</td>
</tr>
<tr>
<td>0.5</td>
<td>Cream time exothermic reaction beginning – physical blowing agent volatilizing</td>
</tr>
<tr>
<td>2</td>
<td>Gel time polymerization beginning</td>
</tr>
<tr>
<td>4</td>
<td>Tack free time surface of polymer solidified</td>
</tr>
<tr>
<td>360</td>
<td>Peak reaction exotherm achieved</td>
</tr>
<tr>
<td>900</td>
<td>Lesage <em>et al.</em>, 2007 - detects no MDI on foam surface</td>
</tr>
<tr>
<td>14400</td>
<td>Reported cure time</td>
</tr>
</tbody>
</table>
• Re-occupancy time dependent on numerous factors, such as:
  – SPF formulations
  – Amount of foam applied per volume of space
  – Degree of ventilation
• Certain components can be liberated from some newly-installed high pressure SPF products for a short period following installation
• Evaluation reports for specific SPF products often include the product manufacturer’s recommended re-occupancy time, which is variable.
Existing Product Testing Capabilities

- SPF products have been tested using the Canadian Standard Laboratory Guide for the Determination of Volatile Organic Compounds from Polyurethane Foam (CAN/ULC S774-06).
- Information is publicly available in some cases from The Canadian Construction Materials Centre which has a searchable database.
- Greenguard Environmental Institute testing program and Product Guide.
Ventilation Considerations

• Spray Polyurethane Foam Insulation – Understanding the Hazards
  – MDI hazards
  – Other Emissions
• Potential Exposure Risks for Other Workers and Building Occupants
• Reducing Risks
  – During Application
    • Jobsite Communication
    • Safety Zone – Clearance from Applicator
  – After Application
    • Post-Application Ventilation
    • Re-Occupancy Time
    • Odor Disclosure
    • Occupant Communication
  – Ventilation Methods
Next Stage of CPI-SPFA Spray Polyurethane Foam Product Stewardship Program

Neeva-Gayle Candelori, Director

ACC Center for the Polyurethanes Industry
Next Stage of SPF Product Stewardship Program

- Worker Performance
- D-I-Y, Consumer, Building and Construction Sector Knowledge
- Research
Worker Performance

- Enhanced EH&S content.
- New mechanism for broader availability, and more rapid availability, of EH&S training to the high pressure community.
- Programs designed to supplement, not replace, existing contractor training.
- Programs will be monitored to track participation and other features (e.g., understandability).
Next Stage of SPF Product Stewardship Program

• DIY, Consumer, Building & Construction Sector
  – Broaden communication on EH&S issues to wider audiences, including building occupants and specifiers
  • Guidance for homeowners on different products, with focus on health and safety issues (e.g., ventilation, re-occupancy, understanding green marketing claims)
• Research
  – Additional areas under consideration
  – Focus on ventilation methods, exposure issues
Summary

- Work will continue in 2010 and beyond.
- We need your engagement to make this program a success.
- We are continuing to update materials and programs regularly, visit our website.

www.spraypolyurethane.com
Thank You

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www.americanchemistry.com/polyurethane
www.americanchemistry.com/tbl
Spray Polyurethane Foam (SPF) - EPA Considerations -

Mary Cushmac
Office of Pollution Prevention and Toxics
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Washington, DC 20460
SPF is one of the fastest growing products in building and construction. (Reuters 2009).
SPF is an very effective insulator and sealant, with widespread use to retrofit schools, residences, and buildings to conserve energy.
Government is investing billions of dollars to promote energy efficiency and green jobs.
Why is this Issue Important? - 2

- Many applicators, helpers, do-it-yourselfers, consumers, homeowners, and decision makers are unaware of the potential hazards from inhalation, skin and eye exposures.

- Some marketing information is misleading – focuses on “green” aspects and does not address potential hazards.

- Often, material safety data sheets (MSDS) do not contain consistent health and safety information.
Why is this Issue Important? -3

- SPF application presents the same hazards as spray-on truck bed liner operations (NIOSH ALERT) and requires the same level of protection.

- Product composition, applicator technique, accurate proportioning of SPF components, temperature, and humidity are important factors that impact quality of foam, curing time and potential exposures to SPF chemicals.

- Often persons not wearing prescribed personal protective equipment are in or near the work site.

- It is difficult to find reliable guidance on re-entry times.
SPF Chemical Composition

- **Side A – Isocyanates**
  - Methylene diphenyl diisocyanate (MDI) and pMDI
  - MDI – based isocyanates (varying species)

- **Side B – Polyol Blend** (variable/proprietary)
  - Polyols (certain % bio-based)
  - Flame retardants
  - Blowing agents
  - Amine or metal catalysts
  - Surfactants

\[ A + B \rightarrow POLYURETHANE \ FOAM \]
Side A - Concerns

- Health concerns with isocyanates:
  - Lung and skin sensitizer (causes an allergic reaction).
  - Leading attributable cause of work-related asthma.
  - Can trigger severe or fatal asthma attacks in sensitized persons upon further exposure, even at very low levels.

- MDI is a hazardous air pollutant. (Clean Air Act)

- NIOSH issued Alerts in 1996 and 2006 to prevent asthma and death in workers exposed to isocyanates.
  http://www.cdc.gov/niosh/topics/isocyanates/

- The European Union has issued new regulations to prevent exposures to MDI in consumer products.
What is a sensitizer?

- **OSHA definition, for purposes of the Hazard Communication Standard:**
  - “A chemical that causes a substantial proportion of exposed people or animals to **develop an allergic reaction in normal tissue after repeated exposure** to the chemical.“
  - “A sensitizer (allergen) causes little or no reaction in man or test animals on first exposure. The problem arises on subsequent exposures when a marked immunological response occurs.

  [http://www.osha.gov/dsg/hazcom/ghd053107.html#a](http://www.osha.gov/dsg/hazcom/ghd053107.html#a)

Links to Health Effects Information on Isocyanates

■ EPA
  - EPA New Chemicals Program – Chemical Category: [http://www.epa.gov/oppt/newchems/pubs/cat02.htm#Isocyanates](http://www.epa.gov/oppt/newchems/pubs/cat02.htm#Isocyanates)
  - TSCA section 8(e) Notifications of Substantial Risk, available at:  [http://www.epa.gov/oppt/tsca8e/](http://www.epa.gov/oppt/tsca8e/)

■ NIOSH
  - Isocyanates Page: [http://www.cdc.gov/niosh/topics/isocyanates](http://www.cdc.gov/niosh/topics/isocyanates)
  - Preventing Asthma and Death from Diisocyanate Exposure, NIOSH ALERT, DHHS Publication No. 96-111:  [http://www.cdc.gov/niosh/asthma.html](http://www.cdc.gov/niosh/asthma.html)

■ OSHA
Side B – Concerns

- Often chemical identities are claimed confidential so it is difficult to evaluate toxicity.
- Amines (catalysts) may be irritants; can cause blurry vision (halo effect).
- Some flame retardants may be persistent, bioaccumulative, and/or toxic.
- Some blowing agents may contribute to global warming or have health effects.
Other Considerations

- Long term stability of polyurethane foam:
  - Fully cured polyurethane foam is not considered a problem unless disturbed.
  - Heating, welding, or grinding generates free isocyanates and other hazards.
  - Fires and thermal degradation can generate and release isocyanates, hydrogen cyanide, carbon monoxide, and amines.
Exposure Assessment

- We need data that accurately assesses exposures with variable applications and product formulations:
  - Measuring total isocyanates and other chemicals.
  - Answering the question – When can occupants, residents, school children, and others re-enter the premises after SPF application?
Typical Exposures - Spray Application

- Generates vapor, mist, and particulates exceeding occupational exposure limits.

- Isocyanates & amines can migrate to other rooms or floors.
Typical Exposures – Trimming Foam

- Cutting, scraping foam that is not fully cured generates dust, particles that may contain isocyanates and other unreacted chemicals.
Typical Exposures - Consumer & Do-It-Yourself Projects

- Consumers, a growing market of Do-it-Yourself applicators, are using one-component cans or two-component kits for sealing cracks, as insulation, or creative arts.

- Users are often unaware of the hazards and the need to prevent skin, eye and inhalation exposures, and the proper type of protections to use.
Best Practices

- When safer alternatives are not available, best practices need to be developed, shared, and implemented to minimize exposures.

- As an example, EPA’s Design for the Environment (DfE) Program works in partnership with the industry to identify and promote best practices to reduce exposures to isocyanates and other chemicals of concern in the workplace and community.

http://www.epa.gov/dfe/pubs/projects/auto
http://www.ccar-greenlink.org/cshops
http://www.epa.gov/collisionrepair
Alternative Technologies

- A new class of hybrid non-isocyanate polyurethanes (HNIPU) is being marketed.

- The Department of Energy provides information on insulation options: http://www.ornl.gov/sci/roofs+walls/insulation/ins_01.html
Marketing Claims

Some claims are misleading:
- “no off-gassing,” “non-toxic” and “safe”
- “green” and “environmentally friendly”
- “plant-based” and “made from soy beans”

May not provide information on toxic chemicals in the product.
May cause important safety information to be overlooked.
Marketing Claims

- Federal law prohibits deceptive acts or practices, including deceptive representations in advertising, labeling, product inserts, catalogs, and sales presentations - Federal Trade Commission (FTC)

- FTC Green Guide provides specific guidance on the use of environmental claims.
  http://www.ftc.gov/bcp/grnrule/guides980427.htm

- All products should be properly labeled by manufacturers/distributors - Federal Hazardous Substances Act/Consumer Product Safety Commission (CPSC)
Government & Industry Involvement

- **Federal Advisory Group**
  - Environmental Protection Agency (EPA)
  - National Institute for Occupational Safety & Health (NIOSH)
  - Occupational Safety & Health Administration (OSHA)
  - Consumer Product Safety Commission (CPSC)

- **Industry**
  - American Chemistry Council’s Center for the Polyurethanes Industries (CPI)
  - Spray Polyurethane Foam Association (SPFA)
  - Diisocyanates and SPF Manufacturers
Goals

- Improve availability of accurate and comprehensive hazard & risk information.
- Develop and communicate “Best Practices” to prevent exposures.
- Ensure accurate marketing claims.
- Address exposure assessment and data gaps.
Achieving these Goals

- Manufacturers need to ensure their products can be applied safely and are properly labeled.
- Hazards, as well as benefits, need to be clearly communicated throughout the product value chain.
- Ensure premises are restricted to workers wearing appropriate personal protective equipment.
- Provide guidance on re-entry time that is based on accurate monitoring data of total isocyanates and other SPF chemicals.

*Communication, training, and best practices are key to safe use and handling of SPF, and to prevent misleading marketing claims.*
Contact Information

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Spray Polyurethane Processes

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Disclaimer: The findings and conclusions in this presentation are those of the author(s) and do not necessarily represent the views of the National Institute for Occupational Safety and Health (NIOSH). Mention of company names or products does not constitute endorsement by the Centers for Disease Control and Prevention (CDC) or NIOSH.
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 – 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.
Industrial Hygiene
Hierarchy of controls

- Elimination
- Substitution – replace high hazard with low hazard
- Engineering – ventilation, enclosure
- Administrative – training, job rotation, procedures, policy
- Protective Clothing and Equipment – respirators, ear plugs, gloves
SPF Recommendations

- Hazard Communication
- Wear Personal Protective Equipment (PPE)- sprayer and helper.
  - Full-Face Supplied-Air Respirator (SAR)
  - chemical protective clothing (i.e. disposable coveralls and gloves).
- Limit access to spray area.
  - Only trained workers with proper PPE.
- 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.
Use of PPE at SPF sites
Implementation Gap

- **Gap between what we know and what workers do.**
- Studies – worker exposures exceed the occupational exposure limits (OELs).
- Studies – appropriate PPE not consistently used.
  - SAR consistently used by sprayers at all NIOSH SPFI walk-thru sites.
- Studies – use of chemical protective clothing (coveralls, gloves, booties) by helpers was inconsistent.

Ensure consistent use of PPE throughout industry – respiratory, eye and skin.
Initial Assessment of SPF

- The industry has a wealth of information on spray polyurethane products.
- **Published studies indicate that the information is not consistently reaching the worker.**
- We need to work collaboratively to protect the health of the SPF workforce and the consumer/occupant.
- Ensure that correct information gets to the workers.
Challenges for SPP 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
Challenges for SPP 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(s) period to re-enter 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.
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 past spray zone
- Filter and exhaust air at opposite end of spray zone
- Create negative pressure within the enclosure
One Proposed Enclosure
(There is no one-size fits all solution)

Note: the above proposed enclosure has not been tested and is not intended to be applicable to every SPF insulation worksite.
Moving forward

- Government/industry partners must continue working together toward comprehensive solutions to address worker, homeowner, and consumer exposures associated with SPF.

- Practitioners need to be aware of potential hazards and solutions -- even for “green” products and technologies.
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Considerations for Safe Use of Spray Polyurethane Foam (SPF): An OSHA Perspective

Janet Carter
Health Scientist
Directorate of Standards and Guidance
OSHA’s Role and Responsibilities

- Agency Mission – “assure safe and healthful working conditions for working men and women”
  - Safety and Health Standards
  - Enforcement of Standards
  - State assistance
  - Provide research, training, education, information
OSHA’s Concern with SPF

- Linked to Work-related asthma (WRA)
  - Asthma serious condition
  - Can worsen with each exposure
  - May be life threatening
- Hazard information not reaching all users
  - Inconsistent worker protection
OSHA Applicable Standards

- 3 PELS for isocyanates
  - 29 CFR 1910 subpart Z (Air contaminants)
- General duty clause
OSHA Applicable Standards

• 29 CFR 1910.1200; 1915.1200; 1917.28; 1918.90; and 1926.59 (Hazard Communication)
• 29 CFR 1910.134 (Respiratory Protection)
• 29 CFR 1910 Part I, 1926.95 (Personal Protective Equipment)
• 29 CFR 1910.94; 1915.51; 1918.94; 1926.57 (Ventilation)
Employer Responsibilities

- Full Hazard Communication
- Provide worker training
- Appropriate Exposure Control System
  - PPE for **ALL** exposed workers
  - Adequate and appropriate containment and/or ventilation
  - Develop best practices for handling these and **ALL** hazardous materials
Hazard Communication

- Communicate all hazards via:
  - MSDS
  - Labeling of all hazardous substances
  - Warning signs of hazards

- Employee training
Hazard Communication - MSDS

- Material Safety Data Sheets
  - Integral part of communication strategy
  - Must be readily available to all affected workers
  - Must be comprehensive

- Issues with accuracy, consistency and completeness
Hazard Communication - MSDS

MSDS – current deficiencies and inconsistencies

- Hazard and exposure control information varies widely
- Recommendations on respiratory protection vary
- Only a few MSDSs mention the possible need for respiratory protection for “adjacent workers.”

- MSDSs indicate that adequate ventilation is needed but provide no guidance or suggestions on ventilation methods or what constitutes adequate ventilation
- Few MSDSs mention that skin contact may cause an allergic reaction/sensitization
- Several MSDSs mention that dust can be generated during cutting or abrasive processes, however, hazards are identified as “mechanical irritation” and do not mention the possible presence of MDI
Hazard Communication - MSDS

MSDS – more complete information

- 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)
  - May also include generation of dust – may contain isocyanates
Hazard Communication

- MSDS from manufacturers
  - Information should **not** be deleted down the supply chain
  - User accepts liability if change information

- What if a worker or adjacent person is harmed because of inadequate or altered information?
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 ends December 29
  - Announcement for public hearings soon
Training

Employers need to train workers on:

- Hazards associated with use of **ALL** hazardous chemicals including Isocyanates and SPF
- Proper control measures
- Proper use of PPE
- Protecting those in adjacent areas
- Appropriate ventilation
Training

- Training should be available to all appropriate workers

- Training material is available on web:
  - OSHA
  - NIOSH
  - ACC/Polyurethane Industry
Appropriate Exposure Control

- Exposures should be controlled whenever possible
  - PPE should be last resort
  - Problems with compliance
    - Need for education and training

- Consider all phases of operation
  - Start to finish, including clean-up
  - Consider use of PPE for clean-up crew
    - Same as operator/helper

- Develop best practices for work activities
  - Enclosures or partitions
  - Dust control measures
  - Proper air circulation and ventilation
Exposure Control - Proper Use of PPE

- Primary worker (spray applicator):
  - Full saran-coated body cover (no exposed skin)
  - Gloves
  - 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 - training is essential
  - Consider developing checklist to ensure compliance
Ventilation Considerations

- Ventilation crucial for worker safety
- Only vent to outside using approved filter
  - Protect workers or passer-by’s outside
  - Similar methods can be adapted from measures used in truck bed-liner industry, see OSHA issued publications in alliance with CPI for Truck Bed-liners (developed for employers, the documents includes information on how to recognize MDI-related hazards and reduce employees' exposure to MDI)
    - “Spray on Truck Bed Liner Applications Using MDI/PMDI; Seven Important Points” and
    - “Considerations for the Application of Spray-On Truck Bed Liners”
- Similar hazards
- Similar remedies
**Additional Information**

- **OSHA assistance**
  - OSHA has free consultation program
    - Small and medium sized businesses
  - All 50 states participate & Regions have been alerted
  - “Full service consultation”: Covers all working conditions, includes assistance in establishing effective workplace safety and health programs, with emphasis on preventing worker injuries and illnesses. Assistance may also include training and education for the employer and his or her employees and supervisors as well.
  - “Limited service consultation”: Consultant focuses on more specific workplace problems or specific issues or hazardous processes relating to a particular business
  - Information available on website: [www.osha.gov](http://www.osha.gov)

- **DOL and OSHA are working to include safety and health as key message in “Green” jobs training programs**
  - Promote safe use of these materials in the workplace