MICHIGAN

MICHIGAN STATE UNIVERSITY: Prevention of work-related injuries & illnesses through research & investigation

INVESTIGATION/RESEARCH Prevent Work-Related Asthma from Isocyanate Exposure in a Foam Process Used in Two Very Different Industry Settings: "Foam-in-Place" packaging for fragile transportation industry parts and Radiation Therapy Immobility Devices for cancer patients.

The ability of isocyanates to quickly turn from liquid to an expanded solid form results in a variety of uses across widely different industry settings, including automotive and aircraft (transportation) parts manufacturing and health care. In transportation parts manufacturing, a process called "foam-in-place" or "foam-in-bag" is sometimes used to protect fragile parts such as headlights, mirrors, starters/generators, control units and other electronic components for shipping. In hospitals, these same isocyanate components are used in a similar fashion to construct immobility devices for cancer patients undergoing radiation therapy.

In both settings a two-component system that contains MDI is added to a plastic bag, using a similar process and potentially exposing workers who breath in isocyanate fumes or absorb through their skin from contact during pouring and mixing or spills, or from over-pours of isocyanates including excess foam deposited in waste containers. In both settings, explosions from overfill and leakages of the bags may occur. Spray gun malfunction during foam packaging may also expose workers to a high short-term level of isocyanate fumes.

FOAM-IN-PLACE: For packaging parts in shipping areas, the isocyanate is used to fill voids, providing cushioning, blocking and bracing in a shipping box. One bag is typically placed under the fragile part, and the 2-part mixture is fed into the bag through a hose or spray gun. A second bag is then placed over the part and the same process is repeated. The foam-in-place operator must handle and seal each bag after the pouring is complete.

RADIATION THERAPY IMMOBILITY DEVICES: In the hospital setting, the patient is positioned on a table in a radiation simulation room. A radiation therapist then selects the necessary bag size and amount of isocyanate needed, mixes the 2-part isocyanate in a provided container, pours the mixture into the bag, and then positions the bag around the patient to make a foam cushion. The immobility device ensures the patient is positioned so that radiation therapy is delivered to the same location during each treatment.

CASE NARRATIVES

Workers have been reported in Michigan with occupational asthma from exposure to isocyanates while working in both of these settings:

- A man in his 40s developed asthma a few months after beginning to make isocyanate-based radiation therapy immobility devices. An inspection of the radiation oncology department where he worked identified two additional workers with respiratory symptoms in relationship to the foam, one with new onset asthma. The hospital was cited for lack of employee training on the hazards of isocyanates and lack of provision of proper skin protection.

- A woman in her 30s with childhood asthma experienced a worsening of her asthma working as a packager at an automotive parts manufacturing facility. Her job was to pack fragile/expensive parts, using a foam-in-place process. An inspection of the facility identified two additional foam-in-place workers with daily respiratory symptoms. The company was recommended to institute a medical surveillance program for workers in this area.

RECOMMENDATIONS TO PREVENT THE DEVELOPMENT OF WRA

Develop and implement an effective exposure control plan, which includes safe work procedures, employee training and medical monitoring. These recommendations include workplaces even where isocyanate concentrations are below the OSHA Permissible Exposure Limit (PEL) because individuals have become sick in these workplaces.

RECOMMENDATIONS TO PREVENT THE DEVELOPMENT OF WRA, continued

1) **Hazard Communication** - Train workers on the hazards of isocyanates and the recognition of health effects.

2) **Personal Protective Equipment** - Avoid Skin Contact, dermal exposure to isocyanates may lead to respiratory sensitization. Provide butyl rubber, neoprene or nitrile gloves. Latex gloves DO NOT protect against isocyanates. Provide lightweight outer protective wear, including footwear. Consider the use of an air-supplied respirator. Wear chemical goggles where there is a possibility of a splash or spill of liquids containing isocyanates.

3) **Provide Adequate Ventilation** - the type and amount will depend on the size of the application. For guidance on Local Exhaust Ventilation (LEV), refer to the American Conference of Governmental Industrial Hygienists (ACGIH) publication: Industrial Ventilation: A Manual of Recommended Practice. www.acgih.org

4) **Restrict the Foaming Area** - to employees performing the foam-in-place or immobility device creation. Establish an isocyanate work zone limited to workers medically cleared to work with isocyanates.

5) **Include Exposed Workers in a Medical Surveillance Program** - a medical questionnaire and spirometry should be provided. Early recognition of individuals who become sensitized to isocyanates and removal from exposure offers the best prognosis. Medical surveillance is critical to identify individuals before they develop chronic irreversible asthma.

When possible, investigate the use of alternative materials for packaging and patient immobility devices. Consider alternatives such as bubble wrap, packing paper and other media for shipping fragile parts. Consider alternatives such as thermoplastic casts, bead bags, contoured supports and other devices to ensure patient immobility during radiation therapy. Alternatives will depend on the specifics of objects being packed for shipping and target areas for radiation therapy.

DID YOU KNOW?

- Observable hardened foam in a ventilation hood may be an indicator of blockage, resulting in restricted airflow and capture velocity.

- Five NIOSH Health Hazard Evaluations (HHEs) have been conducted to evaluate isocyanate exposures from foam-in-place operations in packaging and shipping. These evaluations have found that the highest concentrations of isocyanates in the air occur while the foam operator is using the foam-in-place system. Other detectable concentrations have been measured near where the bags of foam are placed into boxes and up to 10 feet from the foaming operation. There have been no NIOSH HHEs of radiation therapy immobility devices. However, in the making of radiation therapy immobilization devices, the radiation therapist also has the highest exposure to isocyanates while mixing and pouring the isocyanate into the bag.

RESOURCES

OSHA Fact Sheet **Do You Have Work-Related Asthma?** *A Guide for YOU and YOUR DOCTOR*
https://www.osha.gov/Publications/OSHA3707.pdf

Sample Medical Surveillance Program:

http://www.oem.msu.edu/userfiles/file/Resources/AsthmaProtocolUpdate3_7_2016OSHAfactsheetforworkers.pdf

NIOSH Isocyanate Page:

http://www.cdc.gov/niosh/az/i.html

American Chemistry Council Diisocyanates Resources:

https://dii.americanchemistry.com/Resources/

Agency for Toxic Substances and Disease Registry (ASTDR) Toxic Substances Portal – Methyl Isocyanate:

http://www.atsdr.cdc.gov/MMG/MMG.asp?id=628&tid=116