Occupational and Environmental Exposures of Skin to Chemicals - 2005

Abstract for Poster 66

Surface and skin decontamination of aliphatic isocyanates: a field study

Y. Liu*[1], M.H. Stowe[1], D. Bello[2], J.A. Sparer[1], C. Lutgendorf[1], C. Daly[1], S. Ullman[1], F. Youngs[2], K. Abrahim[1], C.E. Fleming[1], I. Collin-Hansen[1], B. Cartmel[1], R. Gore[2], M.F. Boeniger[3], S.R. Woskie[2], M.R. Cullen[1], C.A. Redlich[1]
[1]Yale University School of Medicine, New Haven, CT, United States
[2]University of Massachusetts Lowell, Lowell, MA, United States
[3]National Institute for Occupational Safety and Health, Cincinnati, OH, United States

- Main Page
- General Information
- Co-sponsors
- List of Planners
- Concise Schedule
- Important Dates
- Preliminary Program
- Workshops
- Short Courses
- Talks and Posters
- Vendor Exhibits and Seminars
- Author Index
- Related Events
- Conference Registration and Local Information
- Call for Abstracts

Background

Surface contamination and skin exposure to isocyanates may cause dermal sensitization leading to asthma. Surface and skin decontamination using commercial products may provide effective measures to reduce the risk of skin exposure to isocyanates. However, little is known about the efficacy of various products in decontaminating aliphatic isocyanates. As part of a large interventional study to reduce isocyanate exposures in the auto body repair and refinishing industry (the Safe Methods for Autobody Shop Health or SMASH Study), we have conducted a series of studies to evaluate the efficacy of various commercial products, including a laboratory experimental study to evaluate the reaction time and mechanical removal efficiency, an in vitro study using guinea pig skin to evaluate the effects of solvents and isocyanate residence time on skin exposure, and this field study to assess the efficacy in auto body shop settings. The objectives of this study were to 1) qualitatively and quantitatively assess the efficacy of surface decontamination products in removing aliphatic isocyanates, and 2) qualitatively and quantitatively assess the efficacy of skin cleansers in removing aliphatic isocyanates.

Methods

Five auto body shops were selected for surface assessment; 13 body shop technicians and painters participated in the skin decontamination evaluation after giving informed consent. For surface assessment, various surfaces associated with painting work, such as mixing ruler and mixing cup, spray gun cup, and mixing bench, were selected. An ammonia-based aliphatic isocyanate decontamination product from Colormetric Laboratories, Inc., (CLI Lab, Des Plains, IL) and a thinner (solvent) as used by the auto body shops for gun cleaning were tested. After a mixing or painting task was done, selected surfaces were first wiped with a SWYPE^{TM} surface sampling pad from CLI Lab.

The pad changed to orange/red color when in contact with aliphatic isocyanates. The color intensity was then rated on a 6-point scale with zero as no contamination and 5 as highest contamination. The surface was then wipe-cleaned 2-3 times with a paper towel soaked with the CLI product or the gun cleaning solvent, followed by a final wiping with a dry paper towel. Another SWYPE^{TM} surface wipe sample was taken to evaluate isocyanates remaining after cleaning. In conjunction with the qualitative assessment, a quantitative assessment was also conducted using a polypropylene glycol (PPG) pad for wiping before and after cleaning. The PPG pad was immediately placed in a solution of 1-(9-anthracenylmethyl)piperazine (MAP) in methylene chloride for extraction and reaction. In the lab, samples were analyzed on HPLC using NIOSH Method 5525 for total aliphatic isocyanates in air with some modifications.

Skin decontamination focused on paint mixing and painting tasks (priming, sealer coating and clear coating). Hands were wiped side by side with both the qualitative pad and the PPG quantitative pad, after the worker performed a mixing task, or unprotected forearms and foreheads also wiped after a painting task. Another wipe was taken after the skin areas were washed with the D-TAM^{TM} skin cleanser from CLI Lab, or with the paint removal products from their own shops. Color intensity was similarly rated as in surface assessment, and quantitative skin wipes were analyzed using the same method. Average color intensity from all surface and skin samples was calculated and compared before vs. after cleaning using a t-test or signed rank test. Efficacies of the CLI cleaners vs. other products were compared using a Wilcoxon rank sum test. Removal efficiency was also calculated as:

[(Total NCO before cleaning - Total NCO after cleaning)/Total NCO before cleaning] *100

Results

A total of 26 pairs of qualitative samples of surface isocyanate decontamination were obtained. The average color intensity significantly decreased ($p < 0.0001$) from 2.85 (SD = 1.43) before cleaning to 0.38 (SD = 0.75) after cleaning. Of 23 pairs using the CLI product, 16 pairs reduced from positive color to no color, 6 pairs decreased but retained some color after cleaning, and 1 pair had no color reduction after cleaning. The 3 pairs obtained from solvent cleaning all had color intensity reduced to zero. There was no difference in average intensity change between the CLI product and the shop solvent. Nine pairs of quantitative surface decontamination samples were obtained all using CLI product. The median amount of isocyanates (μg NCO/in^2) was significantly reduced ($p = 0.0039$) from 1.904 to 0.005. The removal efficiency ranged from 72.68% to 99.99% with a median rate of 99.3%.

A total of 15 paired qualitative samples were obtained for skin decontamination, with a significant reduction in isocyanates ($p = 0.0001$). Of the 9 pairs using the CLI product, 7 reduced to zero intensity. Six pairs of samples were obtained using other cleansers, with 4 pairs reduced to zero color intensity. There was no significant difference in cleaning efficiency between the CLI product and other shop products as shown by average color intensities. A total of 24 pairs of quantitative samples were obtained for skin decontamination, with a significant reduction in isocyanate level ($p<0.0001$). Median removal efficiency was 54.3% for the CLI product and 86.8% for other products combined without statistical significance. These results are consistent with findings from a laboratory study we conducted.

Conclusions

Both the CLI surface product for the decontamination of aliphatic isocyanates and the

solvent used in shops as a thinner for gun cleaning are efficient isocyanate removers. Skin decontaminants currently used in auto body shops to remove paints are also similarly effective as CLI D-TAM^{TM} cleanser, although D-TAM^{TM} is safer on skin and in the environment. More samples are needed and being collected that may provide more conclusive results.

Content last modified: 20 May 2005

Return

OEESC 2005

Occupational and Environmental Exposures of Skin to Chemicals - 2005

Site Contents

The National Institute for Occupational Safety and Health (NIOSH) and the Karolinska Institutet in cooperation with the Stockholm County Council are taking the lead in organizing this conference. NIOSH is maintaining this website.

Disclaimer: Co-sponsorship of the conference and workshop and posting of abstracts and workshop discussion papers (white papers) on a website by NIOSH does not constitute endorsement of the views expressed or recommendation for the use of any commercial product, commodity or service mentioned. The opinions and conclusions expressed are those of the authors and presenters and not necessarily those of NIOSH. Recommendations are not considered as final statements of NIOSH policy or of any agency or individual who was involved. These presentations are intended to be used in advancing knowledge needed to protect workers and the general public.

Menu items on the left provide more information about OEESC-2005.

This conference follows the success of the first International Conference on Occupational and Environmental Exposures of Skin to Chemicals: Science and Policy, which was held near Washinton, DC, in September, 2002.

Return

OEESC 2005

- Main Page
- General Information
- **Co-sponsors**
- List of Planners
- Concise Schedule
- Important Dates
- Preliminary Program
- Workshops
- Short Courses
- Talks and Posters
- Vendor Exhibits and Seminars
- Author Index
- Related Events
- Conference Registration and Local Information
- Call for Abstracts

Occupational and Environmental Exposures of Skin to Chemicals - 2005

Co-sponsors

Major co-sponsors:

National Institute for Occupational Safety and Health, USA

Karolinska Institutet and Stockholm County Council, Sweden

Swedish Work Environment Authority, Sweden

The National Institute of Public Health, Sweden

Swedish Council for Working LIfe and Social Research, Sweden

Swedish Asthma and Allergy Association, Sweden

The Vardal Foundation - for Health Care Sciences and Allergy Research, Sweden

Other co-sponsors:

Swedish Chemicals Inspectorate, Sweden

National Institute for Working Life, Sweden

The organizers of OEESC-2005 appreciate those organizations that supported the goals of this conference through financial or in-kind contributions. Contributions were used to pay the full or partial travel and conference registration costs of invited speakers and guests and to reduce the registration fees of attendees by paying part of the costs associated with such expenses as meeting room rental, poster display board rental, abstract book, breaks, reception and conference dinner.

The conference account is managed by Karolinska Institutet.