

protocols for a number of select hazards. The health risk assessments identify both hazard-specific and generic control measures. **Results:** This presentation includes an overview of the results of health risk assessments; their hazards, control measures, exposure ratings, and other aspects. **Lessons Learned:** Challenges and learning post-implementation included transferring historic exposure monitoring data, report languages legally mandated in some countries, occupational exposure limit variations, and historic practices conducting health risk assessments.

### PO 115-5 Utilizing Web-Based Tools for an Effective Risk Management Program

C. Shaw, Succeed Management Solutions, LLC, Wilsonville, OR.

**Situation/problem:** Risk management efforts have become a costly antiquated nuisance in need of a paradigm shift. It is no secret that the current economic climate is forcing organizations to do more with less. **Resolution:** Web-based solutions are available to the EHS professional which enable effective EHS programs with less staff, which are also cost effective. **Results:** This program will explore web-based solutions available in areas of safety program maintenance and risk assessment and how the EHS professional can take advantage of these tools. **Lessons learned:** This program will outline real world case studies on how EHS professionals have established cost-effective/worker safety first and foremost utilizing various web-based tools

### PO 115-6 Development of a Sample Size Calculator Using Land's Exact Procedure to Assess Occupational Exposures

P. Gao, NIOSH, Pittsburgh, PA.

**Situation/problem:** Calculating suitable sample sizes for estimating the mean occupational exposure is an important issue in exposure assessment. If a sample size is too small, the objectives of the analysis cannot be achieved; if a sample size is larger than necessary, industrial hygienists' resources are wasted. Sample size for a normal distribution can be easily calculated, but may not be inappropriate as workplace exposure data are usually lognormally

distributed. Although several procedures have been derived to calculate sample size for workplace exposure with a lognormal distribution, Land's exact procedure has been recommended as an unbiased estimate of sample size (number) needed for both employers and OSHA inspections. Land's procedure involves an H-score that is also sample size dependant, and the required iterative procedure is laborious without a computer program.

**Resolution:** A powerful Microsoft Windows program, referred to as "Sample Size Calculator" has been developed for industrial hygienists using Microsoft Visual C++. A total of 11,400 H-scores were incorporated into the computer program, which covers different confidence levels (i.e., values), a variety of F values (i.e., the ratio of mean exposure to occupational exposure limit, OEL), and up to 1,000 degrees of freedom. **Results:** The program calculates and displays the required sample size on the screen immediately after entering four values; a mean of the exposure, geometric standard deviation, occupational exposure level (e.g. OSHA's permissible exposure limit), and confidence level.

**Lessons learned:** This computer program will benefit industrial hygienists, OSHA compliance safety and health officers, and others involved in exposure assessment

### PO 115-7 Preparing your Organization for GHS Compliance

J. Braselman, Safetec, York, PA.

**Situation/problem:** With the official announcement from OSHA of the implementation of GHS into the current hazard communication standard, many organizations are struggling to understand the complexities of these new regulations and how they will affect their organization. **Resolution:** This presentation details the specific steps companies must take in order to prepare for and meet the GHS challenge, and offers a broad overview of the Globally Harmonized System (GHS) for hazard classification and labeling, including safety data sheets, pictograms, signal words, hazard statements, and chemical classifications. **Results:** Specific steps, checklists of considerations, regional variations and cost considerations are detailed for organizations preparing for GHS compliance. **Lessons learned:** View the results of four companies that have

begun the process of migrating to GHS platform

### PO 115-8 WITHDRAWN: New Solutions for EMS: Converting from Paper-Based to the Web

J. Payson, NW Natural, Portland, OR.

## Podium Session 116 Respiratory Protection I

Tuesday, May 17, 2011

2:00 p.m. – 5:00 p.m.

Papers PO 116-1 – PO116-9

### PO 116-1 Enhanced Respiratory Protection Offered by a Strapless Filtering Facepiece Respirator

S. Grinshpun, T. Reponen, R. McKay, K. Cho, University of Cincinnati, Cincinnati, OH.

**Objective:** Aerosol particles penetrate into a filtering facepiece particulate respirator (FFPR) through the filter media and face seal leaks. It has been shown for conventional FFPRs that the latter often represents the primary penetration pathway. To reduce face seal leakage, some manufacturers of FFPRs have developed new respirator designs. The objective of this study was to evaluate a strapless FFPR with a medical-grade adhesive, which aims at establishing a better seal between the respirator periphery and the wearer's face. **Methods:** A respirator developed by Wein Products Inc. (Los Angeles, CA) was tested in a laboratory facility with respect to its filter collection efficiency for different particle sizes (0.04 to 1 µm) and face velocities corresponding to inhalation flow rates up to 85 L/min. Field testing was also conducted on 20 human subjects (10 subjects representing general population and 10 subjects recruited from the Cincinnati Fire Department) to evaluate respirator fit for novice and experienced users. **Results:** The filter collection efficiency was dependent on the particle size and face velocity; it was mostly below 0.1%. Fit testing revealed overall fit factors ranging approximately from 240 to 7,100, with the geometric mean values of approximately 2,300 and 2,050 for the general population and firefighters, respectively. No statistical difference was identified between the two subject groups (t-test: p>0.05). Additional subjects are being recruited to increase

the test statistical power and further investigate the respirator performance for different users. **Conclusions:** Fit factors for the strapless FFPR utilizing peripheral adhesive were significantly greater than levels typically observed for conventional FFPRs.

### PO 116-2 Head-and-Face Shape Variations of U.S. Civilian Workers

Z. Zhuang, NIOSH, Pittsburgh, PA; C. Shu, P. Xi, National Research Council of Canada, Institute for Information Technology, Ottawa, ON, Canada; M. Bergman, URS, Corp., Pittsburgh, PA.

**Objective:** In a recent anthropometric survey by the National Institute for Occupational Safety and Health (NIOSH), 3,997 subjects were measured using traditional methods and 953 of them were also scanned using a 3D head scanner. The subjects were representative of the current U.S. civilian population of respirator wearers age 18 to 66. The objective of this study was to quantify head-and-face shape variations of the U.S. civilian workers using modern methods of shape analysis. **Methods:** The raw 3D scan data for the 953 workers were parameterized using geometric processing techniques. This process allowed the individual scans to be put in correspondence with each other in such a way that statistical shape analysis could be performed on a dense set of 3D points. This process also cleaned up the original scan data such that the noise was reduced and holes were filled in. The next step, statistical analysis of the variability of the head-and-face shape in the 3D database, was conducted using Principal Component Analysis (PCA) techniques. **Results:** Through these analyses, it was shown that the space of the head-and-face shape was spanned by a small number of basis vectors. Less than 50 components explained more than 90% of the variability. Furthermore, the main mode of variations could be visualized through animating the shape changes along the PCA axes with computer software in executable form for Windows XP. **Conclusions:** The results from this study could be used for respirator design to achieve safer, more efficient product style and sizing. Future study is needed to determine the overall utility of the point cloud-based approach for the quantification of facial morphology variation and its relationship to respirator performance

### PO 116-3 Total Inward Leakage—An Assessment of Variation in Implementation of Anthropometric Marking and Measurement Techniques

A. Quiring, Scott Health & Safety, Monroe, NC.

**Objective:** In order to address questions regarding the Total Inward Leakage draft concept published by National Institute for Occupational Safety and Health (NIOSH), a study was initiated to assess respirator fit and variability in anthropometric landmarking and measurement for facial dimensions described in the Principle Component Analysis panel and NIOSH's new Bivariate Panel for quantitative fit testing. **Methods:** One hundred subjects will be manually measured using 2D anthropometric landmarking and measurement techniques by three different operators trained in fit test administration on three separate visits. 3D scans will also be taken of the subjects during their initial visit to compare with manual measurement. A quantitative fit test of subjects in elastomeric half masks utilizing Portacount will be conducted following each subject's measurement per OSHA 1910.134. **Results:** Variation in measurement and panel size determination will be assessed visit to visit, within subject and within operators. Geometric mean of quantitative fit tests will be evaluated to determine statistical significance. **Conclusion:** This study seeks to assess the gage repeatability and reproducibility of the anthropometric measurements required to carry out total inward leakage testing on elastomeric half masks per the NIOSH protocol

### PO 116-4 Adsorption Characteristics of Activated Carbon Fibers for Toluene: Application on Respiratory Protection

J. Balanay, C. Lungu, University of Alabama at Birmingham, Birmingham, AL.

**Objective:** Granular activated carbon, the standard adsorbent in respirators against gases and vapors, needs containment due to its granular form. This makes respirators bulky and uncomfortable to wear, resulting to poor compliance in its use. Activated carbon fibers (ACF) are considered viable alternative adsorbent materials

for developing thinner, light-weight and efficient respirators because of their larger surface area, lighter weight and fabric form. This study determined the critical bed depth and adsorption capacity of different ACF types for toluene to understand how thin a respirator can be and the service life of the adsorbents, respectively. The D-R equation was also assessed to predict the adsorption capacity for toluene at low concentrations. **Methods:** ACF in cloth (ACFC) and felt (ACFF) forms with three different surface areas per form were tested. Each ACF type was challenged with six toluene concentrations (50-500 ppm) at constant air temperature (23°C), relative humidity (50%) and air flow (16 LPM) at different adsorbent bed depths. For each adsorbent, breakthrough data were obtained using gas chromatography, and surface area using an automatic physisorption analyzer. **Results:** ACFC has a lower critical bed depth and higher adsorption capacity compared to ACFF with similar surface area for each toluene concentration. Among the ACF types, ACFC 2000 (highest BET surface area =  $1614 \pm 5 \text{ m}^2/\text{g}$ ) has one of the lowest critical bed depths (ranging from 0.11-0.22 cm) and has the highest adsorption capacity (ranging from 595-878 mg/g) for toluene. When the experimental adsorption capacity was compared with predicted, ACFs with lower surface area had the smallest difference. **Conclusion:** ACF has great potential for application in respiratory protection, particularly the ACFC 2000, which is the best candidate for developing thinner and efficient respirators. The D-R equation may need to be modified to better predict the adsorption capacity at low toluene concentrations

### PO 116-5 Advances in Mask Integrity Testing

E. Hanson, M. Serach, Air Techniques International, Owings Mills, MD.

**Situation/problem:** Mask integrity testing goes beyond traditional fit testing and is now utilized as a critical element of respirator protection programs, particularly within the DoD and DoE. The mask integrity tests include a variety of leakage tests on protective masks in addition to fit tests. These tests are conducted on masks directly without the individual present. This testing has historically been somewhat limited due to compatibility with the test heads that were originally developed for military masks.

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