and sampling time. The system shows 0.73% bias at 10% RH and 0.32% bias at 98% RH. It shows 1.01% bias at 10°C and -2.87% bias at 40° C. The system shows -18.6% bias at 4.75 cm/sec and 16.7% bias at 270 cm/sec.

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NEAR REAL-TIME FIELD ANALYSIS OF PERCHLORATE ION BY ION SELECTIVE ELECTRODE. E. Meier, PrSM Corporation, Los Alamos, NM; D. Dale, Los Alamos National Laboratory, Los Alamos, NM.

Field deployable analytical instrumentation has experienced considerable growth in recent years. One driver promoting this movement is the need for real-time analytical data for decision-making purposes. A tested, field-deployable, analytical platform and associated methodology designed for perchlorate analysis will be discussed. The analytical methodology involved the use of an Ion Selective Electrode (ISE) to determine perchlorate concentrations in support of removal and remediation of a highly contaminated perchloric acid hood exhaust system at Los Alamos National Laboratory (LANL). An accurate field-capable analytical method was required due to customer constraints of cost and requisite time delays associated with traditional laboratory analysis. Over a 3-day period nearly 250 samples were collected and analyzed. The ISE analytical results are compared to traditional Ion Chromatography (IC) and Methylene Blue redox indicator determinations. The ISE method shows a high degree of reliability when compared to the IC method.

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ISOCYANATE EXPOSURE ASSESSMENTS USING THE MAP METHOD: A SUMMARY OF RECENT NIOSH HEALTH HAZARD EVALUATIONS. C. Reh, R. Streicher, K. Roegner, NIOSH, Cincinnati, OH.

Background: NIOSH recently developed a sampling and analytical method for determining airborne exposures to isocyanate-containing compounds. The method's derivatizing agent is 1-(9-anthracenylmethyl)piperazine (MAP), which converts the isocyanate into a stable urea derivative. When sampling for isocyanates, air is drawn through a MAP-impregnated filter, MAP-containing impinger, or impinger-filter combination, depending on the process and/or isocyanate species. The samples are analyzed by pH-gradient high pressure liquid chromatography with ultraviolet and fluorescence detection.

Methods: The MAP method was recently used to evaluate airborne isocyanate exposures from four industrial operations. Three of these operations were spray painting, three were foam packaging, one was foam injection, and one was foam molding. The following isocyanates were used during these operations: hexamethylene diisocyanate (HDI), toluene diisocyanate (TDI), diphenylmethane diisocyanate (MDI), HDI-based polyisocyanates, MDI-based polyisocyanates, and TDI prepolymer.

Results: The range of exposures by operation and isocyanate species are shown below:

Spray Painting: HDI - none detected (ND) to 1.9 micrograms per cubic meter (ug/m^3), HDI polyisocyanate - ND to 164 ug/m^3, MDI - 300 to 1364 ug/m^3, MDI polyisocyanate - 304 to 1080 ug/m^3, TDI - 5.1 to 9.6 ug/m^3, and TDI prepolymer - 10.4 to 28.9 ug/m^3.

Foam Packaging: MDI - ND to 7.5 ug/m^3, and MDI polyisocyanate - ND to 13.4 ug/m^3.

Foam Injection: MDI - ND to 5 ug/m^3, and MDI polyisocyanate - ND to 38 ug/m^3.

Foam Molding: TDI - ND to 8.1 ug/m^3.

These facilities used various exposure and process emission controls to protect workers from potentially hazardous isocyanate exposures. An analysis of these control methods provides information on effective methods for controlling isocyanate exposures.

Conclusion: The data from these evaluations demonstrate some of the advantages associated with the MAP method. This method is capable of measuring the different monomer and/or oligomer species used in a given process or formulation, and the improved sensitivity is especially useful when measuring short-term or task-based exposures.

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A CHARACTERIZATION OF EXPOSURE TO ISOCYANATES AT THE WOOD FURNITURE SPRAY PROCESS IN KOREA. N. Lee, G. Yi, J. Park, H. Jung, Occupational Safety and Health Research Institute, Incheon, Republic of Korea.

In Korea, usually the exposure to isocyanates has been evaluated by OSHA 42 which can monitor personal exposure. But OSHA 42 might underestimate the concentration of isocyanates in spray process. The two methods, OSHA 42 and NIOSH 5522 were compared at spray processes of 6 wood furniture plants which used urethane paint of prepolymer adduct of toluene diisocyanate (TDI) and trimethylopropane. The samples were taken by side by side in area and analyzed by fluorescence detector of High Performance Liquid Chromatography. The results were significantly different (paired t-test, $p<0.05$). The geometric mean (GM, n=36) of 2,6-TDI was 4.69 ug/m3 for NIOSH 5522 and 0.46 ug/m3 for OSHA 42. The linear regression model was used to evaluate the relationship between two results. The correlation was r2=0.78, Y=10^(0.558logX+1.036) (X=2,6-TDI concentration by OSHA42, Y=2,6-TDI concentration by NIOSH 5522) when the non-detected samples were excluded. The GM (n=35) concentration of workers exposure was 0.282ug/m3 for 2,6-TDI and 0.101ug/m3 for 2,4-TDI using OSHA 42. Among 6 wood furniture plants, one plant has especially high concentration of isocyanates and the experience of occupational asthma episode. The reason may be the type of urethane paint used. The plant has used not commercial urethane paint, but in-house urethane paints. The GM(n=10) of 2,6-TDI concentration of workers in the plant, 5.96 ug/m3 by OSHA 42 may be calculated as 29.40 ug/m3 by NIOSH 5522 according to linear regression model. The non-monomeric isocyanates were also evaluated. The samples were taken from area and GM (n=36) was 59.48 ug/m3 (range : ND ?538.38 ug/m3). The concentration of non-monomeric isocyantes was high in the plant which has the high concentration of 2,6-TDI and 2,4-TDI.

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USE OF LASER INDUCED BREAKDOWN SPECTROSCOPY FOR ASSESSING SURFACE CONTAMINATION. M. Poppre, ON Semiconductor, Phoenix, AZ.

Traditionally, industrial hygienists have not had a direct reading means of measuring surface contamination levels. A solution to this is the recent development of a field portable instrument that can determine the presence and quantity of various heavy metals on a surface. The technology used in this instrument allows for the detection of metal dusts using either a wipe sample or surface scan with results available at the time of the sampling. The technology employed is laser induced breakdown spectroscopy (LIBS), a form of atomic emission spectroscopy. LIBS works by simultaneously atomizing a sample and exciting the atom's electrons to a higher energy level. A Q-switched, pulsed Nd:YAG laser provides the energy to generate a plasma at the sample surface. A 5 nanosecond, 30 mJ pulse forms a plasma with a duration of 50 microseconds at a temperature of 8,000 K. As the atom's energy level drops back to ground state, they emit wavelength specific light which is transferred via fiber optic cable to a charge coupled device (CCD) detector. The instrument's spectrograph is adjusted to the primary wavelength for each element. Developmental work focused on determination of elemental wavelengths using the CCD and detection limits for a variety of heavy metals. Detection limits were established for Al, As, Ba, Be, Cd, Ca, Cr, Cu, Pb, Mg, Mn, Hg, Ni, Ag, Sr, and Zn. Detection levels ranged from 0.002 mg for Be to 1.46 mg for Pb. By coupling the instrument's detection capability with carefully produced calibration curves, both qualitative and quantitative analysis can proceed. The use of LIBS in a field portable format reduces the turn around time currently seen in traditional surface wipe sampling and analysis.

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EVALUATION OF COAST GUARD RESIDENT MARINE INSPECTORS FOR WELDING FUMES IN A MEDIUM SIZE SHIPYARD. K. Slawson, U.S. Coast Guard Safety and Environmental Health, Portsmouth, VA; W. Luttrell, Old Dominion University, Norfolk, VA.

U.S. flag vessels include commercial ships that are inspected by Coast Guard inspectors as part of a program to promote safety. Any new construction or major modification must meet requirements for acceptable weld repairs. Since it had never been published before, a baseline occupational exposure assessment of Coast Guard resident marine inspectors (RMIs), stationed in a medium size shipyard, was conducted for welding fumes during vessel inspections. This evaluation also served to provide monitoring data to check the observational assignment of RMIs as one similar exposure group (SEG). During this evaluation RMIs wore constant flow personal air sampling pumps with matched-weight mixed cellulose ester filter (0.8 micron) cassettes while conducting routine weld repair checks on two vessels. Over a four-week period three different RMIs were sampled in the breathing zone on nine different days. Samples and field blanks were analyzed for total welding fumes gravimetrically and heavy metals--manganese, lead, zinc, cadmium, iron, cobalt, copper, beryllium, antimony, chromium, molybdenum, nickel, strontium, and vanadium, using atomic absorption spectrophotometry. Although a typical inspection walkthrough takes less than two hours, anticipating no further exposure the remaining day, sampling results revealed strontium (as strontium chromate) time-weighted averages above the occupational exposure limit (OEL) for two of nine samples, perhaps because of strontium in a metal primer. Two out of six samples for total welding fumes, seven out of nine samples for manganese, and one out of nine samples for lead were equal to or greater than 50% of the OEL. Using an industrial hygiene statistics spreadsheet for Microsoft Excel, descriptive statistics and tests for distribution fit were performed. Analysis of total welding fume data supported the observation of one SEG.

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ABSTRACTS