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to platinum salts, spanning a prolonged time period. A course of action had been to set in place. The actions were believed to be correct; controls (with emphasis on PPE) and a long-term program of in-house exposure monitoring. Large amounts of air monitoring data were accumulated and exposures considered well below the ACGIH® TLV®. Sensitization cases continued to occur and the site became resigned to being unable to prevent them.

Resolution: A qualified Industrial Hygienist was appointed to investigate. By observing and analyzing each stage of the process, incorrect assumptions and misunderstandings of where/how exposure could occur were revealed. Sources of exposure were identified and suitable controls devised without, at this stage, undertaking any monitoring measurements. Accordingly, a program was set in place to manage controls. A program of carefully targeted monitoring was set up at a later stage, but greater emphasis remained upon reviewing and improving control at source.

Results: In having a greater understanding of how platinum sensitization occurs and being fully aware of how exposure was potentially occurring, the site was much better able to manage and control the risk. No further incidences of platinum sensitization have occurred and are believed far less likely to occur in the oncoming future.

Lessons learned: The site incorrectly believed: they had sufficient understanding of platinum sensitisation; were able to sufficiently identify sources of exposure; and focus should be upon PPE and air monitoring. This case study demonstrates how resolution to a serious ongoing issue was able to be obtained through careful observation and analysis, professional input, and without any initial monitoring measurements. It sets out to highlight: common types of misunderstanding surrounding an exposure issue; how they occur without utilization of specialist input; and the essential need to follow the basic principles of Industrial Hygiene.

SR-402-08

Improving the Accuracy of the Well-Mixed Room Model Used in IH Mod for the Estimation of Exposures to Aqueous Solvents

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Objective: Exposure modelling is important in the practice of industrial hygiene for managing occupational exposure to chemicals. The well-mixed room model (WMR) describes the concentration of a contaminant in a room with high turbulent airflow using simplifying assumptions. Raoult's law works well for mixtures of substances that are similar. However, for nonideal mixtures, including aqueous solvents, a correction factor, the activity coefficient (AC) must be used when estimating the partial vapour pressure. The objective of this work was to evaluate the effect of introducing AC values when using the well-mixed model for aqueous solvent mixtures.

Methods: First, generation rates of four commonly used organic solvents (acetone, 2-propanol, n-hexane and toluene) were determined using an experimental setting. Subsequently, an exposition chamber (0.09 m^3) with controlled ventilation rates (0.5 L/min) was used to carry out evaporation tests with the five organic solvents at molar fractions of 1%, 10%, and 100% in water. Solvent concentrations were measured in real time using a Gas Chromatography-Thermal Conductivity Detector (Model Varian CP2300). Finally, simulations were performed using IH Mod (version 209) and ACs were calculated using the $_{XL}$UNIFAC computer program (Randhol, 2000). The accuracy of the simulations was assessed by comparing the concentration peaks and the percentages of evaporation calculated after 150 minutes for both the IH Mod generated curves and the ones obtained during experimental measurements.

Results: Calculated generation rates were 25, 26, 111 and 135 mg/min for 2-propanol, toluene, n-hexane, and acetone, respectively. ACs were high for hexane and toluene, but were much lower for 2-propanol and acetone at molar fractions of 1% and 10%. For instance, calculated ACs were 5222 and 173 for 1% and 10% of hexane in water, compared to 10 and 5 for 1% and 10% of acetone in water. At 1% and 10%, maximum concentrations obtained when using ACs were on the same range (+/- 10 %) as the simulated concentrations but none of the maximum concentrations were on the same range when not considering ACs into the models. After 150 minutes, percentages of evaporation ranged from 65% to 90% for real concentrations, from 70% to 90 % for models using ACs, and from 5% to 65% for models without ACs.

Conclusions: AC is an essential parameter for the estimation of exposure to aqueous solvents and it should be implemented in the WMR model equation used in IH Mod.

SR-402-09

Elemental Properties of Coal Slag Bulk Samples and Measured Airborne Exposures at Two Coal Slag Processing Facilities in the United States

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Objective: In 1974, NIOSH recommended a ban on the use of silica sand abrasives containing more than 1% silica due to the risk of silicosis. This recommendation gave rise to abrasives substitutes such as coal slag. Coal slag is used to produce abrasive granules because it is an inexpensive and effective blasting abrasive. In 2010, an OSHA investigation uncovered a case cluster of suspected cases of pneumoconiosis in four workers at a coal slag processing facility. In 2014, NIOSH conducted an industrial hygiene survey at two coal slag processing facilities to characterize elemental properties of coal slag bulk samples and airborne exposure to dust, silica, and metals.

Methods: The industrial hygiene survey consisted of the collection of: a) bulk samples of coal slag and finished granule products for silica and metals; b) full shift area air samples for total and respirable dust, silica, and metals; and c) full shift personal air samples for total and respirable dust, silica, and metals.

Results: Bulk samples consisted mainly of iron, manganese, titanium, and vanadium; and trace amounts of arsenic, beryllium, cadmium, and cobalt. Only unprocessed coal slags from Illinois and Kentucky contained up to 0.46% (4,600 mg/kg) silica. Elevated total dust was identified in the screen and bag house areas (11-36 mg/m^3). Area air samples identified trace amounts of beryllium, chromium, cobalt, copper, iron, nickel, vanadium, and manganese in total dust. Respirable airborne silica (≥0.005 mg/m^3) was identified in the screening areas. Overall, personal dust air samples (0.1- 6.6 mg/m^3 total; and 0.1- 0.4 mg/m^3 respirable dust) were lower than area air samples. All personal air samples for total and respirable dust, silica, and metals were below their respective OSHA PEL.

Conclusions: Silica was less than 1% in all bulk samples, supporting the claim that coal slag is a suitable abrasive substitute for silica sand. All personal air samples for dust and silica were lower than the air sampling results from the 2010 OSHA investigation. Prior to the NIOSH survey, the facility changed procedures to limit time spent in screening and crushing areas and perform maintenance tasks before start up, which may have contributed to lower dust and silica levels. These data are from only two coal slag processing facilities and more air monitoring is needed to better characterize occupational exposures.

CS-402-10

Auto Correction of Flow Rate in a Personal Air Sampling Pump for Changes in Barometric Pressure

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Situation/Problem: Air density, viscosity, and other factors change with barometric pressure and ambient temperature. This has been a major source of error in personal monitoring pump sampling. Flow constancy at ambient conditions is important for determining volume sampled and is particularly critical when using inertial particle size separators such as impactors and cyclones, where flow rate changes affect cut off point.

Resolution: A commercially available personal monitoring pump allows for automatic compensation of ambient temperature and barometric changes, such as calibrating at ground level and sampling in an underground mine or at altitude in a passenger airplane. Bench testing in a pressure chamber produced and verified the data that was used to form a correction algorithm. The pump contains pressure and temperature sensors that provide the data to maintain constant volumetric flow during sampling.

Results: Unit operation was confirmed in field testing at a deep gold mine in South Africa. The results indicate that the pump is capable of maintaining the flow rate at +/- 5% (volumetric) when calibrated at the surface and operated at depth.

Lessons learned: Real time measurement of temperature and pressure along with a correction algorithm can be used effectively to correct for air density changes in a personal air sample when the volumetric pump is calibrated at one altitude and operated at another.

CS-402-11

Analysis of Metals in Paint Using X-Ray Fluorescence Spectroscopy

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Situation/Problem: Metal-based paints are used to protect ship surfaces from corrosion and can contain up to 30 percent heavy metals. Varying levels of lead, chromium, and cadmium can be found during ship repair and maintenance with older ships having a higher likelihood of heavy metal occurrence. Removal of paint containing heavy metals may require specialized abatement which can be costly and time-consuming. Permissible Exposure Limits (OSHA's PELs) and Threshold Limit Values (ACGIH® TLVs®) for exposure to these metals are measured as inhalation exposure (mg/m^3). There are no OSHA regulations specifying acceptable or threshold levels of lead or other heavy metals in paint [measured either as mg/kg or ppm]. The Environmental Protection Agency (EPA) considers paint with 600 ppm of lead or less to be a non-lead-based paint (HUD, 2012). Similar recommendations are not available for chromium or cadmium.

Resolution: The goal of the study was to develop a reliable field method using x-ray fluorescence spectroscopy (XRF) to measure levels of cadmium, chromium (total), and lead in marine paint and to compare XRF sample results to traditional laboratory results analyzed using inductively coupled plasma atomic emission spectroscopy (ICP-AES) technology. A reliable field method was desirable to reduce the time and costs associated with sending maritime paint samples to a lab for analysis prior to disturbance and/or repair activities. This would reduce the time needed to determine the proper level of employee protection prior to paint disturbance or removal operations.

Results: Based on the data collected and compared to pre-determined threshold levels, upper and lower XRF cutoff values (ppm) were established to determine, with a high degree of confidence, a correlation to a laboratory result that is less than or greater than the predetermined threshold level that requires specialized abatement while removing the paint. Between the upper and lower XRF cutoff values, laboratory analysis will be required.

Lessons learned: XRFs can be used to determine the presence of cadmium, chromium, and lead in maritime paint. Such results allow decisions on the need for specialized abatement or other precautions to be made rapidly based on paint samples taken by an XRF device, in lieu, of sending samples to a laboratory for analysis, which can minimize laboratory costs and assist in scheduling work with minimal delay while maintaining employee safety.

CS-402-12

Improving Industrial Hygiene: The Benefits of Organization Development

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Situation/Problem: As industrial hygienists our job includes recommending steps that can be taken to ensure the well-being and health of workers. These steps may include changes that if done more strategically will better help protect worker health. We are taught in our degree programs and in our workplaces what changes need to be made, but we receive little to no training in how to make these changes more strategic so that the changes are sustainable.

Resolution: The field of organization development (OD) provides a means of creating strategic sustainable change within organizations. Cummings and Worley (2009) defined OD as "a process that applies a broad range of behavioral science knowledge and practice to help organizations build their capacity to change and to achieve greater effectiveness."