

if any one of three criteria exist in the facility. The criteria include 25% of the lower explosive limits, chemicals with NFPA health ratings of 4, and 1% of the median lethal concentration.

Problem: Local architects and mechanical engineers need assistance with resolving disputes with the local building code officials. **Resolution:** The first case involved a custom vehicle manufacturer. The chemicals in use consisted of welding gases, a spray adhesive, and spray paint cans. The building code inspector initially required the installation of hazardous exhaust systems along each point where the identified chemicals were used. It was determined that this would have been infeasible. With the assistance of the industrial hygienist the manufacturer was able to reach a compromise with the building code inspector that included periodic industrial hygiene monitoring and corrective action if overexposures were identified.

The second case involved a large medical research center. The research center used approximately 40 different chemicals in laboratory scale. The main point of debate was the requirement that when a hazardous exhaust system is installed, it requires separate building shafts for both the air exhaust ducts and the air intake ducts. This would have substantially increased the cost of the five-story 160,000 square foot expansion and put it behind schedule. An industrial hygienist was asked to provide mathematical exposure modeling in order to prove that the medical research center was not in violation.

Benefit to Others: Industrial hygienists will better understand the mechanical code and how they may assist architects and mechanical engineers with code disputes.

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309.

THE EFFECT ON COMMON AMBIENT OXYGEN SENSORS TO ATMOSPHERIC DISPLACEMENT OF OXYGEN BY HELIUM AT VARIOUS LEAK RATES.

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Numerous manufacturers currently produce oxygen monitoring equipment for industrial safety applications. Due to their small size and low cost, most of these instruments utilize some form of electrochemical cell as their oxygen sensor. Under most conditions, these sensors perform well; however, questions regarding the performance of these sensors in the presence of large amounts of helium or other light gases have been noted by different investigators. Two types of diffusion barriers (capillary and membrane) are typically used with electrochemical oxygen sensors. This study measured the accuracy of different manufactur-

ers' oxygen monitors, utilizing both types of diffusion barriers, when exposed to different concentrations of helium produced at varying leak rates. Many types of laboratories and high tech businesses use liquid helium refrigeration systems for super cooling instruments and equipment. The potential for an accidental release involving large amounts of helium into the atmosphere is very real in facilities of this type. Oxygen sensors of the type discussed are typically used to monitor these facilities for safe oxygen levels. The results of this study show that under certain conditions, some of the sensor designs significantly overestimate the true oxygen concentrations. This over-response could potentially allow employees to enter a hazardous, oxygen deficient environment without warning. The ability to accurately monitor oxygen concentration is crucial to the safety and health of employees. This study will provide industrial safety and health professionals with information on the effects of helium on a variety of commonly used oxygen monitors

310.

NIOSH EVALUATION OF CARBON MONOXIDE EXPOSURES AMONG POLICE AND EMERGENCY MEDICAL SERVICE PERSONNEL AT LAKE HAVASU DURING MEMORIAL DAY WEEKEND. R. McCleery, L. Tapp, J. McCammon, K. Dunn, NIOSH, Cincinnati, OH.

Introduction: NIOSH was asked for assistance in evaluating carbon monoxide (CO) concentrations in the Bridgewater Channel in Lake Havasu City (LHC), Arizona, over the Memorial Day weekend, May 23–26, 2003. The request expressed concern about CO over-exposures among LHC police and Emergency Medical Service (EMS) personnel who patrol the waterway during holidays for as much as 10 hours per workshift.

Methods: Real-time CO monitoring was conducted on podium and EMS personnel with additional general area sampling in and around the channel. Daily pre-shift, mid-shift, and post-shift questionnaires in conjunction with exhaled breath CO measurements were also conducted. Questionnaires included information on work duties and location, tobacco use, and surveys of potential CO exposure symptoms.

Results and Conclusions: There were 78 total workshifts where real-time CO monitoring was performed. Of those 78 workshifts, 54 exceeded the NIOSH ceiling limit of 200 ppm, 64 exceeded the ACGIH excursion limit of 125 ppm, 7 exceeded the OSHA PEL of 50 ppm, 17 exceeded the NIOSH REL of 35 ppm, and 33 exceeded the ACGIH TLV® of 25 ppm. There were 81 total workshifts where exhaled breath analysis and questionnaires were conducted. Of those 81 workshifts, 63 were with nonsmoking participants. Among the 63 nonsmoking participants, 42 had a post-shift percent carboxyhe-

moglobin (% COHb) at or above the ACGIH BEI® of 3.5%, with some levels approaching 15%. For 40 of the 81 workshifts with pre- and post-shift measurements, the cross-shift difference was at or above 3.5%. The questionnaires indicated that the most frequently reported symptom was headache, followed by fatigue or weakness, visual disturbances, and dizziness. NIOSH investigators concluded podium and EMS personnel working in the canal are exposed to CO concentrations approaching and/or exceeding relevant evaluation criteria.

311.

EXPOSURE EVALUATION OF AMBIENT AIR VOLATILE ORGANIC COMPOUND CONCENTRATIONS AT A HOUSTON HIGHWAY TOLL ROADSTATION.

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Toll roads are typically situated to alleviate existing traffic congestion. As a result, these highways often experience relatively high vehicular traffic density. More importantly, toll booth attendants perform their work activities in this environment and are potentially exposed to high levels of vehicular emissions. Previous studies have characterized toll booth attendants' exposures to pollutants such as carbon monoxide and particulate matter, but only one other study (performed outside the U.S.) has addressed exposure to volatile organic compounds (VOCs). Long-term exposure to VOCs, even at moderate levels, may cause an increased risk of adverse health effects, which can include cancer, respiratory and central nervous system problems, exacerbated allergies, and adverse neurological, reproductive, and developmental effects. The main purpose of this study was to characterize typical workshift exposures to a number of automotive-related VOCs for a group of toll booth attendants manning both entrance and exit ramp booths at one of the busiest toll stations in Houston. A secondary purpose was to evaluate the effect of toll booth air-conditioning on the reduction of outside VOC concentrations.

Exposure measurements were performed with diffusive air samplers placed inside and outside exit and entrance ramp toll booths during morning and afternoon/evening workshifts, during two different work weeks. Outside median concentrations for methyl tertiary-butyl ether, benzene, toluene, ethylbenzene, m,p-xylene, o-xylene, 1,3,5-trimethylbenzene, 1-ethyl-2-methylbenzene, and 1,2,4-trimethylbenzene equaled 7.11, 3.90, 3.61, 1.06, 2.94, 0.98, 0.63, 0.59, and 1.19 µg/m³, respectively. Although outside levels were statistically similar at both booths, indoor/outdoor concentration ratios were typically lower for the entrance ramp booth, suggesting a difference in effectiveness of the air-conditioning system. Regression analyses indicated a greater effect of wind velocity and temperature than traffic count on outdoor concentrations.

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