

mize cross-contamination and transport of bacteria during cleaning. Building services were maintained during cleaning. Modeling/risk assessment aided in resolving risk communication issues.

How sharing this work experience will benefit other practitioners of industrial hygiene: This case study illustrates successful adaptation of an accepted protocol to meet the limitations of a building system and occupant needs. Difficulties encountered are likely with aging cooling tower systems.

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UNEXPLODED ORDNANCE DETONATION INCIDENT. T. Mustard, Parsons Engineering Science, Inc., Denver, CO

Case Study: A hazardous waste investigation team inadvertently entered a "radio dead" area while working at a U.S. desert warfare training facility and missed a radio announcement by Range Control of an impending detonation of unexploded ordnance in their vicinity. A blast occurred about 800 m from the team.

Problems: The teams lost radio contact and were hidden from the military explosives ordnance detonation (EOD) team by a small hill. Each team was unaware of the other's presence. The hazardous waste team could have been injured by shrapnel.

Resolution: The hazardous waste team met with military officials and EOD personnel and implemented better procedures for tracking the hazardous waste team throughout the day and for maintaining radio contact with Range Control.

How sharing this work experience will benefit other practitioners of industrial hygiene: Range cleanup teams and hazardous waste teams working on firing ranges will benefit by implementing these procedures.

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FIELD SAMPLING OF 1-TON CONTAINERS FOR RESIDUAL CHEMICAL WARFARE AGENTS. D.R. Butler, Tennessee Valley Authority, Muscle Shoals, AL

Case Study: Sampling of 2800+ 1-ton containers in a field environment.

Problems: (1) Protection of personnel conducting sampling. (2) Qualitative and quantitative detection of chemical agent mixtures. (3) Conducting sampling in a field environment. (4) Analytical interferences.

Resolution: (1) Utilization of a local exhaust-sampling hood. (2) Minicams near real-time sampling instrumentation. (3) Mobile analytical platform. (4) Sampling techniques, DAAMS tube verification.

How sharing this work experience will benefit other practitioners of industrial hygiene: Sharing of problems and solutions will be of benefit for future similar operations.

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ASSESSMENT OF WORKER EXPOSURE TO A MIXTURE OF AIRBORNE CONTAMINANTS (ENDOTOXIN, FORMALDEHYDE, AND PHENOLIC COMPOUNDS). M.D. Walters, Harvard School of Public Health, Boston, MA

Case Study: Workers in a fiber glass insulation manufacturing plant were experiencing a high

incidence of respiratory symptoms. Personal exposure to endotoxin, formaldehyde, and phenolic compounds as airborne contaminants from a manufacturing process were measured. The exposure assessment was performed simultaneously with measurement of health effects including spirometry, peak flow diaries, and symptoms diaries. Exposure and health effects data were analyzed for possible associations.

Situation: Worker exposure to multiple air contaminants in an industrial workplace had to be reliably measured during periods when health effect measurements were being performed. Workers in certain areas wore either full or half-face respirators.

Problems: Endotoxin recovery needed to be maximized by proper choice of sample media and extraction methods. Formaldehyde samples required a different media from that used for endotoxin. Simultaneous collection with separate sampling trains would be cumbersome and reduce the number of workers that could be studied at one time with a given number of sampling pumps. Because respirator protection factors varied between workers (due to different types of respirators) and within workers (due to variation in fit from day to day), lapel sampling could not accurately estimate exposures.

Resolution: A multicomponent sampling cassette was constructed for sampling the important air contaminants. Endotoxin and phenolic compounds were collected on a polycarbonate Nucleopore membrane, and formaldehyde was collected on 2,4-dinitrophenylhydrazine-coated glass fiber filter media. Both media were placed in a single sample cassette. The Nucleopore filter was positioned in front of the 2, 4 DNPH filters. Side-by-side sampling demonstrated that collection of formaldehyde was not affected by the collection of endotoxin and phenolic compounds on the first membrane. Workers' respirators were modified to allow samples to be collected from inside the respirator.

How sharing this work experience will benefit other practitioners of industrial hygiene: This case study presents information on how to sample airborne endotoxin, formaldehyde, and phenolic compounds accurately. It describes how the sampling media can be placed into a compound sample cassette to provide simultaneous exposure measurements. It also demonstrates that an extensive program of personal sampling, inside respirators, is feasible. Finally, the analysis methods employed for each contaminant will be presented with details as to how the sampling procedures were modified to facilitate analytical methods.

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COOPERATIVE DEVELOPMENT OF A SPECIALIZED EXHAUST VENTILATION SYSTEM. D.D. Lee, University of Nevada, Reno, NV

Case Study: In a cooperative effort between members of the university's environmental health and safety and physical plant departments and a representative of AD-TEK Air Decontamination Technology, a highly specialized walk-in exhaust hood was developed and installed in the university's waste handling facilities.

Situation: As with many other colleges and universities, the university bulks its hazardous waste chemicals to reduce disposal costs. The

process of pouring small quantities of hazardous wastes collected from individual campus laboratories presents both personnel chemical exposure and environmental risks.

Problems: The process of pouring waste chemicals from one container to another has the potential to generate airborne vapor concentrations close to employees' breathing zones. The pouring process also entails the risk of accidental chemical spills, which require both containment and cleanup.

Resolution: Through the cooperative efforts of the involved parties, an engineering control system capable of exhausting chemical vapors away from employee breathing zones while simultaneously containing accident spills was developed and installed at the site. The installed exhaust ventilation system contained provisions for spill cleanup, equipment wash-down, and for cleaning the exhaust effluent (acid scrubbing, activated charcoal, and HEPA filtration) prior to discharge from the stack. Coupled with modifications to operational procedures, the exhaust system reduced occupational chemical exposures and achieved effluent discharge quality objectives.

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SYSTEMS FOR CONTINUOUS MONITORING OF TOXIC AND HAZARDOUS GASES. A.L. Sussell, NIOSH, Cincinnati, OH

Case Study: Continuous gas detection systems have become an integral part of occupational and environmental health programs in the semiconductor industry.

Problems: Evaluation of the commercially available systems is difficult since few studies have been done to compare performance and in most cases validated methods have not been published.

Resolution: A survey of industry users was conducted to assess use and performance of these systems in the semiconductor industry.

How sharing this work experience will benefit other practitioners of industrial hygiene: The information collected will assist others in selection, evaluation, and implementation of continuous gas detection systems.

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BENZENE-SPECIFIC MEASUREMENTS AT REFINERIES. W.R. Haag, RAE Systems, Inc., Sunnyvale, CA

Case Study: Oil refineries handle many process streams that potentially expose workers to benzene, especially in transient situations such as tank cleaning, pipe checks, sewer opening, and spills.

Problems: Benzene is regulated at such low limits (TWA=0.5 ppm) that its concentration alone usually defines the toxicity of petroleum vapors as a whole. It is thus a challenge to measure benzene in the presence of much higher HC concentration.

Resolution: A range of benzene-selective measurement methods is compared, including carbon or air-bag sampling followed by lab GC, a portable GC, Draeger tubes, and a new method combining rapid interferent absorption with PID detection of benzene.

How sharing this work experience will benefit other practitioners of industrial hygiene: The advantages and limitations of each method will be presented to assist practical choice of methods for the user's situation.

Abstracts

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