

face contamination. Surface samples are typically analyzed by ICP-AES, which can involve significant costs and delays of days to obtain results. Seeking to reduce beryllium analytical costs and turn-around time, researchers in the Chemistry Division of Los Alamos National Laboratory have developed a method based on the fluorescence of 10-Hydroxybenzo[*h*]quinoline sulfonate. Initial tests with chemical standards and field-collected samples indicated that the method is very sensitive (14 ng/filter LOD) and not subject to interference from other metals (Al, Ca, Li, Pb, U, Zn).

Industrial hygienists at the laboratory field-tested the method for its practical application. It was determined by observation and analytical results that the nylon filter originally selected for sample collection left residual material on the surface sampled. Tests with multiple lots of filters indicated that our standard surface sampling medium (Whatman® 541, 47-mm circles) was acceptable for the new method. Materials likely to be encountered in the workplace (oils, cleaners, etc.) were added to filters spiked with a known amount of beryllium. Subsequent analysis showed no significant interference with the fluorometric method (mean recovery 99.5%). Six pairs of side-by-side samples collected on a surface known to be contaminated with beryllium were analyzed with ICP-AES and the new fluorometric method. Accounting for the variability expected on the contaminated surface, the two methods were very comparable, with a mean relative percent difference of 7.85%.

It was concluded that this method is very promising and practical for preliminary determination of beryllium surface contamination. Surface contamination can be determined rapidly (30 minutes), in a useful range (0.01 to 6 ug/filter), and at relatively low cost with a potentially field-portable system.

329.

DEPARTMENT OF ENERGY BERYLLIUM HEALTH AND SAFETY RESEARCH PROGRAM. D. Weitzman, P. Wambach, J. Slawski, U.S. DOE, Washington, DC.

Chronic Beryllium Disease (CBD) is caused by an immune system response to beryllium particles embedded in lungs. This response can cause progressive damage to the lungs, which, in turn, can result in disability and shortening of life. It appears that 3–5% of the population is susceptible to this disease. The United States Department of Energy (DOE) has used large quantities of beryllium since its inception as the Atomic Energy Commission and anticipates continuing to use it well into the future.

Unfortunately, some workers who worked with beryllium for DOE have contracted CBD and new cases still are occurring. DOE has aggressively addressed this disease but is concerned that gaps in beryllium health and safety technology may hinder further efforts.

DOE has categorized the technology gaps into exposures, controls, and health effects. The exposures category consists of improving sampling methods and using the improved methods to better characterize exposures. Controls consist of developing innovative controls and observing the impact of lower exposures on disease rates. Health effects consists of achieving better understanding of the disease process and improving diagnostics. Pursuing research in all three categories requires developing basic research tools and capabilities such as establishing a library of tissues samples taken from beryllium diseased individuals.

DOE has inventoried current research activities and will coordinate its efforts with other agencies and the private sector to assure that the highest priorities are addressed first and that redundancy is avoided.

Enlisting the participation of the research community in pursuing this research program presents challenges. Past government solicitations for research applications often were not responded to. DOE is addressing the reasons for this apparent lack of interest which it believes were primarily the lack of access to basic tools and materials needed to conduct the research and uncertainty over the stability of funding.

330.

INDUSTRIAL HYGIENE AND SAFETY PRACTICES UTILIZED IN THE DEMOLITION OF A BERYLLIUM FACILITY. R. Baran, Los Alamos National Laboratory, Los Alamos, NM.

In 1959, Building 141 was constructed by the Los Alamos National Laboratory to be used as a metal powder research facility. Over an approximate 25-year period, experiments with a variety of metals, metal powders, and metal powder mixtures were conducted in support of the development of stronger, lighter, and more durable components for aircraft, satellite, and weapons mechanisms. Pre-renovation site characterization determined that these activities had left the building, its equipment, and its supplied air and exhaust ventilation systems contaminated with beryllium, copper, lead, nickel, thorium, uranium, and vanadium. This poster presents the industrial hygiene and safety practices employed by the contractor charged with the decontamination and partial demolition of portions of the facility necessary prior to planned renovations. These included: (1) identification and implementation of engineering controls to prevent airborne dispersion of the metal contaminants; (2) establishment of a transition zone between the controlled, contaminated work area and uncontrolled, clean spaces; and (3) identification of required personal protective equipment (PPE) designed to protect workers performing largely manual, hands-on labor involving close contact with equipment, ventilation systems, and building surfaces highly contaminated with a wide variety of toxic metals. Challenges included development of a

company Chronic Beryllium Disease Prevention Program, as well as the development of an Industrial Hygiene Sampling and Monitoring Plan. Swipe sampling results confirm that the engineering controls used, and practices such as the doffing of PPE within the transition area, prevented the transfer of contamination to clean, uncontrolled areas. Sampling data is presented. Conclusions from sampling enabled management to verify their risk assessment approaches and confirm the adequacy of controls, such as negative air ventilation system strategies and wet work methods, to prevent airborne beryllium and lead from exceeding permissible exposure limits.

331.

EXPOSURE ASSESSMENT AT A BERYLLIUM CERAMICS FACILITY FOLLOWING IMPLEMENTATION OF A DERMAL PROTECTION PROGRAM.

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Efforts to prevent beryllium sensitization and chronic beryllium disease have historically focused on controlling inhalation exposures. Epidemiologic studies suggest that mass airborne beryllium exposure is not a good predictor of risk. The lack of a clear relationship between airborne exposure and sensitization suggests that other exposure pathways, such as dermal exposure, may be more relevant.

A dermal protection program, including use of gloves in production areas, was recently instituted at a beryllium ceramics production facility with a history of beryllium sensitization and chronic beryllium disease in workers. The purpose of this study was to assess the total amount of beryllium on workers' hands following implementation of this program. Wipe samples were collected from the skin (2 hands) of 122 workers (87 production, 35 production support), following at least 1 hour performing their regular work. Additional information was collected on work area, work activity, and glove use. Samples were analyzed for mass beryllium by inductively-coupled plasma atomic emission spectrometry, and normalized to workers' estimated hand size.

All participants reported wearing gloves when working in production areas, including production support workers entering or passing through production areas. Analytical results, although highly variable, indicated measurable levels of beryllium in 99% (121/122) of samples, ranging from less than the limit of detection (LOD = 0.01) to 46 µg. The overall geometric mean, normalized to hand surface area, was 0.27±5.3 µg/100 cm². Levels of beryllium were higher on the hands of production workers, compared to production support workers (0.49±3.6 versus 0.06±4.9 µg/100 cm², p<0.05). These results provide information regarding the relative mass of beryllium found

on the hands of glove-wearing beryllium ceramics workers. Subsequent evaluations of work practices, both programmatic and individual, are being used to refine and improve personal protection practices.

332. MOLECULAR BASIS OF GENETIC RISK ASSESSMENT IN CHRONIC BERYLLIUM DISEASE.

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Chronic beryllium disease (CBD) represents a possible threat to approximately 800,000 workers and other individuals potentially exposed to beryllium. The pathobiology of chronic beryllium disease involves the major histocompatibility complex class II human leukocyte antigen (HLA). Molecular epidemiological studies suggest that inheritance of specific *HLA-DPB1* alleles may be a factor contributing to disease susceptibility. We have studied three-dimensional structural models of HLA-DP proteins encoded by these genes. The extracellular domains of proteins encoded by *HLA-DPA1*01031/B1*1701*, **1901*, **02012*, and **0401*, and *HLA-DPA1*02011/B1*1701*, **1901*, **02012*, **0401* were modeled from the X-ray coordinates of an HLA-DR template. Using these models the electrostatic potentials at the molecular surface of HLA-DP were calculated and compared. These comparisons show specific characteristics in the vicinity of the antigen-binding pocket that distinguish the different *HLA-DP* allotypes. The differences in electrostatics originate from the shape, specific disposition, and variation in the negatively charged groups around the pocket. The more negative the pocket potential, the greater the odds of CBD estimated from reported molecular epidemiologic studies. The impact is caused by substitutions in the beta-chain at positions B55, B56, B69, B84, and B85. Interestingly, these are the same loci that have been identified as genetic markers conferring susceptibility to CBD and other hard metal lung disease through epidemiological studies. These findings suggest that these substitutions may eventually promote an involuntary cation-binding site within the otherwise metal-free peptide-binding pocket, consequently demoting the innate function of HLA by changing the specificity of antigen recognition. Occupational risk assessment pertaining to beryllium exposures may benefit from consideration of the electrostatic characteristics of HLA-DP isotypes.

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333. MAXIMUM ADMISSIBLE CONCENTRATIONS FOR HARMFUL AGENTS IN THE WORKING ENVIRONMENT IN POLAND ESTABLISHED IN 2003.

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Interdepartmental Commission for Maximum Admissible Concentrations and Intensities for Agents Harmful to Health in the Working Environment includes representatives of health and labour administration, various sectors of industry, trade unions, and research institutes in the fields of occupational medicine and work safety. The Commission has appointed the Group of Experts for Chemical and Dust Agents and the Group for Physical Factors, consisting of independent experts in the fields of toxicology, occupational medicine, and occupational hygiene. The experts prepare health-based documentation for recommended exposure limits along with analytical procedures, recommendations with respect to pre-employment and periodical medical examinations, and contraindications to exposure. The proposed MAC and MAI values are then the subject for evaluation by the Interdepartmental Commission and acceptance by the Minister of Labour and Social Policy. The MAC's lists are published in the Law Gazette. These are hygienic standards valid for all branches of the national economy. To 2002 there are 441 MAC values for chemical substances (The Ordinance of the Minister of Labour and Social Policy on the maximum admissible concentrations and intensities of harmful to health agents in the working environment, J. of Law 217, item 1833). In 2003, the Expert Group of Chemical Agents proposed 36 MAC values for chemical substances. According to the type of biological effects, the following categories of MAC values are used: NDS-MAC(TWA): maximum admissible concentration; NDSCh-MAC(STEL): maximum admissible short-term concentration; NDS-MAC(C): maximum admissible ceiling concentration. In the Polish system, the MAC and MAI values documentation are published quarterly in the publication of the Interdepartmental Commission "Principles and Methods of Assessing the Working Environment" which makes it possible for occupational physicians and sanitary inspectors to become acquainted with the problem.

334. OCCUPATIONAL EXPOSURE TO SULFUR AND NITROGEN ORGANIC COMPOUNDS IN POLISH RUBBER INDUSTRY.

E. Koziel, W. Domanski, M. Posniak, Central Institute for Labour Protection-National Research Institute, Warsaw, Poland.

Rubber industry is a very important branch of the national economy. The products of this industry are widely used in many production sectors. Production of rubber products is characterized by the emission of pollutants which are hazardous and harmful to health. The aim of the studies was to identify nitrogen and sulfur organic compounds that are found in workplace air during production and processing of rubber and assessment of workers' exposure. The studies were carried out in three rubber industry factories that produce rubber plates and forwarding tape. In order to identify pollutants, samples were taken in places where the highest concentrations of air pollutants was expected. Charcoal, silica gel, silica gel coated ascorbic acid, and a glass fibre filter with amberlite XAD-2 resin (flowrate 20-120 L/min) were used to sample sulphur and nitrogen compounds. Prior to sampling, the sorbents were extracted in carbon disulphide, methanol, acetonitrile, and dichloromethane. Samples were analysed with gas and liquid chromatography. The GC/MSD tests made it possible to identify over 15 compounds containing sulphur and nitrogen in the mixtures emitted at workstations with mixers, roll mills, calenders, and vulcanizing presses.

Six of the identified chemical compounds of sulphur and nitrogen were identified at all workstations. These substances were determined during a typical production cycle of rubber plates and forwarding tapes. The results of the measurements indicated that the concentration of benzothiazole ranged from 1.42 mgm-3 to 23.50 mgm-3, 2-diio(bis)benzothiazole from 2.01 mgm-3 to 26.11 mgm-3, carbon disulphide from 274.02 mgm-3 to 6519.50 mgm-3, cyclohexyl isocyanate from 1.81 mgm-3 to 70.5 mgm-3, 2-imidazolidinethione from 0.013 mgm-3 to 1.22 mgm-3, and N-nitrosodimethylamine from 0.02 mgm-3 to 0.58 mgm-3. Assessment of occupational exposure to these compounds is very difficult because there are no maximum admissible concentration values for several compounds either in Poland or abroad.

335. CHEMICAL HAZARDS IN POLISH IRON FOUNDRIES.

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Metal founding, especially iron founding, is a branch of industry in which working conditions are very bad. During the whole process in casting production workers are exposed to dangerous, harmful, and strenuous factors that can cause occupational diseases, occupational accidents, and also fatal accidents. Chemical substances are emitted to the air at every stage of castings production, which create different degrees of hazards for human health. Identification studies of harmful chemical substances and metals were carried out at worksta-

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