

**Methods:** We studied 90 active workers and measured lead levels in patella and tibia by the K-X-ray fluorescence method. We applied a questionnaire to collect data on duration of exposure, tasks and hygiene. Many workers had a double job at another printing workshop and the years in the second full simultaneous employment were added to those of the first job. In addition, we quantified external current exposure through lead levels, air and on hands, and internal exposure through lead in blood. Multiple linear regression models were constructed for each bone to identify predictors.

**Results:** Mean age was 45 years (SD 13), mean time of employment was 10.6 years (SD 9.3, range 1 – 40 years) and after adding time at second job 20 years (SD 15.5). Lead in air was 0.54 mg/m<sup>3</sup>, geometric mean for lead on hand before washing was 848.1 mg/m<sup>2</sup> (range 27, 158537) and still considerably high after washing, 73.0 mg/m<sup>2</sup> (3, 1463). Mean lead level in blood was 12.3 mg/dl (SD 5.2, range 3.4, 30.3). Mean lead level in the patella bone was 43.3 µg Pb/g (SD 28.5) and in the tibia 25.9 µg Pb/g (SD 18.8). The strongest predictors for lead in bone were the duration of employment (sum of both simultaneous jobs) and intensity of exposure as defined by task categories (increasing coefficients with increasing intensity of exposures). Also current blood Pb concentration was weakly associated with bone lead levels, possibly because of absorption of lead in bone into the blood. The patella model explains 44%, and that of the tibia 55%, of bone Pb variability.

**Discussion and conclusions:** Current air levels are low and internal exposure levels in blood are not particularly high for most workers, whereas bone lead levels are as high as in smelters. The accumulation of lead in bone increases with the duration of employment, the length of the workday and the level of exposure according to job tasks.

#### **Mo-P-21** DETERMINACIÓN DE LA EXPOSICIÓN A METALES PESADOS EN LA INDUSTRIA METALMECÁNICA EN COSTA RICA

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**Background and aims:** Estudios realizados sobre este tema en otros países revelaron que los niveles de exposición ocupacional sobrepasan varias veces los límites permitidos para hierro y cromo. La forma en que estos agentes químicos pueden llegar hasta el trabajador puede verse influenciada por una serie de factores como por ejemplo el tipo de materia prima, la ventilación, tipo de soldadura, posición del trabajador, entre otros; por lo que se planteó estudiar las variables relacionadas con la exposición ocupacional a metales pesados en una muestra de empresas dedicadas a procesos metalmecánicos de Costa Rica.

**Methods:** El estudio fue exploratorio de corte transversal, incluyó empresas dedicadas a la fabricación de estructuras y muebles metálicos, a las cuales se les aplicaron encuestas higiénicas con el fin de plantear las estrategias de muestreo, para luego cuantificar las muestras (Método OSHA 121), y así obtener los niveles de exposición a cobre, cromo, hierro, níquel y plomo, además se identificaron de forma cuali-cuantitativa los posibles determinantes de la exposición y se realizaron análisis de varianzas para las tareas de corte, soldadura y pulido, y entre subsectores.

**Results:** Participaron 15 empresas (173 muestras en total); se determinó que 7 de ellas sobrepasaron los límites de exposición permitidos para polvos y humos de Fe. La MG (DGE), en general, para las concentraciones de Fe fueron 0,12 (5,92) mg/m<sup>3</sup>, las de Cu 0,04 (4,98) mg/m<sup>3</sup>, Cr 0,07(6,34) mg/m<sup>3</sup>, Pb 0,07(0,06) mg/m<sup>3</sup>; el Ni no fue detectado. En tareas de corte, pulido y soldadura las concentraciones fueron 0,39(5,33) mg/m<sup>3</sup>, 0,66 (10,76) mg/m<sup>3</sup> y 0,58(4,24) mg/m<sup>3</sup> respectivamente y según los subsectores: estructuras metálicas 1,16 (4,77) mg/m<sup>3</sup>, soldadura pesada 0,42(4,95) mg/m<sup>3</sup> y artículos de metal 0,28(3,28) mg/m<sup>3</sup>.

**Discussion and conclusions:** Los polvos y humos metálicos de Fe están presentes en el ambiente del 100% de las industrias. El Pb se encontró en el 13.3% de las empresas. El tipo de material, la ventilación y tipo de soldadura son algunos de los determinantes de la exposición. Además no hay diferencia significativa entre las tareas que se realizan, pero sí las hay entre las actividades.

#### **Mo-P-22** PRESENCE OF AIRBORNE FIBERS IN TUNGSTEN REFINING AND MANUFACTURING PROCESSES

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**Background and aims:** In tungsten refining and manufacturing processes, a series of tungsten oxides (WO<sub>x</sub>) are typically formed as intermediates in the production of tungsten powder. Studies in the Swedish tungsten refining and manufacturing industry have shown that intermediate tungsten refining processes can create WO<sub>x</sub> fibers. The present study was conducted to characterize airborne tungsten-containing fiber dimensions, elemental composition, and concentrations in the U.S. tungsten refining and manufacturing industry.

**Methods:** During the course of normal employee work activities, seven personal breathing zone and 62 area air samples were collected and analyzed using standard fiber sampling and counting methods to determine dimensions, composition, and airborne concentrations of fibers. Mixed models were used to identify relationships between potential determinants and airborne fiber concentrations.

**Results:** Results from transmission electron microscopy analyses conducted indicate that airborne fibers with length > 0.5 µm, diameter > 0.01 µm, and aspect ratios > 3:1 were present on 35 of the 69 air samples collected. Overall, the airborne fibers detected had a geometric mean (GM) length of ~ 3 µm, and GM diameter of ~ 0.3 µm. Ninety-seven percent of the airborne fibers identified had an aerodynamic diameter < 10 µm, indicating that they were capable of reaching the thoracic regions. Energy dispersive x-ray spectrometry results indicate that airborne fibers prior to the carburization process consisted primarily of tungsten and oxygen, with other elements being detected in trace quantities. Based on NIOSH fiber counting "B" rules (length > 5 µm, diameter < 3 µm, aspect ratio > 5:1), airborne fiber concentrations ranged from below the limit of detection to 0.085 f/cc, with calcining being associated with the highest airborne concentrations. The mixed model procedure indicated that process temperature had a marginally significant relationship to airborne fiber concentration.

**Discussion and conclusions:** The finding that temperature was marginally significant was unexpected, since heated processes such as calcining created the highest airborne fiber concentrations. Until more is known about the durability and potential health effects associated with airborne tungsten-containing fibers, it would be prudent to take steps to limit or eliminate occupational exposures.

#### **Mo-P-23** EVALUATION OF OCCUPATIONAL EXPOSURE TO MULTIPLE CHEMICALS IN LABORATORIES

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**Background and aims:** The aim of this study was to assess the profile of occupational exposure to chemicals in laboratories.

**Methods:** A transversal study was carried out at the Petrobras Research Center in order to assess the profile of exposure to chemicals among 3,000 employees whose job was predominantly performed inside on 137 laboratories, in the petrochemical area, half of which were low concentration, lengthy exposures (the study was based on environmental assessments carried out in 2004). To assess the damage to health, result from occupational exposure to chemicals agents.

**Results:** 484 chemicals were identified (including 246 chemicals agents and 238 chemicals mixtures) in 243 workplaces. This resulted in 2,738 exposure situations with an average of 3.73 chemicals per location. The 1,563 workers under exposure were divided into 168 Homogeneous Exposure Groups (GHE) comprised by 1 to 44 subjects (mean = 4.55; median = 3; mode = 1). On average, 4.91 GHE were identified in each workplace. In 14% (382 situations) the frequency of exposure was daily, at 82.1% (2,249 situations) the use ranged from two to three times a week and the remaining 3.9% (107 situations) use was sporadic (once week or less). 977 environmental samples were measured. Regarding the GHE, it was observed that 91.9% of the assessments showed results below action level. This is equivalent to 92.5% of the amount of workers and fits into the low concentration exposure category. It was also observed that 49.6% of GHE (i.e. 49.9% of workers) showed concentrations lower than detection limit in analytical techniques, whereas concentrations were equal to or greater than action level among 8.1% of GHE and 7.5% of workers.

**Discussion and conclusions:** Exposure to chemicals in laboratories occurs basically under varied, repetitive, multiple, in low concentration and predominantly to solvents.

#### **Mo-P-24** ENVIRONMENTAL EXPOSURE TO ASBESTOS AROUND AN ASBESTOS-CEMENT PLANT IN QUITO, ECUADOR

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**Background and aims:** Asbestos imports and use are not banned in Ecuador and articles like asbestos cement plaques and brake linings are largely manufactured and used in the country. There are some plants producing asbestos-cement plaques situated close to living areas in Quito. One plant was studied, considering the internal process, the use of asbestos (chrysotile), the safety and hygienic controls and the program for waste disposal.

**Methods:** Samples of dust were taken around the industrial plant with personal active pumps and the filters were sent to the lab in Italy (Dipartimento di Ingegneria del Territorio, dell'Ambiente e delle Geotecnologie Prevenzione -Servizio Prevenzione e Sicurezza Ambienti di Lavoro, Sede di Civitanova Marche). A questionnaire, spirometry and X Rays were applied to 25 persons living in the surrounding more than 15 years. No asbestos effects were found in X Rays, but symptoms of respiratory diseases related to dust exposure were identified.