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A study was conducted to demonstrate lead-based paint removal effectiveness from interior/exterior wood, masonry, and concrete surfaces of barracks and buildings at Fort Campbell using four innovative technologies. The technologies demonstrated included wet abrasive blasting with a chemical stabilizer, wet abrasive blasting with a surface stabilizing pretreatment, xenon flash-lamp, and encapsulant paint remover. Effectiveness was defined as achieving a residual lead level on the substrate of <1 mg/cm^2 (measured using a X-ray fluorescence spectrum analyzer) without resultant damage to the substrate. Economic parameters necessary to accurately estimate the cost of using each of the technologies were also determined.

An XRF spectrum analyzer was used to quantify the change in lead levels on the substrate before and after paint removal, with verification testing using inductively coupled plasma atomic emission spectroscopy (ICP-AES). ICP-AES analysis was also used to quantify the change in lead levels in airborne particulate and settled dust wipe samples before and after paint removal. Aerodynamic particle size distributions of lead particulate were measured using a multistage personal cascade impactor. Toxicity characteristic leaching procedure (TCLP) was used to determine if the chemically stabilized waste exhibited the Resource Conservation and Recovery Act (RCRA) toxicity characteristic for lead of >5 mg/L. It is concluded that the technologies demonstrated may be less expensive, faster, and more environmentally sound compared with other traditional for lead-based paint mitigation technologies.

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ANALYSIS OF LEAD ON DUST WIPES USING FIELD PORTABLE X-RAY FLUORESCENCE. D.W. Sackett, B. Allen, NITON Corp., Bedford, MA; G. Piacitelli, NIOSH, Cincinnati, OH

Methods for on-site analysis of lead on dust wipes would be a valuable tool for both risk assessment and clearance activities. Benefits include expedited transfer of property back to the property owner or tenant and thorough investigations of a property for in-place management programs and for elevated blood lead investigations.

We have performed an initial evaluation using field portable X-ray fluorescence (XRF) for analysis of dust wipes. Twenty-eight dust wipes were collected at several Rhode Island lead abatement projects, and analyzed by a field portable XRF. The wipes and XRF results were sent to a NIOSH laboratory for digestion and analysis by flame atomic absorption spectroscopy (flame AAS). For lead dust levels #1000 mg/wipe (20 out of 28 wipes), the XRF data agreed very well with the flame AAS results. The correlation coefficient (R^2) is 0.97, regression yields a slope of 1.02, and the average percentage deviation is 15%. For the full set of data (values up to 19,000 mg/wipe) the correlation coefficient was 0.95, but regression analysis yielded a slope of 0.58, and the average percentage deviation is 21%. The presence of a few large, high-lead paint chips appears to cause the poorer agreement for the full data set.

Further evaluation of the XRF method was performed using ELPAT dust wipe rounds 16 through 19. ELPAT proficiency requirements were met on all of these rounds. The initial results from this study suggest that field portable XRF can provide useful quantitative data for on-site risk assessment and clearance decisions.

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EVALUATION OF A PORTABLE X-RAY FLUORESCENCE INSTRUMENT FOR THE DETERMINATION OF LEAD IN WORKPLACE AIR SAMPLES. J.C. Morley, K. Ashley, J. Deddens, NIOSH, Cincinnati, OH; S. Clark, University of Cincinnati, Cincinnati, OH

OSHA regulations for worker exposure to lead specify worker protection levels based on airborne concentrations of lead dust. The rapid, on-site determination of lead in air filter samples using a portable X-ray fluoresence (XRF) instrument with an attachment to hold the filter would expedite the exposure assessment process and facilitate compliance with the OSHA standard.

A total of 65 lead in air filter samples were collected with closed-faced, 37-mm cassettes at bridge blasting lead-abatement projects. The lead loading range of the sample set was 0.1 to 1514.6 mg of lead/sample. Samples were initially analyzed with a field portable Niton7 700 Series XRF using an experimental nondestructive XRF method. Samples were subsequently analyzed using the NIOSH Sampling and Analytical Method 7105 (Graphite Furnace AA) as a reference method. The paired data were not normally distributed; therefore, the nonparametric Wilcoxon signed rank test was used. There was no statistically significant difference between the data from the field portable XRF method and the NIOSH method (p-value= 0.72). Linear regression of the data resulted in a slope of 0.959 and an r^2 of 0.985. The XRF instrument limit of detection (LOD) and limit of quantitation (LOQ) were determined to be 6.2 and 17.1 mg of lead/sample, respectively. The XRF method accuracy was ± 27%.

These data indicate that there is no statistically significant difference between the field portable XRF method and NIOSH Method 7105. The instrument LOQ of 17.1 mg of lead/sample is sufficiently sensitive to quantitate lead exposures below the OSHA action level of 30 mg/m^3, given a sample volume of 570 liters. Although the method accuracy of ± 27% is greater than the NIOSH accuracy criterion of ± 25%, the method was evaluated using field samples. Laboratory prepared aerosol samples would be expected to give better precision. This research led to the development of NIOSH draft Method 7702, "Lead by Field Portable XRF."

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SYNTHESIS OF EPIDEMIOGICAL STUDIES ON THE RELATIONSHIP BETWEEN DUST LEAD AND BLOOD LEAD LEVELS IN CHILDREN. D.E. Jacobs, B. Lanphear, HUD Office of Lead Hazard Control, Washington, DC; T. Matte, S. Dixon, R. Clickner, B. Dietz, W. Hartley, J. Rogers, R. Bornschein, P. Ashley, K. Mahaffey, W. Galke, R. Kaufmann, M. Rabinowitz, M. Farfel, C., J. Schwartz, U.S. Department of Housing and Urban Development, Washington, DC; P. Succop, University of Cincinnati, Cincinnati, OH

This study combined virtually all of the available epidemiological studies of the relationship between dust lead levels in residential structures and blood lead levels in resident children into a large single cohort. The purpose of this analysis was to develop the best scientific estimate of the contribution of lead-contaminated house dust to children's blood lead levels. Dust lead levels are currently used for both risk assessment and postabatement clearance purposes by the U.S. Department of Housing and Urban Development in federally assisted housing. Data were standardized by age, sex, race, dust sampling methods, season, site of study, socioeconomic status, and other variables. A number of statistical models were evaluated. The model selected predicts the log transformed child's blood lead as a linear function of log-transformed measures of environmental exposure, including paint lead, dust lead, soil lead, water lead, and air lead. The model was also adjusted for measurement error. Results indicate that a dust lead level of 25 mg/ft^2 on floors will protect 95% of all children from developing blood lead levels greater than 15 mg/dL, which is the blood lead level specified by the Centers for Disease Control and Prevention requiring environmental intervention. This method of analysis is contrasted with meta-analysis of discrete epidemiological studies.

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THE EFFECT OF ENVIRONMENTAL EXPOSURE TO LEAD ON CHILDREN'S HEARING. K.M. Pawlas, J.A. Sokal, M. Gazdzik, Institute of Occupational Medicine and Environmental Health, Sosnowiec, Poland; K. Osman, M. Vachter, Institute of Environmental Medicine, Stockholm, Sweden; A. Schutz, Lund University, Lund, Sweden

Adverse effects of lead exposure on cognitive function in children were showed in many studies. Neurotoxic effects of lead on peripheral, central, and autonomic nervous systems were well-documented, too. Recently only a few studies were focused on auditory function of children exposed to lead. They showed that lead intoxication was associated with hearing threshold elevation in occupational as well as in environmental lead exposure. Our study has focused on assessment of the effects of environmental lead exposure on hearing of children in the Katowice province.

The study group consists of 155 children (80 boys and 75 girls) aged 4-13 years with average lead concentration in blood: 10.4 ± 7.3 mg/dL (min. = 2.1 mg/dL, max. = 47.6 mg/dL). Hearing evaluation was performed on blind basis and consists of otolaryngological examination, otological questionnaire, impedance audiometry, brain stem audiometry, and hearing threshold measurement in the range 500-8000 Hz using conventional audiometry. The examination was carried out by specially trained personnel in the audiometric room.

The study showed that the relationship between hearing threshold elevation in the range 500-8000 Hz and blood lead concentration was linear. Trend of the linearity was highly statistically significant. The brain stem audiometry showed that latencies of waves: I, III, V, and interval III-V of peak latencies were prolonged, too, but not statistically significant. Multivariate analysis confirmed that the main factor impacting hearing was lead. Further study is needed to clarify this problem.

Abstracts

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