

Lead in Paint, Soil and Dust

*Health Risks,
Exposure Studies,
Control Measures,
Measurement Methods,
and
Quality Assurance*

Michael E. Beard and
S. D. Allen Iske, editors



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Foreword

This publication, *Lead in Paint, Soil and Dust: Health Risks, Exposure Studies, Control Measures, Measurement Methods, and Quality Assurance*, contains papers presented at the 1993 Boulder Conference on Lead in Paint, Soil, and Dust held in Boulder, Colorado at the University of Colorado on 25–29 July 1993. The conference was sponsored by ASTM Committees D-22 on Sampling and Analysis of Atmospheres, E-6 on Performance of Buildings, D-1 on Paint and Related Coatings, Materials and Applications, and D-18 on Soil and Rock. Michael E. Beard, U.S. Environmental Protection Agency, and S. D. Allen Iske, Ph.D., CIH, Miles, Inc., presided as conference cochairmen and editors of this publication.

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Overview

Introduction

This special technical publication (STP) compiles the texts from a series of presentations given at the 1993 Boulder Conference on Lead in Paint, Soil, and Dust. The conference was sponsored by ASTM Committees D-22 on Sampling and Analysis of Atmospheres, E-6 on Performance Buildings, D-1 on Paint and Related Coatings, Materials, and Applications, and D-18 on Soil and Rock and was held at the University of Colorado, Boulder, Colorado, between 25–29 July, 1993. This was the tenth in a series of biannual conferences to advance the science and knowledge in various topics concerning environmental and atmospheric measurements.

Specifically, this 1993 Boulder Conference provided an opportunity to review the latest results in research on monitoring and controlling environmental exposures to lead in paint, soil, and dust. The program for the conference was arranged to provide a multidisciplinary overview of environmental lead-monitoring research programs and the status of analytical methods as well as certification programs for analysis of environmental samples. The primary goal for the conference was to provide an up-to-date review of technical topics relating to lead monitoring while bringing the disciplines of exposure assessment and analytical chemistry together to promote a better understanding of their mutual interests, needs, and limitations for monitoring of lead.

The ASTM committees sponsoring this conference provided a forum for the presentation of state-of-the-art research by a selected group of distinguished researchers as well as for formal and informal discussions between all attendees. The technical presentations provided the experienced professional in lead monitoring with an up-to-date review of research while for the newcomer to the lead area an introduction of current status of knowledge. The conference was a benefit to industrial hygienists, health researchers, chemists, agronomists, building management and operations personnel, laboratory managers, governmental regulatory authorities (federal, state, and local governmental officials), anyone interested in the lead monitoring issues, and academic researchers.

The publication of the papers will serve to extend the information and experience presented during the conference to those in attendance and to serve as a resource for all to use.

Summary of Presentations

Papers in this publication summarize the presentations and discussions given by the authors during the conference. The manuscripts support the discussions held during the week covering the topics of Health Risks, Exposure Studies, Control Measures, Measurement Methods, Quality Assurance, and Laboratory and Field Measurement Accreditation. The following is a brief summary of each of the presentations made at the conference.

Although all presenters were requested and expected to submit a formal paper to be included in this special publication, all authors did not submit finished written papers. In addition, a few submitted papers had to be rejected for publication based on technical issues. All papers published in this text have been fully approved after a thorough “peer review” process by selected expert reviewers and the editors for this publication. A designation of an

“*” after a paper’s reference in this summary section indicates that the paper was presented at the conference but a formal paper is not published in this book.

Health Risks

Three papers were presented on the health effects and risks of environmental lead exposure to open the conference. *Mahaffey** presented the opening paper with an overview of adverse health effects of lead as the basis for establishing soil and dust standards. She presented research regarding pediatric lead poisoning and on the implications of biokinetics (that is, internal redistribution of lead) in assessing health effects from environmental exposures.

Weis et al. discussed their work on determining the gastrointestinal absorption of lead using immature swine as a plausible mammalian model for juvenile children. The experimental design of a series of investigations to understand the bioavailability of lead using a lead reference substance and a residential soil from a mining and smelter area were discussed.

The session closed with *Marcus and Elias* leading a discussion on the significance of different sources and pathways in childhood lead exposure. Different methods and models for predicting the factors for a child’s total lead exposure are detailed from three cross-sectional studies.

Exposure Studies

Several papers were arranged on this topic to review the pathways and extent of exposure to lead. *Clickner and Rogers* began the session with a review of the findings from a national survey of lead-based paint in housing. The estimates on the amount and hazards of lead-based paint as well as the sources and pathways in residential homes were described.

Kinateder et al. presented data to assess the long-term efficacy of various abatement methods for lead-based paint with findings from an earlier U.S. Department of Housing lead-based paint abatement demonstration. Results from soil and dust samples were reported as well as compared with corresponding data from other abatement efficacy studies.

Eberle highlighted a demonstration project using multifamily public housing to examine the problems and opportunities associated with lead-based paint abatement in conjunction with scheduled modernization of these structures.

Limited capability of the lead isotope ratio technique to determine the source of lead for blood lead content was shown by *Rabinowitz*. The potential benefits using this technique for clues to the origin and transport of lead pollution were noted; however, the limitations and variations in the isotope ratios must be considered.

Burgoon et al. reported on information derived from an EPA scientific literature search investigating the sources of lead contamination of soil. The authors strived to make some global evaluations for the sources for soil contaminations, geographic variations in soil lead levels, and correlating these lead-contaminated soils with elevated levels in children’s blood.

A paper summarizing the statistical evaluation of the relationship between lead in environmental media (dust, soil, water, and air) and blood-lead levels using data from infants from late pregnancy to two years of age (Brigham and Women’s Hospital Longitudinal Lead study) was presented by *Menton et al.* The goal was to assess statistically the environmental pathways of lead exposure.

Further studying the impact of abatement of lead in soil with a reduction of blood lead content of children was reported by *Elias and Grant**. Preliminary evidence for a quantifiable reduction in blood lead for the population of children that received intervention in their homes through abatement was presented.

With the other papers concerning lead exposures, *Farfel and Lim* outlined a planned study to compare full lead-paint abatement techniques with three different levels of repair and maintenance (R&M) intervention. The authors cited the importance of this new R&M approach to reduce lead in dust since lead-contaminated dust has been noted to be one major source of exposure for children.

As an appropriate closing paper to this session, *Burgoon et al.* summarized the efficacy of lead abatement in reducing children's lead exposure. Key studies were used to provide results and conclusions.

Control Measures

Control measures are used to reduce or eliminate exposure to lead (such as removal, encapsulation, and so forth) to meet lead action levels or "clean" standards. This session was opened with a paper by *Sussell et al.* discussing the hazard evaluation of crews using three different methods of "cleaning" the rooms of a building contaminated with lead-based paint. Correlation of worker exposure data to paint-lead concentrations were drawn.

As a second in the three-part series of papers on the long-term efficacy study of abatement methods, *Buxton et al.* presented the statistical modeling results as well as the performance of the studied lead-based paint abatement methods. Observed correlations of the lead levels in the household dust and soil measured at different locations were made.

*Lefkowitz and Harris** led a discussion on the engineering considerations and design of a decontamination needlegun system with local exhaust. Applications and safety/health requirements were cited.

*Weaver** commented to the attendees about atmospheric lead from automobiles (gasoline). Weaver cited that the estimation of lead from gasoline's environmental fate is urgent and must be primary to all lead control. Control of lead in a child's environment should be the focus. A somewhat contradictory paper to Weaver was next presented by *Jacobs*. Jacobs reviewed historical, epidemiological, and analytical evidence to support his presentation that lead-based paint constitutes a major source of lead poisoning in young children today in the United States. Jacobs further described the principal pathway of childhood lead exposure from lead paint in soils along with the direct ingestion path. Jacobs also noted soil contains lead from other sources such as residues from leaded gasoline and industrial sources in some locations.

Measurement Methods

An expanded session was necessary to accommodate the papers concerning the evaluation of measurement methods for determining lead levels using various instrumental techniques. *Harper et al.* summarized the research efforts in progress to evaluate the performance of measurement methods for lead in paint and paint-contaminated medias. The methods were evaluated for reliability and cost-effectiveness. The development of reference standards was discussed.

*Binstock et al.** discussed surface sampling using the wipe collection method to collect dust samples. The development of a field sample collection design was presented with laboratory and field validation data. *Grohse et al.** continued the discussion for field sampling using portable X-ray fluorescence (XRF) instruments or field test-kits for lead assessment. Grohse described the development of performance parameters to compare the methods.

Bernick et al. presented data supporting the use of field-portable XRF instruments for analyzing lead in soils and sediments as near real-time data with cost savings. *Vincent and Boyer* continued the session comparing the results for "real world" soil and dust samples

from an abatement project using XRF with other instrumental (atomic absorption spectroscopy [AAS] and inductively coupled plasma [ICP]) data. Factors for variance in data as well as the importance of sample preparation were discussed.

Dewalt et al. completed the series of papers on the EPA's long-term efficacy study of abatement methods by presenting the sampling and analysis methods used for the study. Dewalt also provided the quality control measures implemented for the study from the field as well as in the laboratory. The results were statistically analyzed and sources of variability found.

Demyanek et al. investigated the use of adhesive lift-sampling technology for evaluation of lead in surface dust. This paper compared the use of this adhesive lift technique compared to other traditional surface-monitoring methods such as vacuum and wipes during field studies.

Scanning electron microscopy (SEM) and XRF used to determine lead levels in house dust samples collected as a post-lead abatement clean-up process following lead-paint removal or encapsulation was presented by *Mamane et al.* An analysis of the lead data results with particle size, morphology, and chemistry was developed.

The session closed with *Johnson and Hunt* presenting initial data for a new approach to lead in soil analysis. Johnson described the use of individual particle analysis (IPA) with SEM and EDX to characterize particles in size, shape, and elemental composition in a timely, efficient manner. Results suggested soil lead from paint undergoes a relatively rapid transformation and redistribution.

Quality Assurance

Quality assurance procedures are essential to ensure reliable lead measurements including the use and development of reference and performance audit measures. *Watters and DeVoe* introduced this topic with information on the design, development, and application of Standard Reference Materials (SRMs) and primary methods of measurements. The importance of these SRMs and primary methods to develop traceability to a U.S. national system of measurement as well as a potential worldwide acceptance was emphasized. *Hartwig* outlined that the goal of any "legitimate" analytical laboratory is to provide data of the highest quality possible. The components of a quality assurance/quality control program to minimize errors and control analytical variables were outlined.

Binstock et al. discussed the work required to develop method evaluation materials (MEMs) to support environmental lead studies. MEMs must meet target concentrations for regulatory levels and real-world data as well as meet homogeneity criteria for instrumental use.

Pella et al. updated the current status of NIST efforts to generate standard reference materials (SRMs) for both field paint-screening techniques and for laboratory quantitative analyses. Reference standards at various concentrations were and are being required.

Vincent et al. finished the session on quality assurance with a presentation on the submission of quality assurance double-blind samples during a lead abatement project. These audit samples included soils and dusts and were submitted for quality assessment of the analytical laboratories. Statistical interpretation of data results were summarized.

Laboratory and Field Measurement Accreditation

Accreditation or certification programs or both are key in providing performance criteria for programs and laboratories. *Scalera* reviewed the National Lead Laboratory Accreditation

Program (NLLAP) objectives and requirements of the program and the goal to assure that their recognized laboratories have the capability of analyzing for lead in paint, soil, and dust.

Unger discussed that accreditation of lead-testing laboratories through the American Association for Laboratory Accreditation (A2LA) program has been recognized by the EPA for the NLLAP program. The essential elements of the accreditation process were described. Next, *Peters and Hurley* detailed the American Industrial Hygiene Association's Environmental Lead Laboratory Accreditation Program (AIHA's ELPAT) program to accredit laboratories analyzing environmental samples for lead content. Hurley cited the key elements in this proficiency performance program as well as its recognition by EPA for the NLLAP program.

The last paper of the conference was given by *Cada** on state certification programs for laboratories completing lead analyses. The role of the Association of State and Territorial Public Health Laboratory Directors to represent the needs and difficulties of public health laboratories was discussed.

Final Comment

The cochairs for this conference sincerely hope the publication of the proceedings from the 1993 Boulder Conference will be beneficial to the scientific world. This STP reviews the current status of research as well as hopefully stimulates future work to understand this complex lead issue.

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