C4 Automated Scanning Electron Microscopy of Lead Ore Dust

Richard S. Brown, MS, MVA, Inc., 5500 Oakbrook Parkway, Suite 200, Norcross, GA 30093*

The goal of this presentation is to present to the environmental forensic community the use of scanning electron microscopy (SEMEDS) as a tool to investigate the particle size distribution of lead ore dust (galena) in a controlled, closed experiment and to determine the presence of lead particles on submitted items of clothing.

This presentation will impact the forensic community and/or humanity by demonstrating the techniques used for criminal forensic science which are applicable to environmental law and litigation. Attendees will gain an understanding of how particle sizing is performed utilizing an automated scanning electron microscope after dust collection from airborne particulates. Sampling procedures for examining clothing and a respirator filter will be shown for the detection of a nonwater soluble, high atomic number particulate such as lead sulfide. The size distribution supported claims by the plaintiffs that they had been exposed to respirable lead dust during their workday.

Environmental forensic microscopy is the application of microscopy to the collection, analysis and identification of small particles and the interpretation of any results as they pertain to environmental investigations and governmental regulations. In this example, the forensic environmental microscopist was asked to determine the size of fine particles available in the lead ore concentrate that could potentially become airborne and be inhaled or ingested. Items of clothing, including a respirator worn during a typical workday, were examined for the presence of fine (less than 2.5 micrometer) particles containing lead. The handling of the lead ore concentrate was simulated in a controlled, closed environment to observe and collect samples of any dust produced. The experiment was videotaped and air samples were collected to determine what the airborne particle size distribution could be.

Sections from the submitted clothing and the respirator filter were placed in a solution of water and a dispersant. Particles were separated from their respective substrates by ultrasonicating the sample sections in the water/dispersant solution for several minutes. The resulting particle suspension was deposited onto a polished carbon substrate for analysis by SEM-EDS. Examples of lead-rich particulate were documented. No quantitative measure of the particulate released from the clothing and the respirator was performed.

A glove box was prepared to simulate the handling of the lead ore concentrate. Lead ore concentrate was transferred from one container to another by scooping, pouring and sweeping within the glove box. The glove box was equipped with a clear viewing area so that the handling of the lead ore concentrate could be video taped using a focused beam of light. Particles that entered the focused beam of light were highlighted in the same way as ambient dust is highlighted by a ray of light coming through a crack in an otherwise darkened room. This effect where the fine suspended dust particles are highlighted is known as the Tyndall effect; the reflection of light by particles suspended in a transparent medium. Suspended particles were collected with air filter cassettes present in the glove box during the simulation. Particle sizing over the range of 0.5 to 10 micrometers was performed utilizing automated scanning electron microscopy on the collected air filter samples to determine the size distribution of the lead ore dust generated during the simulation.

Forensic Environmental Microscopy, Lead Ore, SEM

 ** Presenting Author*