

NASA TECH BRIEF



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Health Hazards of Ultrafine Metal and Metal Oxide Powders

Facilities that handle ultrafine metal and metal oxide powders will be interested in knowing that a comprehensive study has been made and an excellent report has been issued appraising special health hazards associated with, and the control of, ultrafine metal and metal oxide operations. Materials studied included nickel, tungsten, thorium oxide, aluminum and aluminum oxide, magnesium oxide, zirconium oxide, niobium, molybdenum, cobalt, and chromium.

The studies were conducted specifically for powder metallurgy work at the NASA Lewis Research Center, but are believed to be generally applicable to other operations generating respirable fine dusts which can be toxic. Proposed safe limits of exposure to the ultrafine dusts were based on the known toxic potential of the various materials as determined in more conventional particle size ranges and a theoretical consideration of the effects due to the smaller particle sizes.

Toxicological data available in the literature were reviewed. Tentative threshold limit values for occupational exposures to ultrafine dusts were proposed based on the assumption that all particles in an air sample might be individual particles and might exert their physiological effects as individual particles when inhaled. These suggested threshold limit values are from two to fifty times lower than current threshold limit values recommended by the American Conference of Governmental Industrial Hygienists. The proposed levels reflect the potential increase in toxicity of the materials due to their existence in the ultrafine powder state.

Experimental studies dealing with electron microscopy, particle size, aerosol generation and sampling,

degree of agglomeration, and nature of airborne contaminants including pyrophoricity and effective particle size were conducted. Results indicated that the test metal and metal oxide powders when airborne are highly agglomerated with 95 percent or more of the weight of the airborne substances represented by particle agglomerate sizes greater than 0.1 micron in diameter.

An industrial hygiene survey of laboratory work areas was made. Operations and operational practices were thoroughly reviewed. Air monitoring samples were obtained as well as urine samples from the personnel working in the area. These samples were then analyzed using chemical techniques developed or revised specifically for this project. Analytical results of the dusts collected during air sampling demonstrated that air monitoring was essential for the control of dust levels. Detailed analytical and air monitoring procedures were furnished. Based on this survey, control measures for all operations were recommended. To complete the study, medical aspects were included; a continuing industrial hygiene and surveillance program was outlined; and recommendations for future toxicological research were made.

Notes:

1. The NASA Lewis Research Center has found this study useful in establishing guidelines for the operations and handling of fine powder materials. During several years that operations with these powders have been carried out, no clinical signs of chemical toxicity have been detected in any of the operating personnel. The chemical monitoring developments have been particularly useful. Analysis has shown that the operating practices

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recommended have been effective in controlling dusts produced during various operations.

Patent status:

No patent action is contemplated by NASA.

2. Documentation is available from:

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