

PM TOXICOLOGY: LATEST FINDINGS AND EPRI'S NEW RESEARCH INITIATIVES

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Consistent with recent epidemiological studies, toxicological findings related to particulate matter (PM) suggest that PM components are not all equally harmful to health. Recent work using residual oil fly ash (ROFA), concentrated ambient particles (CAPs), and collected urban particulate have enabled the assessment of the effect of individual particle components on biological responses. Such studies have also provided valuable insight into the etiology of PM-induced health effects.

EPRI is supporting several new toxicological initiatives to investigate PM and health effects. The Toxicological Evaluation of Realistic Emissions of Source Aerosols (TERESA) Study is a comprehensive effort to evaluate the formation and toxicity of secondary particles from coal combustion. To date, the toxicity of coal combustion emissions has been examined only in terms of primary particles, but these emissions may not reflect population exposures because of atmospheric chemistry. TERESA involves on-site sampling of emissions at coal-fired power plants across the U.S., followed by dilution and introduction into a reaction chamber to simulate atmospheric chemistry. Target mass concentration output from the chamber will be in the range of 200-300 $\mu\text{g}/\text{m}^3$. Extensive characterization of emissions will be carried out, including gases (CO, CO₂, NO_x, SO₂, O₃, NH₃, hydrocarbons), particle number, size distribution, mass, and composition (including SO₄, NO₃, NH₄, strong acidity, metals, EC, OC, and organics). Aged emissions will enter an exposure chamber in a mobile toxicological laboratory, where normal rats and a rat model of myocardial infarction will be exposed to emissions and multiple toxicological endpoints will be evaluated. Particle formation, composition, and toxicity will be compared for different atmospheric conditions and dilution scenarios, providing information on the effects of atmospheric chemistry on secondary particle formation and health effects. The ultimate goal of TERESA is to compare the toxicity of secondary coal combustion and mobile source emissions to better understand the components of PM responsible for adverse health effects. The TERESA study is the first to investigate the toxicity of actual power plant emissions using mobile laboratories, and the first to incorporate secondary atmospheric chemistry. In preparation for fieldwork at the first study plant in Wisconsin, the sampling apparatus and reaction chamber are currently being developed and tested.

EPRI is also supporting a study focusing on the harvesting effect. The objective of this study, being carried out in aged mice, is to evaluate whether or not exposure to PM increases the risk of mortality in aged animals showing signs of age-dependent decay. Previous work had identified physiological variables that define homeostasis in mice, and showed that declines in heart rate and loss of circadian patterns in body temperature were the best predictors of imminent death. The current work evaluates the effect of PM on this loss of homeostasis near the end of life. Preliminary results suggest that PM exposure exacerbates age-related bradycardia, and advances the hypothesis that cardiac susceptibility to PM exposure is dependent on mechanisms of homeostatic decay associated with aging.