

Leaching and XAFS Characterization of PM_{2.5} from Combustion of U.S. Coals

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ABSTRACT

There is currently much debate about the health hazards and source attribution issues associated with ambient atmospheric particulate matter (PM), especially the fraction that is less than 2.5 μm (PM_{2.5}) in size. Much ambient PM_{2.5} is believed to originate from the gases and primary PM emitted by large-volume anthropogenic combustion processes, both stationary (e.g. fossil-fuel power-generation plants) and mobile (e.g. vehicular exhausts), and their subsequent reactions in the atmosphere. In this work, we are using various analytical methods to characterize fine particulate matter derived from the combustion of seven different coals. Three of the coals are from high-sulfur eastern U.S. bituminous coal regions, whereas the remaining four coals come from low-sulfur, western U.S. coals of various ranks. All seven coals were combusted in a down-fired refractory-lined combustion unit rated at 50kW and the fine fly-ash was separated by a cyclone with a 2.5 μm cut-point into coarse particulate matter (PM_{2.5+}) and fine particulate matter (PM_{2.5}) fractions. Elemental speciation analysis of PM samples was done by XAFS and Mössbauer spectroscopies supplemented by a leaching protocol for both important major elements (S, Ca, Fe) and various key trace elements (Cr, Zn, As, etc.). The leaching protocol consisted of both an aqueous and an acid (1N HCl) step. Whereas identification of aqueous-soluble species is of prime interest for health related issues, identification of acid-insoluble species may be of significance for source attribution.

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