Journal Articles

1. England, G.C.; Watson, J.G.; Chow, J.C.; Zielinska, B.; Chang, M.-C. O.; Loos, K.R.; Hidy, G.M. 2007. Dilution-Based Emissions Sampling from Stationary Sources: Part 1—Compact Sampler Methodology and Perfomance, *Journal of the Air and Waste Management Association* 57: 65-78. (NYSERDA will have limited reprints available. Contact emep@nyserda.org)

Abstract

This paper presents the design and performance of a compact dilution sampler (CDS) for characterizing fine particle emissions from stationary sources. The sampler is described, along with the methodology adopted for its use. Dilution sampling has a number of advantages, including source emissions that are measured under conditions simulating stack gas entry and mixing in the ambient atmosphere. This is particularly important for characterizing the semivolatile species in effluents as a part of particulate emissions. The CDS characteristics and performance are given, along with sampling methodology. The CDS was compared with a reference dilution sampler. The results indicate that the two designs are comparable for tests on gas-fired units and a diesel electrical generator. The performance data indicate that lower detection limits can be achieved relative to current regulatory methods for particulate emissions. Test data for the fine particulate matter (PM2.5) emissions are provided for comparison with U.S. Environment Protection Agency (EPA) Conditional Test Method 040 for filterable particulate matter (FPM) and the EPA Method 202 for condensable particulate matter. This comparison showed important differences between methods, depending on whether a comparison is done between in situ FPM determinations or the sum of such values with condensable PM from liquid filled impingers chilled in an ice bath. These differences are interpretable in the light of semivolatile material present in the stack effluent and, in some cases, differences in detection and quantification limits. Determination of emissions from combustors using liquid fuels can be readily achieved using 1-hr sampling with the CDS. Emissions from gasfired combustors are very low, requiring careful attention to sample volumes. Sampling volumes corresponding with 6-hr operation were used for the combined mass and broad chemical speciation. Particular attention to dilution sampler operation with clean dilution air also is essential for gas-fired sources.

2. England, G.C.; Watson, J.G.; Chow, J.C.; Zielinska, B.; Chang, M.-C. O.; Loos, K.R.; Hidy, G.M. 2007. Dilution-Based Emissions Sampling from Stationary Sources: Part 2—Gas-Fired Combustors Compared with Other Fuel-Fired Systems, *Journal of the Air and Waste Management Association* 57: 79-93. (NYSERDA will have limited reprints available. Contact emep@nyserda.org)

Abstract

With the recent focus on fine particle matter (PM2.5), new, self-consistent data are needed to characterize emissions from combustion sources. Such data are necessary for health assessment and air quality modeling. To address this need, emissions data for gas-fired combustors are presented here, using dilution sampling as the reference. The dilution method allows for collection of emitted particles under conditions simulating cooling and dilution during entry from the stack into the air. The sampling and analysis of the collected particles in the presence of precursor gases, SO2, nitrogen oxide, volatile organic compound, and NH3 is discussed; the results include data from eight gas fired units, including a dual-fuel institutional boiler and a diesel engine powered electricity generator. These data are compared with results in the literature for heavy-duty diesel vehicles and stationary sources using coal or wood as fuels. The results show that the gas-fired combustors have very low PM2.5 mass emission rates in the range of ~10^{-4} lb/million Btu (MMBTU) compared with the diesel backup generator with particle filter, with ~5 x 10^{-3} lb/MMBTU. Even higher mass emission rates are found in coal-fired systems, with rates of ~0.07 lb/MMBTU for a bag-filter-controlled pilot unit burning eastern bituminous coal. The characterization of PM2.5 chemical composition from the gas-fired units indicates that much of the measured primary particle mass in PM2.5 samples is organic or elemental carbon and, to a much less extent, sulfate. Metal emissions are quite low compared with the diesel engines and the coal- or woodfueled combustors. The metals found in the gas-fired combustor particles are low in concentration, similar in concentration to ambient particles. The interpretation of the particulate carbon emissions is complicated by the fact that an approximately equal amount of particulate carbon (mainly organic carbon) is found on the particle collector and a backup filter. It is likely that measurement artifacts, mostly adsorption of volatile organic compounds on quartz filters, are positively biasing “true” particulate carbon emission results.