



Project Summary

Comparison of Automated and Manual Sulfuric Acid Sampling Systems

Walter R. Dickson

Three sampling systems designed to measure gaseous sulfuric acid (H_2SO_4) in combustion source emissions were evaluated. The three systems are: (1) a commercially available monitor produced by Severn Science Limited (SSL) of Great Britain, (2) a prototype sulfuric acid mist monitor (SAMM) designed and constructed by the Environmental Sciences Research Laboratory (ESRL) of EPA, (3) a miniaturized acid-condensation system (MACS) for performing manual H_2SO_4 measurements, also designed by ESRL. All three systems were evaluated in the laboratory using a thermal generator to produce H_2SO_4 . Following the laboratory evaluation the three systems were evaluated at a coal-fired utility plant equipped with an electrostatic precipitator (ESP) control device. Sampling was conducted for one week at the ESP inlet and for another week at the ESP outlet. The commercially available monitor (SSL) was compact and simple to operate but gave unexplainable positive responses. The prototype monitor (SAMM) was found to be sound in measurement principle but in need of significant packaging improvements to be practical. The manual sampling system (MACS) was highly practical and simple to operate but gave lower results than the automated systems due to the equilibrium of H_2SO_4 with the surface of the probe and filter holder.

This Project Summary was developed by EPA's Environmental Sciences Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same

title (see Project Report ordering information at back).

Introduction

Due to the possible correlation between primary sulfate emissions and visibility degradation, acid rain, inhalable particulate formation, and surface materials damage, there has been increased attention on measurements of such emissions. Measurements of primary sulfate emissions from fossil-fuel-fired systems usually attempt to separate gaseous H_2SO_4 from the metal sulfate salts. As the H_2SO_4 can react with the particulate matter in such emissions, both reversibly and irreversibly, such separation can be difficult and unpredictable. Studies have shown that the measurement of gaseous H_2SO_4 is best achieved, either manually or automatically, by first separating the particles with a high-temperature quartz media.

Much of the pioneer work on gaseous H_2SO_4 measurements was performed by researchers interested in corrosion studies in Great Britain and Germany. From these early studies emerged an automated method that measures H_2SO_4 colorimetrically after reaction with Barium Chloroanilate. The gaseous H_2SO_4 is separated from particulate sulfate with a high-temperature quartz probe plug. This measurement concept has been packaged into an automatic monitor and is available commercially from Severn Science Limited (SSL) of Great Britain.

More recently developed methods have focused on the temperature-controlled condensation of the acid after particle removal. The acid is condensed in a

temperature-controlled Goksoyr-Ross type coil that avoids the collection of water and sulfur dioxide, common inter-ferents. This technique, now accepted as the manual procedure for H₂SO₄ measure-ments, was also recently incorporated into an automated monitor. This prototype Sulfuric Acid Mist Monitor (SAMM) col-lects the H₂SO₄ in a Goksoyr-Ross type coil and then measures the conductivity of the collected acid. Both the SAMM and the manual Miniature Acid Condensation System (MACS), which uses the temper-ature-controlled condensation of H₂SO₄, were developed by EPA's Environmental Sciences Research Laboratory.

Procedure

This study involved the side-by-side evaluation of the three methods (SSL, SAMM, and MACS). The evaluation included a laboratory study using a ther-mal generator to produce particle-free H₂SO₄. Over an H₂SO₄ concentration range of 2 to 20 ppm (v/v), the two automated methods (SSL and SAMM) agreed ($\pm 10\%$) with the manual method (MACS). In the SAMM, a small electro-static separator was used as an alterna-tive to filter media.

The three sampling systems also were field-tested at a coal-fired utility plant. A full week of sampling at an electrostatic precipitator (ESP) inlet resulted in average H₂SO₄ concentrations of 12, 12, and 10 ppm using the SSL, SAMM, and MACS, respectively. Sampling at the ESP outlet during the second week gave average concentrations of 4, 4, and 3 ppm for the SSL, SAMM, and MACS, respectively.

Summary of Results

1. During field evaluation, the commer-cially available SSL monitor operated well and was compact and simple to

operate. The average results agreed well with results from the SAMM. The instrument did give transient positive responses that did not agree with responses from the other two methods, could not be explained, and should be investigated further.

2. The SAMM was found to be extremely cumbersome in its prototype form and in need of major design changes. The monitor produced results that agreed with the SSL results. While the measurement principle of the prototype was acceptable, the system appeared to offer no advantages over the SSL monitor.

3. The MACS operated well and was highly portable and easy to use. Its results were consistently low when compared to results from the two monitors. These low results were attributed to the retention of some of the H₂SO₄ in the MACS probe. Such probe losses are not encountered with the monitors due to the estab-lishment of an equilibrium between the acid and the surface areas of those systems. For sources with low H₂SO₄, the MACS requires a more sensitive SO₄²⁻ determination than the conventional Barium-Thorin proce-dure.

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The complete report, entitled "Comparison of Automated and Manual Sulfuric Acid Sampling Systems," (Order No. PB 83-144 840; Cost: \$10.00, subject to change) will be available only from:

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