



MSE Technology Applications, Inc.



Thermal System Offgas Treatment Test Bed

- Full-service testing of innovative air pollution control technologies
- On-site engineering support staff and analytical capabilities
- Proven experience demonstrating innovative particulate, NO_x, mercury, and dioxin control technologies
- Capable of accessing industrial emission problems and providing responsible solutions

Technologies for the Future, Responsible Solutions for Today

MSE Technology Applications, Inc. (MSE) is a diversified technical firm with over 25 years experience providing professional support services to the U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), other government agencies, and non-government clients. Headquartered in Butte, Montana, MSE owns and operates the Mike Mansfield Advanced Technology Center (MMATC) situated on a 53-acre site (Figure 1). This nationally known, premier facility provides equipment and support systems to test innovative air pollution control (APC) equipment from bench-scale through engineering- or pilot-scale systems. The MMATC is a permitted small emission source through the State of Montana. Our environmental coordinator is experienced in obtaining permit modifications to support a variety of test programs at the facility.



Figure 1. Mike Mansfield Advanced Technology Center.

Under contract with the DOE-Mixed Waste Focus Area, MSE started the Controlled Emissions Demonstration (CED) Program in the fall of 1994 and continued through 2002. The mission of this multiyear/multitask project was to demonstrate innovative APC technologies to assist the four operational DOE incinerators in complying with the newly promulgated Maximum Achievable Control Technology standards for Hazardous Waste Incinerators. Since the successful conclusion of the CED Program, MSE has maintained the offgas treatment test bed (Figure 2) to offer potential customers a means to test and advance the development of APC technologies.

SERVICES AND CAPABILITIES

Staffing: MSE is committed to working with its customers to provide high quality and cost competitive support to meet the client's needs and requirements. Our engineering staff is available to help develop an experimental design; modify a test bed configuration; install equipment; and execute testing, sampling, and data reduction. At the conclusion of the test campaign, MSE can provide a written evaluation of the technology and recommendations for advancement or provide the raw data, allowing the customer to evaluate the results.

Equipment: As a result of the CED Program, MSE has a full-scale offgas treatment system and a quarter-scale test bed available to demonstrate innovative APC technologies. The mass flow rate capacity of the main offgas treatment system is approximately 20 lb_m/min.

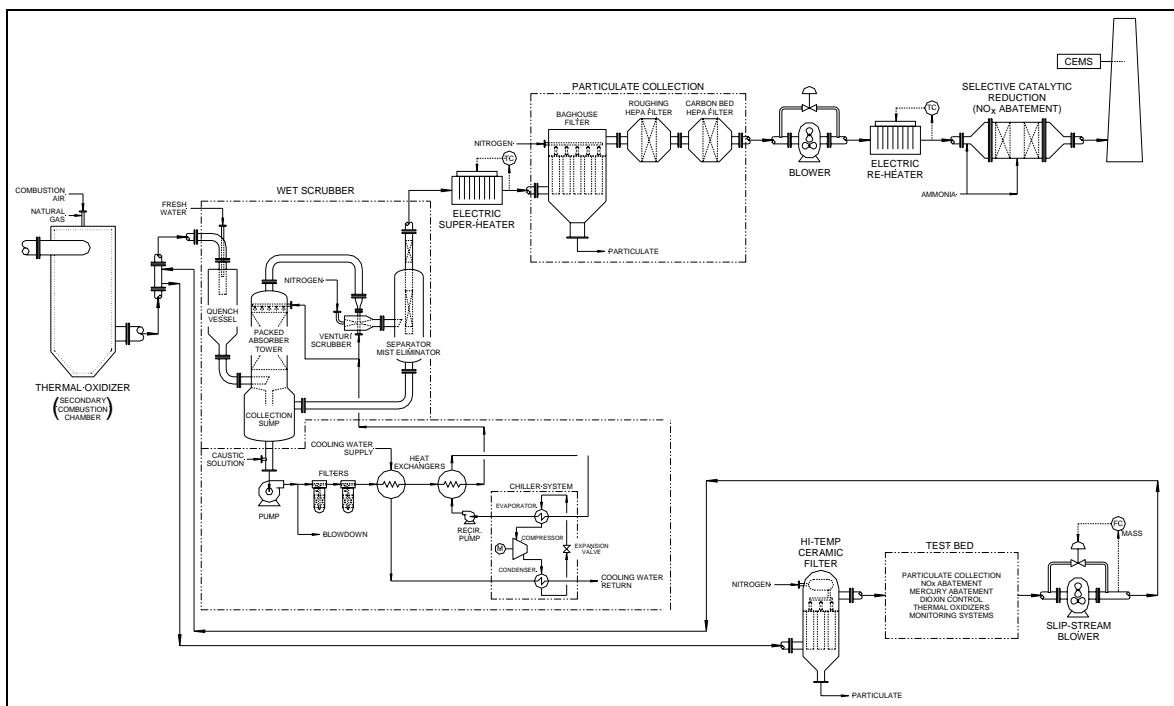


Figure 2. Offgas treatment test bed.

Both systems can be easily modified to accommodate the testing of a variety of APC technologies and emission monitoring equipment. By simulating emission conditions and accurately assessing system performance, MSE can provide the information and field data with which to make informed decisions without the investment of large capital costs and facility downtime.

Sampling: To determine the emission reduction capabilities, and operating efficiencies of the APC technologies being tested at the MMATC, inlet and outlet offgas samples are collected and analyzed for targeted hazardous air pollutants. Typical sampling methods and protocol varies from instrumental analysis methods to EPA manual sampling methods. In May 1998, MSE trained its field staff to collect manual samples using established EPA methods. By using this in-house capability, MSE can reduce project costs and apply the savings to the generation of test data. EPA sampling methods, which were used during past projects, include Method 5, Determination of Particulate Emissions from Stationary Sources; Method 12, Determination of Inorganic Lead Emissions from Station Sources; Method 18, Measurement of Gaseous Organic Compounds by Gas Chromatography; Method 23, Determination of Polychlorinated dibenzo-p-dioxins and Polychlorinated dibenzofurans; Method 29, Determination of Metal Emissions from Station Sources; and Method 101A, Determination of Mercury Emissions from Stationary Sources (see Figure 3).



Figure 3. MSE personnel performing stack sampling.

Analytical: After sample collection, MSE recovers the various liquid solutions from the sample trains and sends them for quantification by certified analytical laboratories. To maintain high quality analytical results, MSE periodically audits the individual laboratories to verify that EPA protocol is being followed and that the analytical equipment is in proper working condition.

To verify system performance from a qualitative perspective, MSE has three gas chromatography (GC) instruments equipped with various detectors including two mass spectroscopy (MS) units. During past projects, the GC/MS units have provided both qualitative and quantitative results on the destruction efficiencies for principle organic constituents, primarily chlorinated solvents. The GC/MS units may also be operated in scanning mode to provide a qualitative assessment of the organic constituents within the flue gas. In addition to the GC/MS units, MSE also owns an automated column cleanup unit, a thermal gravimetric analyzer, and a differential scanning calorimetry unit.

PREVIOUS CUSTOMERS AND TESTING PROJECTS

Particulate Control: Working with the DOE-MWFA, one of the concerns of hazardous waste incinerator operators was to confine radiological contamination upstream of the wet scrubber and any downstream APC devices. To meet this objective, MSE and the DOE-MWFA identified numerous vendors that manufactured high temperature ceramic and high-efficiency particulate air-grade filters. To evaluate the performance of these units, MSE modified the slipstream test bed to provide a greater than 1,600 °F gas stream to the test filters. By collecting upstream and downstream gas samples (in accordance with EPA Method 5), the particulate removal efficiency of the individual filters could be quantified.

NO_x Abatement: Although oxides of nitrogen (NO_x) abatement technologies are relatively standardized, MSE has evaluated a multicomponent unit designed to reduce high concentrations of NO_x (30,000 to 50,000 ppm) to mandated compliance levels (>200 ppm). The technology—developed by John Zink, Inc.—uses stage combustion to control NO_x emissions. Major challenges on the project included designing an NO_x formation system and accurately quantifying the NO_x concentrations upstream and downstream of the test unit. To measure the high NO_x emissions, MSE designed, fabricated, and commissioned a dual-stage dilution probe that met the sampling requirements for the project. Work in this field led to follow-on projects to assess how the system impacted mercury speciation and if it could reduce sulfur trioxide (SO₃) emissions.

Other technologies demonstrated for NO_x abatement included selective catalytic reactors technologies that used nonhazardous catalysts. Under this project, MSE developed and commissioned a multiport sampling probe to measure the NO_x concentrations at various stages within the catalyst system. MSE also evaluated a pulse-corona discharge system for NO_x abatement.

Mercury Abatement: Recent legislation is proposing limitations on mercury emissions from hazardous waste incinerators and coal-fired generators. The current state-of-the-art technology for reducing mercury emissions is either to inject activated carbon into the flue gas or pass the gas through a thin bed containing layers of activated carbon. As the gas mixes with the carbon, mercury is adsorbed by the carbon and removed from the gas stream. Other novel sorbents, such as gold and carbon impregnated onto a substrate, perform similarly. In the initial test for DOE, MSE evaluated three adsorbent technologies and developed the expertise to chemically oxidize elemental mercury for capture by wet scrubbing systems.

Recently, MSE has teamed with Croll-Reynolds Clean Air Technologies to develop and market an innovative mercury reduction system that uses a mercury selective reagent gas to oxidize elemental mercury vapor. In the oxidized state, mercury takes the form of fine particulate that can be removed from the gas stream using a wet-electrostatic precipitator (ESP). This patented oxidization process uses the corona field generated by the wet ESP to help enhance the mercury oxidation process. MSE completed the initial proof-of-concept testing and quantitative bench-scale testing on demonstration test cell. Based on the preliminary results, MSE believes this innovative technology is capable of removing 80% to 90% of the total mercury present at the inlet to the precipitator.

Dioxin Control: One of the problems associated with burning chlorinated wastestreams is the formation of dioxin and furan compounds. Typically, these toxic compounds are formed by slowly cooling the offgas in the presence of a catalyst. To prevent the formation of dioxin compounds, MSE has investigated hot filtration and quenching systems located immediately downstream of the thermal oxidizer.

Thermal Oxidizers: An integral part of a typical hazardous waste incineration process is a thermal oxidization unit to reduce emissions of principle organic constituents (POCs). Typically, these units use natural gas or fuel oil to heat the inlet gas stream to > 2,000 °F

and provide a gas residence time of 2 seconds. The additional mass added by the fossil fuel source increases the volumetric flow rate of the offgas treatment system, which affects capital and operational costs of the facility. To minimize the increase in volumetric flow associated with conventional fossil fuel thermal oxidizers, MSE tested various flameless or low-flow thermal oxidizers that used electrical heaters to increase the offgas temperature to >2,000 °F and maintain the temperature for 2 seconds. To help the oxidation of POCs, these oxidizers used oxygen enrichment to oxidize the POCs and minimize the total volumetric flow.

Although the application of low-flow thermal oxidizers have limitations with respect to hazardous waste incineration, their application for treating small emission sources (i.e., applications to industrial paint booths) may provide cost savings and help secure emission permits.

Monitoring Systems: In addition to testing and evaluating APC technologies, MSE has also tested and evaluated innovative emission monitoring systems. Past applications included on-line continuous monitors for metals, organics, dioxins, and mercury.

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