Stationary Power

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The EMS Energy Institute?s Stationary Power Program builds on the Institute?s strong foundation in the study of fossil and biomass fuels and their utilization to address issues that concern those involved in the energy community: environmentally responsible development and utilization of our energy resources, efficient utilization of existing energy resources, and development of alternative fuels for the future.

We recognize that the energy community is extremely diversified and dynamic, consisting of private industries, governmental agencies, and utilities whose interests range from fuel development in the front end to flue gas cleanup at the backend. The Institute responds to the varied interests and goals of its customers by providing support in identifying and solving existing problems while providing the expertise and facilities to evaluate new technologies and fuels.

Research

Fuel Preparation and Characterization

The Institute has on site a wide variety of pilot- and demonstration-scale coal preparation and cleaning equipment as well as bench-scale analytical equipment to evaluate the composition of solid and liquid fuels. The effects of various cleaning and preparation techniques on fuel quality, handleability, and combustion can be determined. The Institute has the capability to characterize selective physical properties and complete chemical composition of solid and liquid fuels using traditional and advanced methodologies. Fuels include:

- Coals of all rank
- Biomass of all types
- Petroleum-based fuels
- Alternative fuels, such as coal-water slurry fuels, engineered fuels, and emulsions

Reagent/ Sorbent Characterization and Evaluation

The Institute has the capability to characterize and evaluate limestones as reagents in wet flue gas desulfurization systems and as sorbents in fluidized bed combustors for reducing SO_2

emissions. The Institute has particular expertise in determining the qualities of limestones that make them attractive as a reagents/sorbents in a given system as well as the ability to evaluate limestones in a variety of on-site bench- to pilot-scale units.

Combustion Systems Development

The Institute has experience in all aspects of combustion systems from fuel storage and handling to the burner and the stack as well as total system integration. The capabilities of the Institute allow for technology development and evaluation on the demonstration scale. Specific areas of expertise include:

- System integration/ burner development
- Pollution control technologies
- Boiler system retrofits

Combustion Research

Determining combustion behavior is an integral part of evaluating a fuel, especially when developing new alternative fuels. The EMS Energy Institute has years of experience in conducting combustion tests firing fossil, biomass, and alternative fuels in conjunction with other fuels. Specific areas of research include:

- **Fluidized-bed combustion** - The Institute assists the fluidized-bed combustion industry by evaluating sorbent behavior for SO_2 capture, determining the influence of fuel properties on combustion performance and sulfur capture, assisting in materials handling issues, working with operators and regulatory agencies when developing new policies, improving combustor operation by reducing bed agglomeration, and evaluating combustion performance and emissions of alternative fuels.
- **Pulverized coal combustion** - The Institute assists the pulverized coal combustion industry by evaluating fuels for combustion and emissions performance, determining kinetic parameters for coal pyrolysis/combustion for pollution control and burner design, and assessing deposition and boiler tube erosion.
- **Coal-water slurry fuel combustion** - The Institute's CWSF research and development experience focuses on establishing acceptable formulation and preparation procedures and obtaining satisfactory combustion performance in fuel oil-designed industrial boilers, and during cofiring with pulverized coal in utility boilers. Fundamental, pilot and demonstration scale activities have provided detailed understanding of the chemical and physical phenomena involved in CWSF rheology and stability, atomization and combustion, mineral matter transformations, atomizer tip and boiler tube erosion, ash settling and deposition, boiler derating, and emissions.

Biomass/opportunity fuels

The Institute has experience in evaluating biomass/opportunity fuels/carbon neutral feedstocks as boiler and gasifier fuels, including animal fats and proteins, vegetable oils, animal tissue,

manure/litter, grasses/crop residues, wastes wood products, food processing wastes, waste seeds, refuse-derived fuels, sewage sludge, and biomass pyrolysis products.

Emissions Characterization and Reduction

The Institute?s stationary combustion emissions program encompasses the formation and control of pollutants from all types of boilers, firing a variety of fuels, and using multiple emissions control options. Areas of research include fluidized-bed, watertube, firetube, and stoker boiler systems; fossil and alternative fuels and waste products; wet and dry scrubbers; fabric and ceramic filters; low-NO_x burner technology; selective and non-selective catalytic reduction; and CO_2 capture technologies. Pollutants include SO_2, NO_x, fine particulate matter, trace metals including mercury, VOCs, and dioxin/furan TEQs.

Gasification

Gasification studies are currently being performed in a circulating fluidized-bed gasifier and a laboratory-scale fluidized-bed reaction system (both atmospheric pressure) capable of gasifying a variety of traditional fossil fuels as well as biomass materials. The gasification systems are used to assess fuel and operating conditions on gas composition and yields and the performance of co-gasification of coal and biomass. In addition, a high-temperature entrained flow reactor is used to study pyrolysis and gasification kinetics, mineral matter transformations, and interactions of coal and biomass ash with refractory materials; and an issued batch fluidized bed reactor tests limestone samples for sulfur capture from power plant scrubber applications.

Stationary power systems

Stationary power systems research is focused on fuel characterization coupled with the utilization and emissions of these fuels in industrial and utility boilers. Research is conducted using a broad array of reactors, combustors, and boilers fully equipped with state-of-the-art-emission monitoring technologies. Stationary power systems research includes:

- Boiler hardware development, integration, and optimization
- Boiler emissions, characterization, and control technologies
- Evaluation of sorbents and technologies for SO_2 and acid gas control
- Fundamental fuel characterization of pyrolysis and combustion kinetics
- Evaluation of traditional, alternative, and renewable fuels
- Fine particulate/mercury emissions control technologies
- Inorganic mineral matter transformations
- Oxy-fuel and oxygen-enhanced combustion
- Fundamental and applied gasification studies