

Mercury Research Program

The CANMET Energy Technology Centre's mercury research program is aimed at understanding the mechanisms behind speciation and release of mercury to the environment and introducing innovative approaches to measure and control mercury emissions from combustion sources. By developing novel, cost-effective emissions control and measurement techniques, the program helps industry meet current and anticipated environmental regulations. CETC provides expertise, state-of-the-art facilities and testing services to help our clients develop and select either mercury-specific or integrated emissions control technologies that best fit their current and future operational needs.



Pilot-Scale Mercury Speciation Sampling & Testing

Program Elements

Industrial users of fossil fuels are facing a constant challenge to achieve better fuel efficiency with changing fuel quality, while also having to comply with more stringent environmental regulations.

CETC's mercury research program covers a wide range of technology issues. This comprehensive R&D program has been designed to assist clients in identifying novel, efficient and cost-effective technology solutions to measure, monitor and control mercury emissions. Other trace element emissions and pollutants are also covered here and in other CETC programs.

R&D Areas

Subject areas that are studied under this program include, but are not limited to:

- improving efficiency of conventional air pollution control devices for mercury removal;
- identifying new mercury sorbents and effective oxidizing catalysts;
- developing novel mercury control processes;
- designing measurement systems for on-line, near real-time determination of mercury species; and
- studying combustion kinetics and mercury speciation mechanisms.

Mercury Emissions and Regulations

It is generally accepted that emissions from anthropogenic (human) activities contribute significantly to the total mercury being released to the environment. Recent estimates of mercury emissions from human activities in Canada total approximately 11 tonnes per year, 35% to 40% of which originate from combustion sources. U.S. estimates exceed 150 tonnes per year and 86%, respectively. The major industrial sources of mercury emissions in North America include utility boilers, incinerators and steel manufacturing. Among these, fossil-fuel power plants are the largest point source of mercury emissions.

The U.S. Environmental Protection Agency has recently decided to regulate emissions of mercury from coal- and oil-fired power plants. Also, Environment Canada has initiated a “Strategic Option Process” to examine the need for the control and containment of several trace elements, including mercury.

CETC has an unrivaled window into these regulatory activities. Our scientists are consulted by, and participate with national and international agencies in formulating these regulations. Therefore, our technical team can design experiments that anticipate the direction and scope of forthcoming environmental regulations.

Current Activities

CETC has a wide range of ongoing mercury-related research activities, including the development of:



Dry Sorbent Injection

- several mercury conversion and capture processes that incorporate innovative strategies employed throughout the combustion system;
- new strategies for removal of mercury and other pollutants using condensing heat exchangers; and
- an integrated source dilution sampling and measurement system for on-line, near real-time determination of all mercury species.

New concepts and processes to monitor and control mercury emissions can be tested using our bench- and pilot-scale facilities. These include:

- experiments with different sorbents and oxidizing catalysts;
- experiments with simulated coal flue gas; and
- experiments with actual coal flue gas.

These tests may involve burning different fuels and blends, injecting gases for process simulation purposes, adding activated carbon or sorbents, spiking the flue gas with mercury, ash injection and re-burn, sampling on-line or using standard wet chemistry methods for mercury speciation.

Supporting Resources and Test Facilities

Resources

CETC’s team of scientists and engineers has broad experience to support mercury-related research projects. Our team can help you respond to mercury emission-related RFPs by designing experiments, selecting equipment, testing, sampling, analyzing data and reporting and to serve as technical consultants in support thereof.

Combustion Facilities

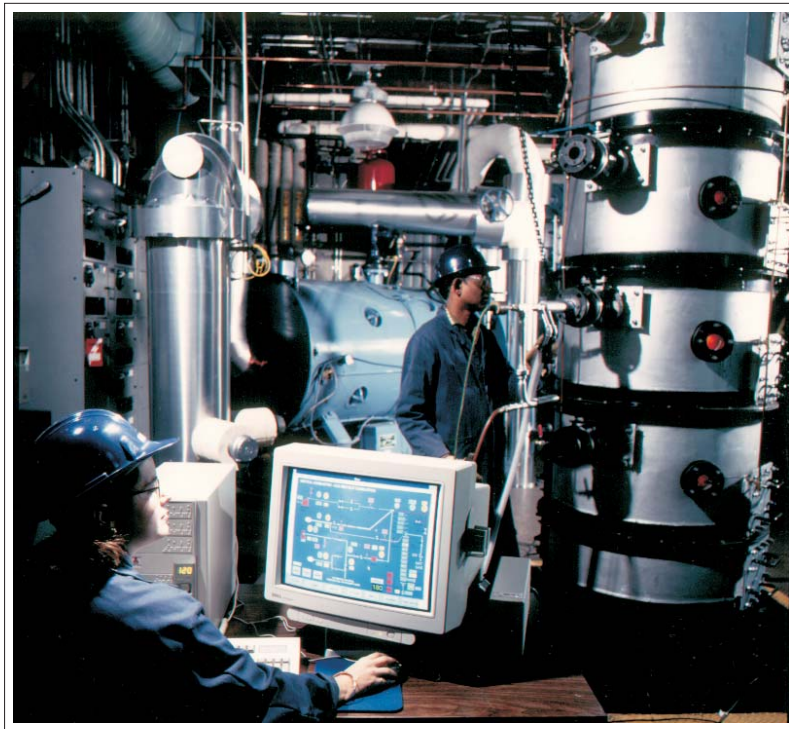
CETC offers a range of world-class and unique research facilities to help clients evaluate and develop novel technology solutions for mercury emissions from combustion systems.

CETC's pilot-scale facilities include:

- a flame research tunnel furnace, designed for a thermal input of 0.7 MW (2.4 million BTU/hr), that can be fired by coal, oil, natural gas, or other specialty fuels and burners;
- a 0.4 MW (1.4 million BTU/hr) pilot-scale research boiler. Solid, liquid, or gaseous fuels can be fired in this boiler using a variety of burners;
- a 0.3 MW (1 million BTU/hr) vertical combustor, designed to burn coal, natural gas or oil and other fuels;
- a circulating fluidized-bed combustion unit with a bed area of about 0.1 m². The unit can fire solid and liquid fuels, with and without sorbents for capturing sulphur and other compounds;
- a bubbling bed combustion unit to study the fate of trace metals in feedstock; and,
- a 4.3 meter long rotary kiln furnace that can be fired with natural gas, fuel-oil or a combination of both. The maximum input of the furnace is about 1 MW (3.4 million BTU/hr).

The above facilities allow continuous monitoring of heat flux, temperature and gas flow rate, as well as withdrawal of entrained fly ash for analysis and on-line gas analysis at all critical points. Moreover, these combustion units are equipped with down-stream emission control units, such as wet scrubbers and electrostatic precipitators.

Other auxiliary devices that are available and can be used for mercury R&D projects include



Vertical Combustor

mercury generation and injection devices, gas injection systems for simulating flue gases, dry sorbent injection units and spray injection systems.

Analytical Laboratories

CETC's analytical and characterization laboratories use state-of-the-art equipment and techniques to support the mercury and other combustion-related research programs.

Our analytical laboratory is capable of performing standard or non-routine, mercury-specific analytic tests and analyses. These include, but are not limited to:

- Ontario Hydro Method for the measurement of speciated mercury emissions;
- analysis of recovered absorbing solutions collected from sampling train using a Tekran 2600 CVAFS mercury analysis system;

- analysis of particle-bound mercury collected from sampling train and the determination of mercury in coal and ash deposits for mass balance purposes using a Milestone DMA 80 direct mercury analyzer;
- analysis of hydrogen halides and halogens emissions (Method 26) using a Dionex DX 500 ion chromatograph system; and
- other applicable fuel-related tests such as: proximate, ultimate, calorific value, major, minor, and trace metals, fluorine and chlorine in coals and ash deposits.

CETC's Characterization Laboratory provides clients with physical, chemical, elemental, spectroscopic, chromatographic, and molecular characterization data and their interpretation.

Our laboratories also have external agreements for complementary analytical techniques not listed above.

Information about CETC

The CANMET Energy Technology Centre forms part of the Energy Sector's Energy Technology Branch, the key science and technology arm of Natural Resources Canada. CETC works with clients to develop and deploy economic energy technologies with marked environmental impact.

We help assemble research consortia and facilitate strategic partnerships between technology developers, suppliers and users. Our partners include domestic and foreign private sector companies and utilities, other federal and municipal departments, universities and internationally recognized research organizations.

CETC is committed to working collaboratively with your organization to address technical challenges in an effective, timely and price-conscious manner. This commitment is fueled by our energetic workforce, who think creatively, set bold objectives and exceed your expectations.

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