

LEHIGH ENERGY UPDATE



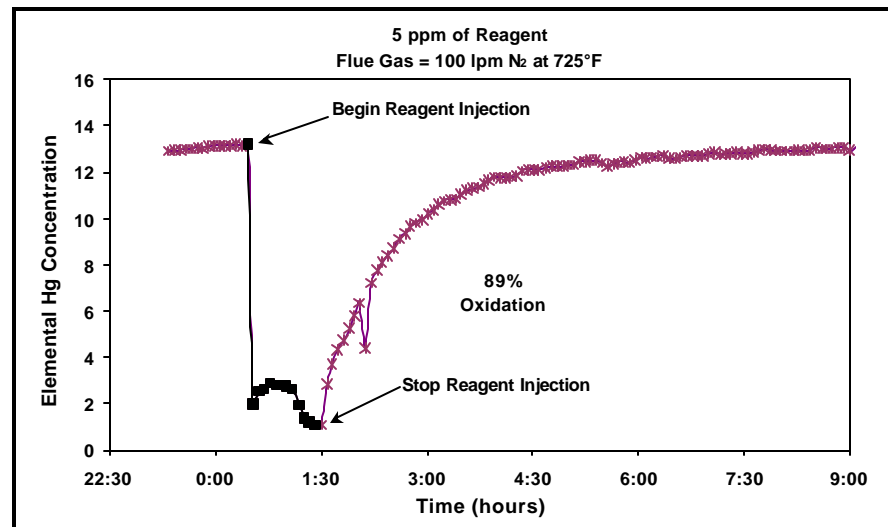
January 2004, Vol. 22 (1)

CENTER RESEARCH PROJECTS FOCUS ON MERCURY CAPTURE

EPA is in the process of issuing rules which will specify the extent to which Hg from coal fired boilers must be controlled and the procedures which power generation companies will be required to follow. Some states will very likely impose even more stringent standards than those being contemplated by EPA. These new regulations will place a tremendous burden on the utility industry unless cost effective, commercially available methods for mercury control, which are effective for the wide range of boiler types and coals that are used in the U.S., can be developed over the next few years.

Research results published by EPRI and DOE show that mercury capture in some units which burn eastern bituminous coals can be handled through techniques such as activated carbon injection. Some boiler back-end equipment combinations are also proving to be effective at mercury capture with some eastern coals. For example, high levels of mercury capture have been achieved at some units equipped with SCR reactors for NO_x control and wet SO₂ scrubbers. However, field test results also show that, due to low chlorine content, units fired with lignite and sub-bituminous coals will have a relatively difficult time achieving high levels of mercury removal.

The Energy Research Center is carrying out research on methods to increase mercury collection efficiency and to reduce the cost of



Laboratory test data show strong effect of gaseous reagent on oxidation of elemental mercury.

controlling mercury. These research projects, under the direction of Drs. Harvey Stenger, Carlos Romero, Edward Levy and Christopher Kiely, focus on different aspects of mercury control technology.

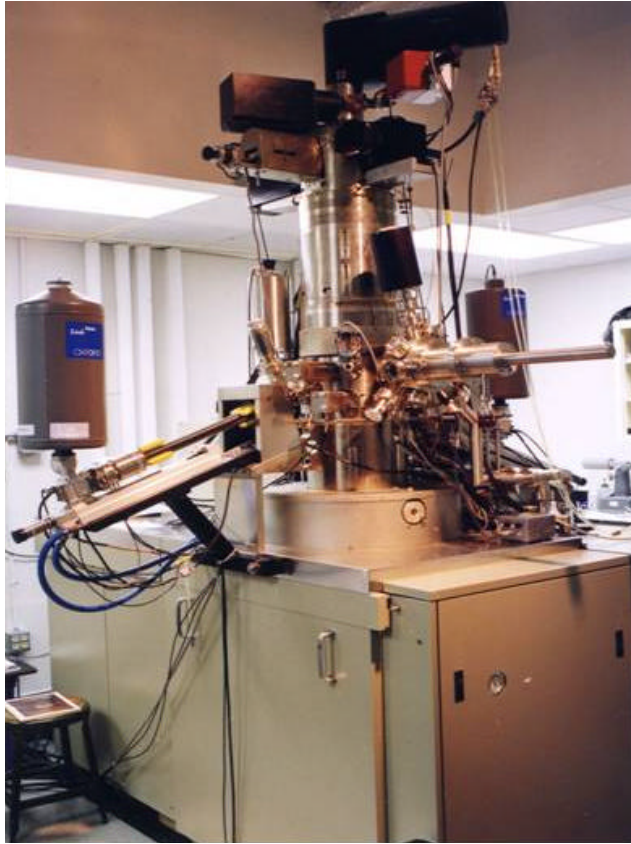
Stenger's research, carried out in collaboration with Foster Wheeler, is searching for cost effective chemical reagents and sorbents, which when injected into the boiler, will make the mercury easier (and less expensive) to capture.

Stenger notes, "The reagents we are testing are intended to convert the gaseous elemental mercury into mercury compounds, which are easier to remove from the flue gas. Our research is also searching for alternatives to activated carbon sorbents. The mineral-based sorbents we plan to test are potentially lower in

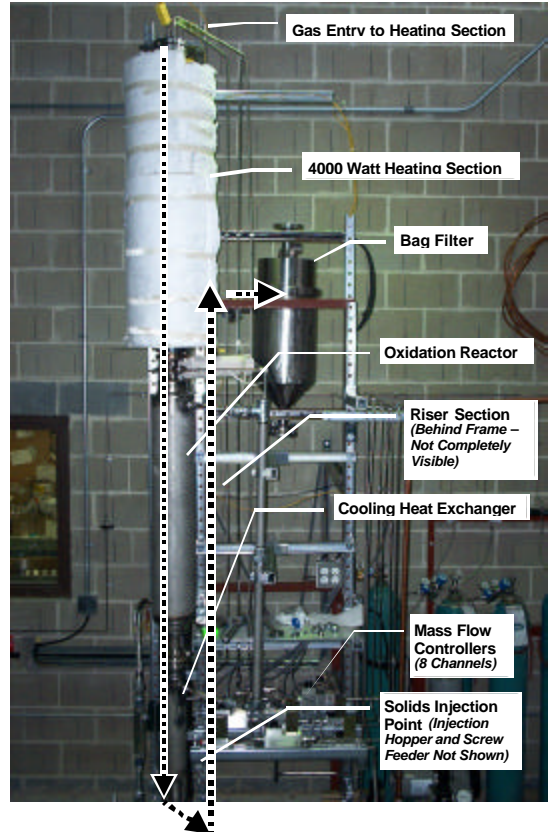
cost than activated carbon. They would also make it possible to avoid creating the high carbon levels in fly ash which often occur with use of activated carbon."

Stenger's mercury capture experiments are being carried out in a newly constructed laboratory test facility. Located at the Energy Research Center, the facility simulates the flue gas temperatures and compositions encountered in a coal fired power plant.

Romero adds, "My research program, supported by a consortium of utility companies, DOE, and the Pennsylvania Infrastructure Technology Alliance, is examining the potential to enhance mercury capture through the use of boiler tuning methods. By adjusting boiler control settings, we believe it should



This Scanning Transmission Electron Microscope is one of several state-of-the-art instruments which is being used to examine activated carbon and fly ash.



Laboratory mercury test facility for studying reagents and sorbents for enhancing mercury capture. Dashed arrows show gas path through the apparatus.

be possible to establish conditions in the boiler which are more conducive for mercury capture. These theories are supported by computer simulations my team of investigators has carried out.

We are planning field tests for January and February 2004 at two coal-fired boilers to test the concept and gather data on the enhancements to mercury capture which occur. An important aspect of these tests will be to identify other changes and tradeoffs which occur as a result of the changes to boiler operating conditions.”

Levy's and Kiely's research program, supported by DOE, the Pennsylvania Infrastructure Technology Alliance, and industry is exploring the feasibility of processing used activated carbon so it can be

regenerated and reused in a boiler for additional mercury capture. The approach they are taking uses fluidized beds for processing the activated carbon and experiments are presently under way in the Center's Fluidized Bed Laboratory.

Kiely adds, “A second part of the our project involves use of the University's Electron Microscopy Laboratory to examine fly ash from coal fired power plants. This is being done in an effort to determine what portions of the ash are most effective in capturing mercury. Some researchers believe that mercury is most readily captured by the unburned carbon in fly ash. The microscopy studies are also examining fly ash which has passed through SCR reactors to determine if the SCR causes changes in the

surface chemistry of the ash which then leads to enhanced mercury capture.” #

For more information either on SO₃ formation, air preheater fouling or mercury capture research, please contact John Sale at (610) 758-4545 or by E-mail at jws3@lehigh.edu.

RESEARCHERS' PROFILES

- Dr. Christopher Kiely has a Ph.D. in Physics and is Professor of Materials Science and Engineering. He is also the Director of the Nanocharacterization Laboratory within the Center for Advanced Materials and Nanotechnology. Kiely specializes in the characterization of nanomaterials by electron microscopy.
- Dr. Edward Levy is Professor of Mechanical Engineering and Mechanics and Director of the Energy Research Center. His research deals with emissions control and performance improvement in coal-fired power plants.
- Dr. Carlos Romero is an Associate Director of the Energy Research Center with a Ph.D. in Mechanical Engineering. He is a specialist in combustion kinetics and emissions control.
- Dr. Nenad Sarunac has a Ph.D. in Mechanical Engineering and is an Associate Director of the Energy Research Center. His research focuses on power plant heat rate improvement, emissions control and process optimization.
- Dr. Harvey Stenger has a Ph.D. and BS in Chemical Engineering and has been a Professor at Lehigh University for 20 years. His research interests involve chemical reacting systems including mercury removal from flue gas, hydrogen production from hydrocarbons, fuel cell design optimization, and selective catalytic reduction.