R & D facts

U.S. Department of Energy
Office of Fossil Energy
National Energy Technology Laboratory

Environmental Science

04/2007

Trace Metal Capture Laboratories

Description

Onsite trace metal capture efforts focus on developing low-cost and effective mercury removal solutions to meet the goal of capturing more than 90 percent of mercury emissions from U.S. coal-fired plants by 2010. NETL laboratories are designed to support integrated, multi-task modeling and experimentation. Numerous sorbents have been examined for mercury and arsenic capture in simulated coal-derived gases. This research directly supports national initiatives in the 2005 Clean Air Mercury Rule and Energy Policy Act, as well as both the 2002 Global Climate Change and Clear Skies Initiatives. Three NETL trace metal capture patents—conceived and studied at in-house laboratories—are now licensed and being commercially demonstrated.

PG sorbents for trace metal capture from coal-derived gases represents the most recent collaborative research and development effort in this area, resulting in a Cooperative Research and Development Agreement (CRADA) and license between NETL and Johnson Matthey, Plc. Specific sorbents remove mercury, arsenic, and selenium from coal-derived fuel gases at high temperatures. Coal gasification uses abundant coal reserves while generating environmentally-friendly power.

The Thief process is a cost-effective alternative to activated carbon injection (ACI) for mercury removal from flue gas. Activated carbons are expensive, ranging from $500 to $3,000/ton compared to $90-to-$200/ton for Thief carbon sorbents. Laboratory, bench, pilot-scale, and field tests demonstrate that carbon sorbents are comparable to activated carbons for mercury capture. The Thief process has been licensed to Mobotec USA.

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The Photochemical Oxidation (PCO) process introduces a 254-nm ultraviolet light into the flue gas, leading to oxidation of mercury and facilitated mercury removal in a downstream SO_2 scrubber, wet electrostatic precipitator (WESP), or baghouse (fabric filter). Field tests demonstrate greater than 90 percent of oxidation and capture achieved in simulated flue gas streams contain elemental mercury. NETL researchers received the 2005 Award for Excellence in Technology Transfer from the Federal Laboratory Consortium for the PCO method, which has been licensed to Powerspan Corp.

Onsite facilities include a laboratory-scale and bench-scale packed-bed reactor for screening sorbents, catalysts, and photochemical techniques for trace metal control of coal-derived gas streams.

Packed-bed reactors:

- Lab-scale reactor outer diameter ¼-inch-by-20-inch quartz tube with flow rates between 60 and 120 ml/min
- Bench-scale reactor outer diameter 1-inch-by-20-inch quartz tube with flow rates between 2 and 10 l/min
- Gases containing mercury include simulated flue gases, simulated fuel gases, or slipstreams of flue gas from an onsite coal combustion facility.
- Mercury continuous emissions monitors (CEMs) measure mercury in the gas phase
- Cold vapor atomic absorption spectrophotometer analyzes spent sorbent
- Operating temperature: ambient to 750 °F