EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Success Story

EPRI, We Energies Test Technologies to Reduce Mercury and Selenium in Wastewater

Pilot feasibility testing of selenium and mercury removal. We Energies and other power companies are looking at technological solutions to reducing contaminants in FGD wastewater.

In response to a permit condition authorizing discharges associated with a new flue gas desulfurization (FGD) system at its Pleasant Prairie Power Plant, We Energies was asked to investigate the efficacy and cost-effectiveness of advanced wastewater treatment technologies that might be capable of lowering mercury levels from the FGD discharge. We Energies knew that reducing levels of mercury, selenium, and other contaminants in FGD wastewater was also of interest to other companies within the electricity sector. The company turned to EPRI to organize a multi-company collaborative effort to test several technologies. EPRI identified a number of possibilities and then worked with the project's 10 participating companies to choose the most promising technologies for short-term feasibility tests. Three of the tests conducted at the Pleasant Prairie plant showed favorable results—two for mercury level reductions and one for selenium level reductions. We Energies is confident that the project's scientifically sound results will serve as a baseline for further R&D and that the research has brought the industry closer to effective solutions.

We Energies Engages EPRI on a Multi-Company Research Project

Flue gas desulfurization (FGD) systems can remove up to 99% of sulfur dioxide emissions from the flue gas of coal-fueled power plants. However, in addition to removing the target substance SO_2, there are a number of other substances, including metals that are transferred to the circulating limestone slurry in the FGD system. To control the water chemistry of the circulating limestone slurry, the FGD system has a discharge (often referred to as "FGD blowdown") that is routed to a wastewater treatment facility. The FGD system wastewater may contain mercury, selenium and other trace elements. To protect aquatic species, the wastewater will require treatment before it is discharged into lakes and rivers.

"EPRI has the expertise and ability to coordinate multiple power companies as well as technology developers to collaborate and share resources. EPRI lends credibility to the results; they're well respected by the regulators and throughout the industry."

~ Elizabeth Hellman, Principal Environmental Engineer, We Energies

Although there are no federal limits on mercury and selenium for the electricity industry, the U.S. Environmental Protection Agency plans to revise its water discharge limits (effluent guidelines) for power plants, and the revisions may include such limits. Many states already regulate selenium and mercury discharges through water quality standards. For example, states bordering the Great Lakes and the Ohio River have set goals for mercury of between 1.3 and 12 parts per trillion (ppt). To date, however, no one has demonstrated a technology that can reliably reduce concentrations to these levels.

Challenge

We Energies needed to identify and evaluate technologies that offered potential to reduce mercury and selenium levels in FGD wastewater to very low levels.

Solution

We Energies approached EPRI to develop a collaborative project involving a number of power companies to perform feasibility tests on the most promising technologies for mercury and selenium reductions.

Results and Benefits

The project provided accurate, credible data on the state of several potentially effective technologies, data that will be useful in discussions with regulators and for future technology development.

One of the first EPRI members to face these issues directly was We Energies that commenced operation of an FGD system at its Pleasant Prairie Power Plant in Wisconsin in 2006. As part of the permit to install the FGD system, the Wisconsin Department of Natural Resources (DNR), requested that We Energies examine the effectiveness of technologies available for further reducing its mercury discharges. Realizing that these issues face the entire industry, and knowing that EPRI's reputation as an independent, unbiased evaluator would lend credibility to the results, the Company requested EPRI's help in setting up a collaborative, multi-company study. The study eventually involved 10 member companies under EPRI leadership.

The project's technical approach was to survey and identify technologies that showed promise, conduct laboratory feasibility studies to screen technologies that could potentially achieve the target mercury and/or selenium objectives, and then conduct pilot feasibility tests to further evaluate the most promising technologies. Because FGD wastewater characteristics can vary widely depending on the source water, coal type, and plant operations, another purpose was to examine the results of different technologies applied to different wastewaters. The feasibility tests were limited in scope and duration, but EPRI researchers felt that the tests could show which technologies were worthy of further evaluation and that test results could provide data to support continued research on more technologies.

Feasibility Testing Provides Baseline for Future Research

The EPRI staff searched the professional and vendor literature to identify technologies with the potential for effectively removing mercury and/or selenium in FGD wastewater. They then worked with participating companies to select candidate technologies for feasibility testing. As laboratory studies began, EPRI developed project plans that described the important characteristics of FGD wastewater and suggested standard treatment and analytical methods. The plans were designed to make the test results as comparable as possible. After laboratory bench tests were complete, EPRI worked with the vendors and utility staff to set up on-site tests using water directly from the FGD systems. We Energies conducted four feasibility tests at Pleasant Prairie. Three had promising results:

- **Mercury removal by microfiltration combined with adsorbent media.** Measured mercury levels were generally less than 100 ppt, with only several data points near 12 ppt.
- **Mercury removal by iron and sulfide additives with microfiltration.** Reduced filtered mercury to an average of about 90 ppt.
- **Selenium removal by iron cementation.** Demonstrated that a significant decrease in levels of selenium—including selenate, the form that is hardest to remove—was possible, best performance was about 160 parts per billion, which did not achieve the goal of 50 parts per billion.

Although none of these technologies could reliably lower mercury levels significantly below the level of the existing treatment technology at Pleasant Prairie, several indicated promise. We Energies continues to hold discussions with DNR, and is confident that it can demonstrate that the project has conducted scientifically valid tests. The company also used some aspects of the experimental technologies to fine-tune its existing wastewater treatment systems and improve performance.

EPRI manager Paul Chu says, "We Energies was instrumental in championing the project; it brought in other companies so the project could test various potentially effective new technologies." EPRI awarded five We Energies staff a 2009 Technology Transfer Award for their leadership in this project. "These results will be instrumental in determining how best to focus future research aimed at developing cost-effective advanced treatment technologies for mercury and selenium reduction" according to Elizabeth Hellman, Principal Environmental Engineer, We Energies.

Related EPRI Products

Title	Product ID
Mercury Removal from FGD Water with Microfiltration Combined with SAMMS Adsorbent Media, 2009	1020576
Selenium Removal by Iron Cementation from a Coal-Fired Power Plant Flue Gas Desulfurization Wastewater in a Continuous Flow System–a Pilot Study, 2009	1017956
Laboratory and Pilot Evaluation of Iron and Sulfide Additives with Microfiltration for Mercury Water Treatment, 2009	1016813

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com)

CONTACTS

Paul Chu, *Senior Project Manager*
650.855.2362, pchu@epri.com

1020840 March 2010

Electric Power Research Institute
3420 Hillview Avenue, Palo Alto, California 94304-1338 • PO Box 10412, Palo Alto, California 94303-0813 USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com