PROJECT facts

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MULTI-POLLUTANT EMISSION CONTROL: PILOT PLANT STUDY OF TECHNOLOGIES FOR REDUCING HG, SO_3, & NOX

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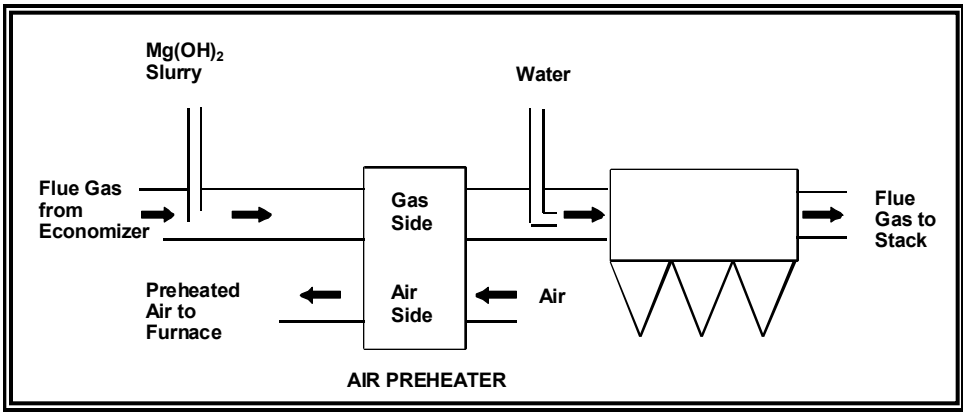
Background

In December 2000, EPA announced its intention to regulate mercury emissions from coal-fired power plants. Additionally, President Bush's Clear Skies Act calls for reduction in mercury from the electric utility sector. In anticipation of these actions, U.S. Department of Energy's National Energy Technology Laboratory (NETL) issued a competitive solicitation for advanced/novel mercury control technologies. CONSOL was awarded a cooperative agreement from this solicitation.

Previous research conducted by CONSOL and others showed that mercury can be removed from the flue gas from coal-fired furnaces by cooling the flue gas to lower temperatures than typically employed in power plants. This approach to mercury control has not been employed because of concerns of corrosion caused by acid condensation at the reduced flue gas temperature. CONSOL also showed that magnesium hydroxide, $Mg(OH)_2$, is an effective reagent for the removal from the flue gas of sulfur trioxide (SO_3), the precursor to sulfuric acid and that $Mg(OH)_2$ produced as a by-product from a Thiosorbic Lime scrubber performed better than commercial grade $Mg(OH)_2$. Thus, a mercury control process was conceived in which the flue gas is cooled to cause the mercury to absorb on the fly ash and the mercury and fly ash are collected in the existing particulate collection device. $Mg(OH)_2$ is injected to prevent acid corrosion of the plant components.

Under the cooperative agreement with NETL, CONSOL is constructing a pilot plant facility operating on a flue gas slipstream from a coal-fired utility boiler. The pilot plant will operate on flue gas slipstream (1.7 MW equivalent) from



Multi-Pollutant Emission Control: Pilot Plant Study of Technologies for Reducing Hg, SO_3, & NOx

the 288 MW pulverized-coal-fired Mitchell Station of Allegheny Energy. The Mitchell Station is equipped with low NOx burners and burns high-sulfur coal. The pilot unit will consist of an alkaline sorbent injection system, air preheater and electrostatic precipitator (ESP). The alkaline sorbent, magnesium hydroxide, is injected prior to the air preheater to neutralize the SO_3. The $Mg(OH)_2$ for the pilot-plant tests will be by-product slurry from the Thiosorbic Lime scrubber at the Allegheny Energy's Pleasant Station. Flue gas temperature will be reduced via the air preheater or separately, via the water sprays, from the typical 320°F to the 220-250°F range. At the low temperature, Hg will absorb on the fly ash that will be collected in the pilot ESP. Mercury removal with the fly ash will be determined at a variety of temperatures ranging from approximately 320°F to the 220°F at the inlet of the pilot ESP. In conjunction with the mercury removal studies, a series of long-term tests to evaluate the impact of this technology on corrosion and on the performance of specific utility components will be completed.

A potential benefit of the process concept, in addition to removal of mercury and SO_3, is that an improved heat rate can be obtained for those boilers equipped with enough air-preheater capacity. The improved heat rate would reduce fuel consumption and costs and simultaneously reduce the emissions of nitrogen oxides, carbon monoxide, sulfur dioxide, particulates, and even carbon dioxide for a given amount of electric energy produced.

Objectives

The objective of the project is to demonstrate that by simply lowering the flue gas temperature mercury can be removed from the flue gas and deposited on the fly ash surface. This demonstration will determine the maximum amount of mercury that can be adsorbed onto the fly ash. The project will also define optimal quantities of $Mg(OH)_2$ for SO_3 neutralization, as well as optimal temperature for mercury removal. It is anticipated that this technology concept will provide 80-90% mercury removal at a cost an order of magnitude lower than powdered activated carbon injection.

Description

In addition to CONSOL Energy, other project partners include: Allegheny Energy Supply, who is providing the Mitchell Station as the host site; ALSTOM Power Inc., who is providing the air preheater and technical assistance; Environmental Elements Corp., who is providing the pilot ESP and technical assistance; and Carmeuse North America, who is providing the by-product $Mg(OH)_2$.

A series of short-term tests will be conducted to evaluate the impacts of Mg/SO_3 molar ratio, gas temperature at the ESP inlet, and water-spray cooling. These will be followed by a long-term test at the preferred conditions. Mercury mass balances around the pilot plant and removals of the individual mercury species will be determined with the Ontario Hydro method analysis of the fly ash collected in the ESP. Corrosion of plant components will be monitored by inspection and through the use of corrosion probe. Tests will be conducted on the collected fly ash to examine possible mercury mobility.

Results

A project kick-off meeting was held on October 5, 2001. Duct penetrations and tie-in pipe installation were completed on May 22, 2002, at the Mitchell station during the scheduled outage. The pilot air heater (photo shown below) and ESP are on site. The engineering work on the pilot plant is completed. Currently, construction bids are being solicited. Following selection of a construction contractor work will begin at the Mitchell Station. Pilot plant operation is expected to begin in January 2003.