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Title: Trial of Amended Silicates™ for Mercury Control at Miami Fort Station
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Abstract

Amended Silicates™ is a patented sorbent designed to be injected into the flue gas stream at coal-fired power plants for capture of vapor-phase mercury. Mercury-laden sorbent is collected along with fly ash in the plant's existing particulate control equipment. In this application, Amended Silicates sorbent is used in a fashion identical to that for powdered activated carbon (PAC). A distinguishing feature of Amended Silicates is that use of the sorbent allows the continued sale of fly ash as a pozzolan additive in concrete. PAC has been shown in numerous utility trials to contaminate fly ash such that it is not suitable for use in concrete.

The Amended Silicates technology was developed with funding from the EPA and DOE, and has been successfully tested on a slipstream from a Colorado power plant and full-scale in a short-term trial at another Xcel Energy plant burning Powder River Basin coal. The trial reported here evaluated the use of injected particulate sorbents to control mercury emissions from Duke Energy's Miami Fort Unit 6 for a period of six weeks under various conditions. Unit 6 is a 185-MW boiler with a cold-side electrostatic precipitator (ESP). Load on Unit 6 is adjusted to accommodate daily demand. The plant burns run-of-the-river coal originating from Kentucky, West Virginia, Ohio, Pennsylvania, and Illinois. Typical coal is a bituminous rank with ash contents ranging from 8-15% and sulfur contents of 1.6-2.6% on an as-received basis.

The project team included the host utility, Duke Energy, mercury control technology suppliers Amended Silicates, LLC and its parent companies; sorbent manufacturer Engelhard Corporation; analytical support teams from the University of North Dakota Energy and Environmental Research Center (UNDEERC) and Western Kentucky University; fly ash reseller Boral Material Technologies; and various other supporter organizations.

The trial at Miami Fort Station began in late 2005 with the installation of a sorbent injection system designed by the team. The injection system was employed for both sorbents used during the trial – Amended Silicates and NORIT's DARCO Hg. Over fifty tons of the Amended Silicates material was made by Engelhard Corporation (now part of BASF) specifically for the trial. The trial began with a period of baseline monitoring during which no sorbent was injected. Sampling during this and subsequent periods indicated only zero to ten percent mercury capture by the native fly ash. The split between elemental and oxidized mercury in Unit 6 flue gas appeared to be fairly even. The fraction of elemental mercury ranged from 1/3 to 2/3 of the total mercury during the tests, with the variation believed to be caused by changes in the fuel source.

After the baseline period, Amended Silicates was injected at several different rates, followed by a 30-day trial at a fixed injection rate of 5-6 lb/MMacf. After the 30-day trial, PAC was injected at several different rates to provide a comparison. Approximately 40% mercury control was achieved with either Amended Silicates or PAC sorbent injection at injection rates of 5-6 lbs/MMacf. Higher injection rates did not achieve significantly increased removal. Similar

removal efficiencies have been reported for sorbent injection trials at other plants with cold-side ESPs.

Sorbent injection did not detrimentally impact plant operations. ESP operating parameters and stack opacity were not affected by sorbent injection. Subsequent inspection of the ESP did not show any effects of the sorbent on the ESP internal components.

Samples of fly ash and sorbent/fly ash mixes were tested by Boral and Separation Technologies for their suitability for use in concrete. The presence of PAC in fly ash from Miami Fort rendered the ash unusable as a concrete additive. The presence of Amended Silicate sorbent did not degrade fly ash quality. Samples of concrete made with the fly ash / Amended Silicate blend had compressive strength values matching that for samples made without Amended Silicates.

Economic analysis for mercury control on Unit 6 concluded that the cost for mercury control using either PAC or Amended Silicates was approximately equal if fly ash sales were not a consideration. If the plant did sell its fly ash, the effective cost for mercury control could more than double if those sales were no longer possible, due to lost by-product sales and additional cost for waste disposal. Accordingly, the use of Amended Silicates could reduce the overall cost of mercury control by approximately 50% versus PAC for locations where fly ash is sold as a by-product.