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Power Plant in Southern TX – CEMS Feedback Control Loop Implementation and Sorbent Savings

Situation: The plant in question was using brominated activated carbon to control mercury on a 925MW unit equipped with a Spray Dry Absorber and Fabric Filter. The Powdered Activated Carbon (PAC) feed rate, delivered by the Activated Carbon Injection (ACI) system, was adjusted based on a linear curve that related PAC injection to the coal feed rate. To ensure Mercury Air Toxic Standards (MATS) compliance, the plant would monitor previous emissions data and adjust the slope of the curve, as necessary. Although this control method increased PAC feed rate with boiler load, and allowed them to address process changes, the plant still had prolonged periods of lower than needed mercury emissions, as well as, periods of high (non-compliant) mercury emissions.

Motus Group was contracted by the plant to evaluate their ACI feed rate controls and historical operating data, then implement a new control loop that maintained mercury emissions below the MAT's limit without over-injecting PAC.

Analysis: When operating at low loads, the average emissions were below 0.5lbs/TBtu 80% of the time. At high loads, the emissions exceeded 1.2lbs/TBtu, the MATS limit, more than 22% of the time. The average mercury emissions achieved were 0.83lbs/TBtu, well below the MATs compliance level (again, 1.2 lbs/TBtu), while the average feed rate was 199lbs/hr. Controlling the ACI system in this fashion risked non-compliance, and resulted in injection of more PAC than would otherwise be required to maintain compliance. To complicate things, some of the ACI system IO were not available to the plant DCS since it was controlled by a separate PLC. Figure 1, below, outlines the costs of over feeding and underfeeding PAC (i.e. compliance fines and sorbent expenses).

After reviewing the data above, Motus Group determined that a feed forward control loop, based on the coal flow, coupled with a feedback control loop based on mercury emission, would best address the plant's need. This method of control would allow the plant to adjust PAC flow quickly in response to load changes while, allowing the feed rate to be adjusted if mercury emissions were either low or high.

Motus Group then prepared a control narrative that described the IO points and calculations required to implement the new control loops. Using the control narrative, the plant DCS logic and ACI system logic were modified to implement the new control loops and provide the operators the necessary controls, alarms, and visualization to ensure compliance was being maintained, while PAC consumption was minimized. Motus Group traveled to site to perform the PLC programming, work with the DCS administrator to load the new DCS logic, test the control loops, and tune the control loop response.

Resolution: After implementing the improved control loop, mercury emissions at low load were below 0.5lbs/TBtu only 1% of the time, while the emissions at high load were over 1.2lbs/TBtu only 1% of the time. The average mercury emissions were 1.1 lbs/TBtu, slightly under the compliance level, with an average sorbent injection rate of 155 lbs/hr.

Table 1, below, details the annual savings realized by reducing sorbent usage, as well as the ROI for implementing the improved Hg control strategy.

Figure 2, below, graphically represents the improvements that were captured through this method of feed rate control.

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ACI COST SAVINGS:		
PAC Cost, [$/LB]	$0.55	$/LBS
Original Average Feed Rate, [LB/HR]	199	LBS/HR
New Average Feed Rate, [LB/HR]	155	LBS/HR
Delta, [LB/HR]	44	LBS/HR
Unit Availability, [%]	80%	%
Sorbent Savings per YEAR	$169,594	$
Project Cost, [$]	$19,500	$
ROI ESTIMATE:	**1.5**	MONTHS

Table 1: Sorbent Savings per Year and ROI Estimate.

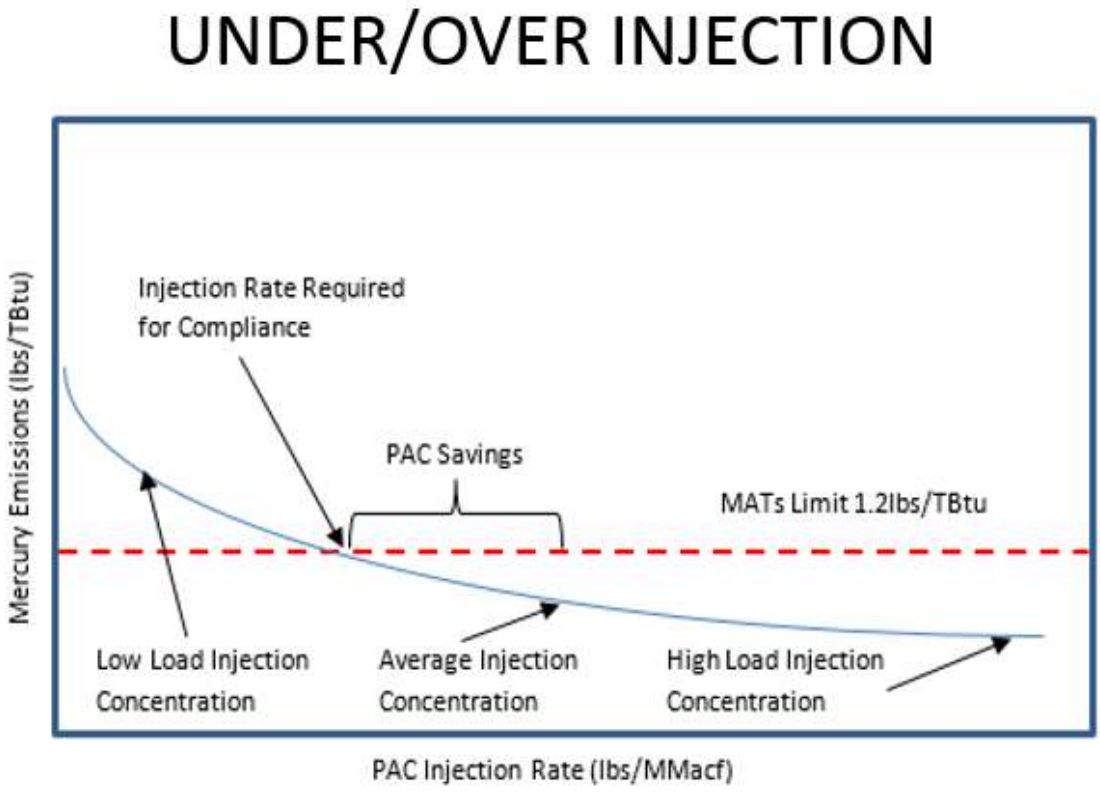

Figure 1.

Curve showing the benefits and cost savings captured by injecting the correct amount of PAC. In this case, the method of achieving the correct injection rates was via a CEMS feedback control loop.

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FEEDBACK CONTROL LOOP

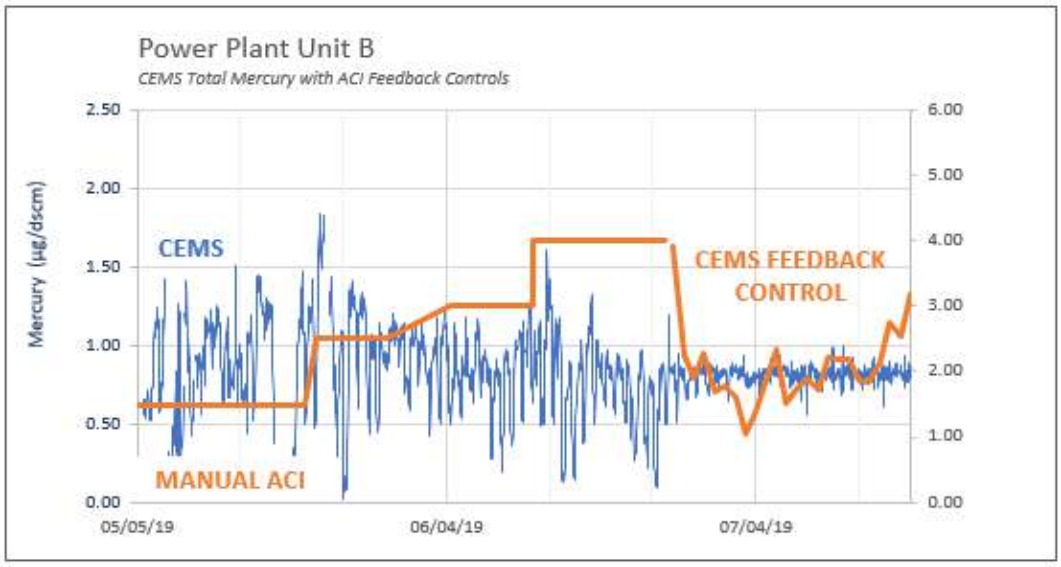

Figure 2.

PI data analysis from before and after the CEMS feedback control loop is implemented. The swings in Hg (blue) can be seen to drastically decrease after the control loop was implemented. This tighter control led to a decrease in average daily PAC feed rates (usage) and a large cost savings.