Coal-fired utility plant uses Nalco technology to meet new discharge requirements

NALCO
An Ecolab Company

CASE STUDY – AIR PROTECTION TECHNOLOGIES

CH-1081

Mercury presents a real and serious problem. When mercury enters the water supply, bacteria convert it to methylmercury, a neurotoxin, which then enters the aquatic food web. People are exposed to methyl-mercury almost entirely by eating contaminated fish and wildlife. According to the National Research Council, more than 60,000 children are born each year at risk for adverse neurodevelopmental effects due to in utero exposure to methylmercury.[1]

The human and financial costs associated with mercury have long been recognized and, in the late 1990's, the US Environmental Protection Agency (EPA) took action to reduce stack emissions of mercury. Emission control technologies effectively capture most of the mercury before it leaves the stack and these measures have been adopted by many coal-fired power plants.

When stack gas mercury is removed in a Flue Gas Desulfurization (FGD) scrubber, as an example, the mercury is taken from the stack gas and moved to the FGD wastewater, from the gas phase to the liquid phase. The mercury problem is not solved, only changed.

As more plants adopt air emissions control technology, more mercury finds its way into the wastewater treatment plant. Ultimately, that mercury makes its way into the aquatic environment. In September 2009, the US Environmental Protection Agency (EPA) announced plans to change the rules surrounding power plant wastewater discharge. "The high level of toxic-weighted pollutant discharges ... and the expectation that these discharges will increase significantly in the next few years," drove the decision.[2] The new rules will be issued on July 23, 2012 with the final rule due by January 31, 2014.

Environmental groups have sought this action for years. According to Environmental Integrity Project attorney Jennifer Peterson, "These rules were supposed to have been written nearly 30 years ago – they are not new requirements. Wastewater treatment

Environmental Indicators	eROI	Economic Results
Annual mercury discharge reduced by 87% (1,164 pounds/year)	ASSETS	Achieved emissions compliance goals of the customer

Nalco reports eROI values to customers to account for contributions in delivering both environmental performance and financial payback.

[1]Toxicological Effects of Methylmercury, Committee on the Toxicological Effects of Methylmercury, Board on Environmental Studies and Toxicology, National Research Council, National Academy Press, Washington, DC, 2000
[2]http://water.epa.gov/scitech/wastetech/guide/steam_index.cfm

is affordable, and our waterways are not a dumping ground for toxic waste from coal-fired power plants."[3]

NEW REQUIREMENTS

One of Nalco's largest coal-fired utility customers recognized these changes were coming and took steps, early, to meet the new requirements. The company understood the importance of compliance with the new, tighter restrictions on mercury discharge set forth by the Ohio River Sanitary Commission (ORSANCO), changes to their National Pollutant Discharge Elimination System (NPDES) permit (including new limits on mercury, selenium and arsenic) and the anticipated changes to the Clean Water Act.

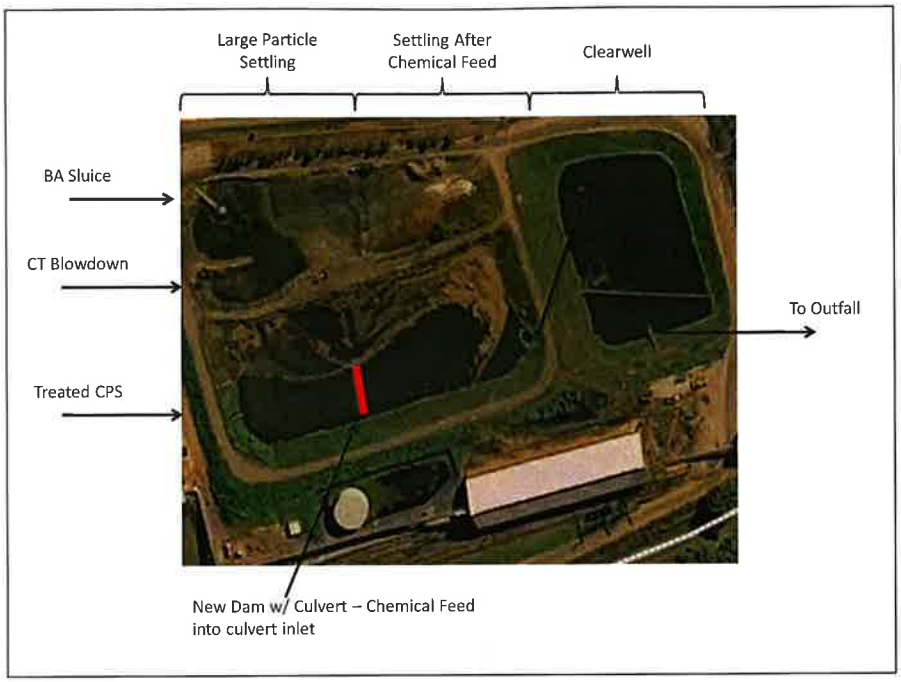

Figure 1 - *Ash Pond System Overview*

SYSTEM DESCRIPTION

The plant operates two, coal-fired units generating 1600 MW. A settling pond system collects wastewater from various sources, including bottom ash sluice water, effluent from an FGD wastewater treatment plant (WWTP) and plant wastewater sumps that receive demineralizer regeneration wastes and various other waste streams. The settling pond was designed originally to remove only total suspended solids (TSS) from the wastewater prior to discharge at the outfall. To meet the new requirements, better performance needed to be obtained from this existing asset.

The wastewater plant processes about 6 million gallons of waste-water each day. Figure 1 shows the ash pond system layout. First, bottom ash sluice enters the de-watering pond where large particulate coal combustion products settle out. Cooling tower blowdown water sluices the bottom ash to the pond for a few hours every day. Periodically, dredges remove the solids from the dewatering basin for use in cement production.

Next, treated effluent from the FGD wastewater treatment plant (WWTP) is intermittently pumped to the following section of the ash pond system, the bottom ash pond. The FGD WWTP process sends hydroxide and sulfide compounds, used to facilitate metals removal, to the bottom ash pond, along with wastewater from the collection sumps within the power plant.

Last in the ash pond system process is a large clearwell pond, where settling of the smallest particulate occurs, prior to effluent discharge at the final outfall.

Bottom ash sluice water is the largest volume contributor to the ash pond system, but the FGD chloride purge stream (CPS) contributes the highest concentration of pollutants. Table 1 shows average (baseline, prior to chemical treatment) concentrations of various pollutants at various points in the system, as compared to the newly established NPDES limits.

The biggest challenge: reducing mercury discharge from the ash pond system. When this project started, mercury concentrations in the ash pond discharge averaged 73.2 ppt, six times the allowable 12 ppt daily average limit as specified in the new NPDES permit.[4]

[3]Groups Applaud EPA Action to Reduce Water Pollution from Power Plants, Environmental Integrity Project Press Release, 9 November 2010.
[4]River water, the primary water source for the plant, contains 7 ppt of mercury, adding to the difficulty of keeping plant discharge concentrations below 12 ppt.

Table 1 – *Average Pollutant Levels vs. NPDES Discharge Limits*

Pollutant	Raw River Water	Treated CPS	WW Collection Sump	Bottom Ash Pond Effluent	Clearwell Pond Discharge	NPDES Limit (daily avg)	NPDES Limit (daily max)
Arsenic, As, ppb		4.5	4.7	4.1	3.6	309	451
Selenium, Se, ppb		77.9	2.2	8.0	7.3	26.7	53.6
Mercury, Hg, ppt	7.0	1420	13.3	61.6	73.2	12	18

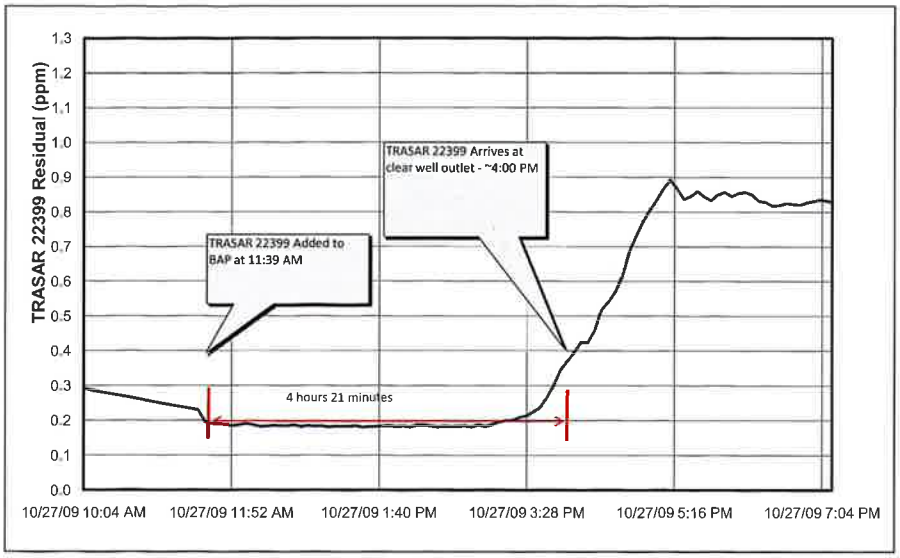

Figure 2 – *A diagnostic TRASAR study determined the system retention time*

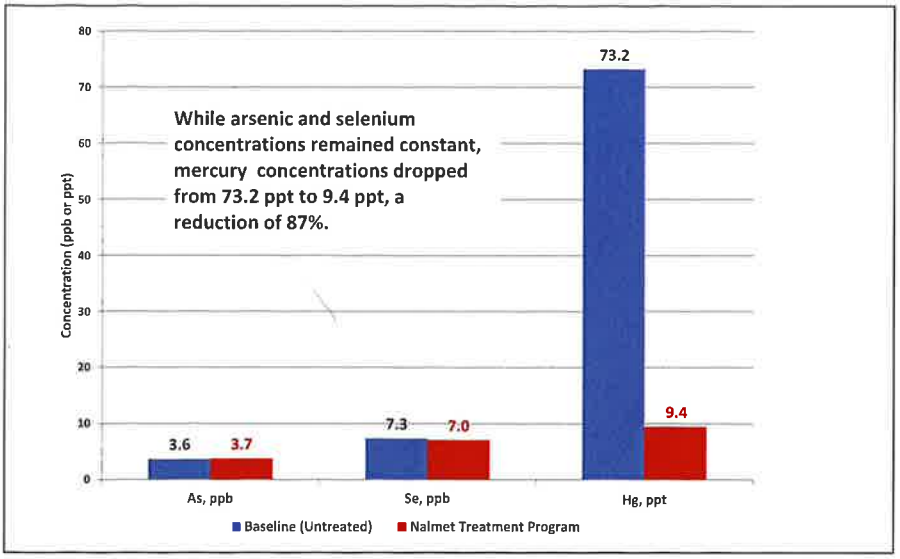

Figure 3 – *Effluent concentrations, Baseline (Untreated) vs. NALMET Program*

SOLUTION

With only a few months to comply with the new NPDES discharge permit, a team of people from the utility and Nalco worked to identify and implement a strategy to remove mercury across the ash pond system.

Adequate mixing of the treatment chemicals into the wastewater is a challenge in a settling pond system like this, where flowrates are very low and no mixing tanks are available. In this case, plant personnel solved the problem by routing the wastewater stream through a series of culverts in the bottom ash pond section. These culverts serve as restrictions that increase the velocity and turbulence of the ash pond wastewater flow. They also provide the kind of mixing needed to effectively inject chemical treatments.

To determine the residence time available through the ash pond system, a Diagnostic TRASAR study was conducted. A Diagnostic TRASAR Study involves adding a known quantity of an inert, fluorescent material to a water system and then measuring its concentration over time using a very precise and sensitive TRASAR fluorometer. In this case, the TRASAR material was added to the inlet stream of the ash pond system and its concentration measured over time at the clearwell pond discharge. The results are shown in Figure 2. The retention time for the ash pond system was approximately 4 hours.

Bench top jar testing identified the most effective chemical treatments and dosages. The jar testing protocol was designed to convert dissolved

metals to particulates and then effectively settle these solids. Jar testing identified NALMET 1689 as a promising treatment for metals removal and Nalco 71301, a high molecular weight cationic emulsion, for effective solids settling and water clarity.[5]

RESULTS

Using temporary feed systems, the products were injected continuously to the inlet of the culverts. Figure 3 shows the arsenic, selenium and mercury levels at the clearwell outlet/discharge point during both the baseline conditions (without chemical treatment) and with application of the NALMET-based treatment program. Neither arsenic nor selenium concentrations changed. Mercury concentrations fell from 73.2 ppt (baseline) to 9.4 ppt with the NALMET treatment program. This reduction (~87%) allows the plant to comply with the new NPDES discharge limits for the ash pond outfall.

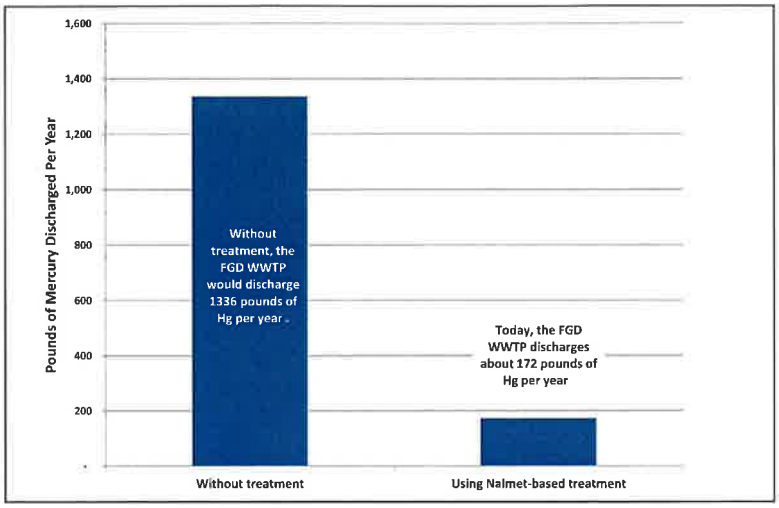

Figure 4 - *NALMET treatment decreased the amount of mercury discharged into the invironment*

Since the conclusion of the evaluation, a permanent chemical feed and storage system, with flow-based control, has been installed and this power plant consistently meets the discharge limits for mercury and other pollutants. Power plant and Nalco personnel are working to further optimize the treatment.

RETURN ON INVESTMENT

Every power plant wants to be a good corporate citizen of the community in which it resides. Every power plant wants to minimize its environmental impact. Those desires must be balanced with the needs of the community for reliable, low-cost power.

In this case, technology provided a solution to a very real problem. Since transition to the new treatment, mercury concentrations are consistently lower than the target. Mercury concentrations in the outfall have been 9.4 ppt, a reduction of 87%. Without treatment, about 1,336 pounds of mercury would enter the environment. Today, the plant discharges only 172 pounds of mercury

[5]NALMET 1689 was applied at 10 ppm. Nalco 71301 was applied at 3 ppm.

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