CASE STUDY

MOLASSES TO MICROC: POWER GENERATION STATION MEETS SELENIUM REDUCTION GOALS WITH MICROC® 4100

A Pennsylvania coal-fired power generation station switches from molasses carbon sources to EOSi's carbohydrate-based MicroC® 4100 to remove up to 80% selenium across their wastewater treatment system — and achieve complete denitrification from their final effluent.

Client: Coal-Fired Power Generation Station

Location: Pennsylvania, USA

Flow Design/Actual:

410 gallons per minute (gpm)/300 gpm

Treatment Technology: **Anoxic/Anaerobic** Biological Process for Nitrate/Selenium Reduction and Sequencing Batch Reactor (SBR) for Organics Removal

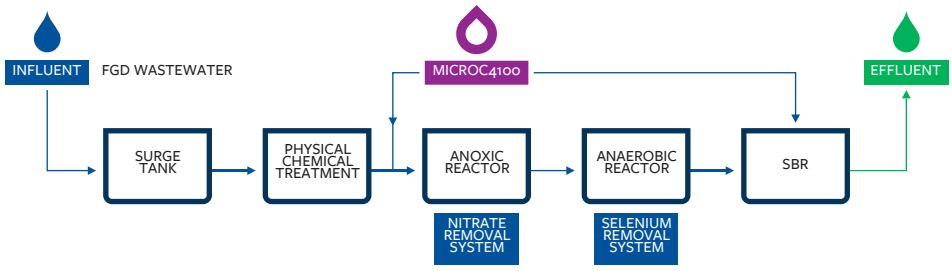
Target Total Selenium Concentration:

< 0.21 mg/L

Background

In 2013, the US Environmental Protection Agency (EPA) released proposed Effluent Limitation Guidelines (ELGs) for the category regulating steam-electric power generating point sources. The proposed ELG rule will require specific treatment of wastewater from flue gas desulfurization (FGD) processes, with treatment goals identified for selenium, nitrate and nitrite, arsenic, and mercury. The diverse chemistry of these contaminants combined with the very low concentrations in the proposed standard present a formidable challenge for the power industry to achieve.

Figure 1



Discharge permits have been issued for some FGD wastewater treatment facilities. Selenium, mercury, chlorides, total dissolved solids (TDS), organics, and other trace metals are typically the parameters of interest in the most recent National Pollutant Discharge Eliminating System (NPDES) permits regulating FGD wastewater.

Reducing Nitrate and Selenium

This coal-fired power generating plant installed a new anoxic/anaerobic biological treatment system at the existing FGD wastewater treatment system to remove nitrate and selenium from the FGD blow-down to meet the NPDES effluent limits (numerical limits for selenium). See the Fig.1 process flow diagram above.

When both nitrate and selenium are present in wastewater, nitrate will be preferentially reduced before selenium and must be removed before effective selenium reduction occurs.

Typically, FGD wastewaters do not have sufficient organic carbon to support the microbiological reactions to denitrify and reduce selenium, therefore, an external source of organic carbon is required for the anoxic/anaerobic treatment system.

Molasses vs. MicroC® 4100 Results

Design engineers evaluated carbon sources during a six-month bench-scale study comparing the use of molasses vs. carbohydrate-based MicroC® 4100. EOSi provided technical support for MicroC 4100 application during the bench-scale study. At the conclusion of the study, design engineers decided to move forward with MicroC 4100 because of its optimal COD/nitrogen ratio, denitrification and selenium removal performance, reactor stability, ease of handling and operation, and cost-effectiveness.

MicroC® Premium Carbon Sources

Figure 2

Total Selenium Removal in the Wastewater Treatment System

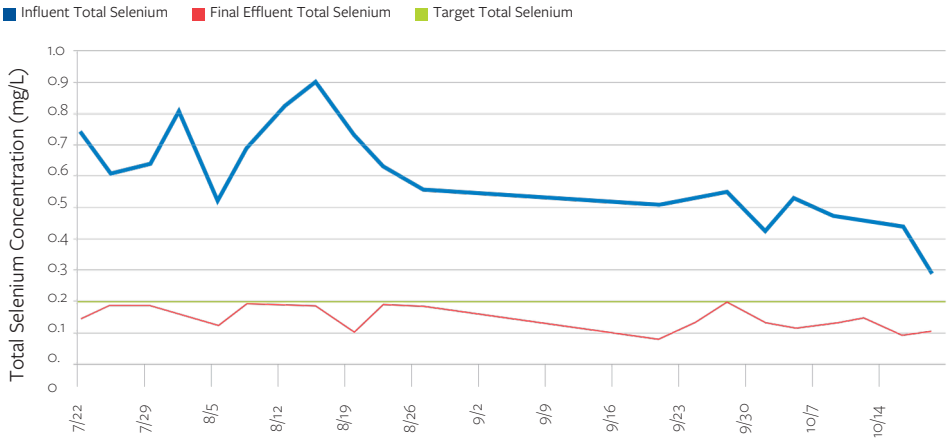


Figure 3

Selenium Reduction Across the Anoxic/Anaerobic Treatment System

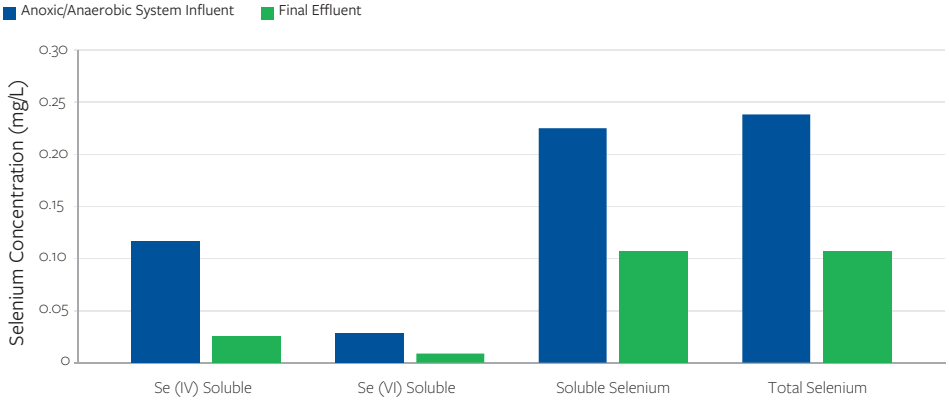
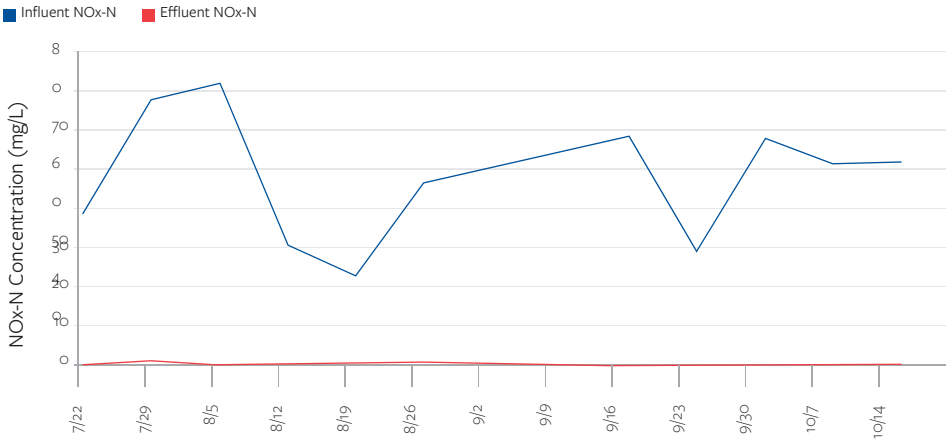


Figure 4

Influent and Effluent NOx-N Concentration



The influent total selenium concentration from the FGD blowdown ranged from 0.30 to 0.90 mg/L. MicroC 4100 was added to the anoxic/anaerobic treatment system's influent line continuously at an average rate of 4 gallons per hour, and added further during the anoxic step in the SBRs at a rate of approximately 3 gallons per batch. The resulting reduction of total selenium throughout the wastewater treatment system and the anoxic/anaerobic treatment system is shown in Fig. 2 and Fig. 3, respectively.

The final effluent from the wastewater treatment system had a total selenium concentration range of 0.10 to 0.21 mg/L during the testing months from July through October (presented in Fig. 1). The results revealed 35% to 45% of selenium across the anoxic/anaerobic treatment system was removed, and 66% to 80% selenium removed across the complete wastewater treatment system, with the plant operations team reporting a total selenium concentration of < 0.10 mg/L.

Nitrogen data revealed that the anoxic/anaerobic treatment system using MicroC 4100 successfully reduced the nitrate and nitrite (NOx) concentrations of 30 to 72 mg/L down to <1 mg/L — indicating complete denitrification (see Fig. 4).

EOSi's MicroC® 4100 Benefits

Compared to using molasses as a supplemental carbon source, EOSi's MicroC® 4100 provides more consistent quality, composition, COD concentration, and a long shelf life, while requiring minimal on-site labor, and eliminating the inherent difficulties of storing and handling molasses. Using MicroC 4100 as a reliable and readily degradable source of supplemental carbon for denitrification and selenium removal, the FGD wastewater treatment system has consistently met their target total selenium and nitrate concentrations in the effluent.