CASE STUDY

Improving Condenser Performance with PURATE™ and OMNI™ at a Combined Cycle Power Plant in Spain

eROI℠ by Ecolab

BACKGROUND

Clean surface condensers are at the heart of power plant production efficiency. In a thermal power plant, controlling issues such as macrofouling and biofouling help maintain condenser performance close to design, and maximize profitability while reducing CO_2 emissions.

An 860 megawatt (MW) combined cycle plant located on the coast of the Mediterranean Sea uses sea water for once-through cooling of its surface condenser. The plant was experiencing significant macrofouling issues arising from mussel settlement in their main cooling system pipes, filters and condenser tubes (Image 1). This impacted the profitability of the plant significantly due to unscheduled shut-downs needed to manually clean the condenser to remove tons of mussels from the system.

The use of bleach was proving to be inefficient due to the very limited impact on mussel mortality and larvae elimination. Additionally, bleach-system maintenance costs were very high, and unavailability of the dosing station sometimes led to macrofouling events.

The Power Plant sought an efficient technology to control macrofouling, reduce unscheduled downtime, recover MW availability and decrease maintenance costs.

SITUATION

The use of chlorine dioxide (ClO_2) was identified as the best technology for the control of macrofouling in once-through cooling system, with a very limited impact on the environment. A 52 kg/h PURATE unit was delivered and commissioned (Image 2).

The treatment began with a higher-dose, temporary "cleaning phase" when ClO_2 was added continuously for four days at 1.0 ppm. Subsequently, the ClO_2 treatment was reduced to a twice-daily slug dose at the entry of the canal through which the sea water flows to the surface condenser. The ClO_2 residual is monitored at the outlet of the condenser to ensure a minimum 0.2 ppm residual is maintained.

Larvae of mussels are monitored with a microscope to identify the breeding season, when the risk of settlement is the highest. This helps to better design the dosing strategy of ClO_2 and adjust it accordingly.

ANNUAL SAVINGS

ENERGY

Increased power output

€800,000

GREENHOUSE GASES

Reduced taxes on CO_2 emissions

€100,000

NET VALUE DELIVERED

€900,000

In conjunction with the PURATE treatment, the OMNI Condenser digital tool is used to track the performance of the surface condenser in real time and to demonstrate the positive impact of ClO_2 on condenser efficiency due to fouling elimination and improved heat transfer.

Image 1: Macrofouling of condenser caused by mussels and debris

NALCO Water
An Ecolab Company

RESULTS

Following the application of the treatment strategy with PURATE, an inspection of the condenser showed a limited quantity of debris, including mussel shells, in the inlet water box of the condenser and no new settlement of young mussels. This indicated the macrofouling issue had been remediated.

Review of the OMNI Condenser data also demonstrated an improvement in key performance indicators such as cleanliness factor, terminal temperature difference (TTD), MW production penalty, and CO_2 emissions penalty (Figures 1-3). This improvement in condenser performance can be attributed to a reduction in biofilm on condenser surfaces after treatment.

OMNI Condenser data continues to show performance has been maintained after the initial cleaning phase and subsequent maintenance dosage of ClO_2 with PURATE.

The Total Value Delivered was estimated to be 800.000€/year as additional revenue on the power output (MW) and 100.000€/year in reduced taxes for CO_2 emissions.

Not reflected in this €900.000 savings amount are additional savings related to eliminating manual condenser cleanings, reducing chemical discharge to the sea and gaining efficiency in maintenance and chemical handling.

CONCLUSION

In today's competitive power market, extracting the maximum energy out of the fuel is crucial for power plants and particularly for combined-cycle plants using natural gas.

PURATE is advanced ClO_2 technology that can improve surface condenser performance and power plant efficiency.

When combined with OMNI Condenser digital technology, surface condenser performance can be monitored in near real-time to identify, diagnose and quantify potential issues, optimize the treatment program and validate that the impacts on Total Cost of Operation are maximized and maintained.

Image 2: The PURATE chlorine dioxide generator.

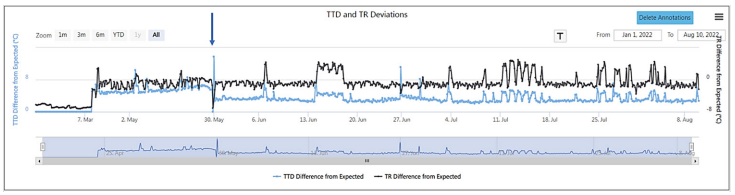

Figure 1. OMNI Condenser performance data showing after PURATE ClO_2 treatment, TTD improves while TR (temperature rise) remains stable, indicating an improvement in heat exchange resulting from a reduction in microbial-related fouling.

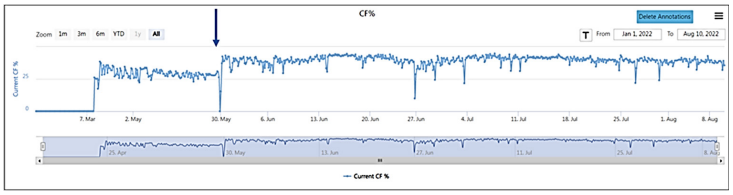

Figure 2. OMNI Condenser performance data shown after PURATE treatment. Cleanliness Factor of the condenser improved 10%.

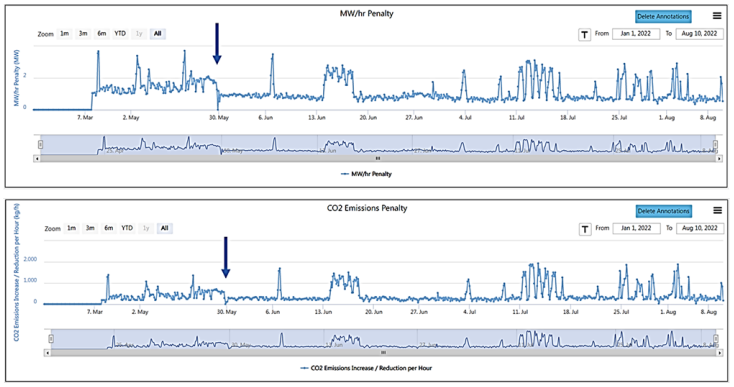

Figure 3. OMNI Condenser performance data showing MW Penalty reduction of 1.05 MW and CO_2 Emissions Penalty reduction of 370 kg/hour after PURATE treatment.

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