

Improving condenser performance with PURATE™ and Ecolab® CondenserIQ™ at a combined cycle power plant in Spain

CASE STUDY

► 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 CO₂ 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 shutdowns 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.



IMAGE 1: Macrofouling of condenser caused by mussels and debris

► SITUATION

The use of chlorine dioxide (ClO₂) 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 ClO₂ was added continuously for four days at

1.0 ppm. Subsequently, the ClO₂ 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 ClO₂ 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 ClO₂ and adjust it accordingly.

In conjunction with the PURATE treatment, the CondenserIQ™ is used to track the performance of the surface condenser in real time and to demonstrate the positive impact of ClO₂ on condenser efficiency due to fouling elimination and improved heat transfer.

eROISM
by Ecolab

ANNUAL SAVINGS



ENERGY

€800,000

Increased power output



GREENHOUSE GASES

€100,000

Reduced taxes on CO₂ emissions



TOTAL VALUE DELIVERED

€900,000

► 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 CondenserIQ™ data also demonstrated an improvement in key performance indicators such as cleanliness factor, terminal temperature difference (TTD), MW production penalty, and CO₂ emissions penalty (Figures 1-3). This improvement in condenser performance can be attributed to a reduction in biofilm on condenser surfaces after treatment.

CondenserIQ data continues to show performance has been maintained after the initial cleaning phase and subsequent maintenance dosage of ClO₂ 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 CO₂ 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.



IMAGE 2: The PURATE chlorine dioxide generator

► 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 ClO₂ technology that can improve surface condenser performance and power plant efficiency.

When combined with CondenserIQ 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.

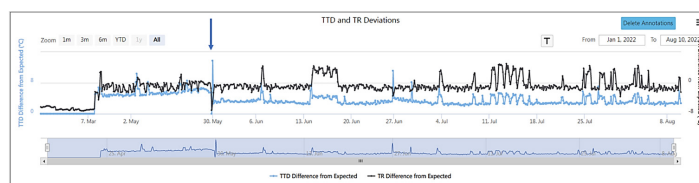


FIGURE 1: CondenserIQ performance data showing after PURATE ClO₂ treatment, TTD improves while TR (temperature rise) remains stable, indicating an improvement in heat exchange resulting from a reduction in microbial-related fouling

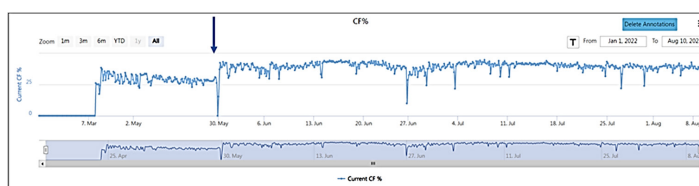


FIGURE 2: CondenserIQ performance data shown after PURATE treatment. Cleanliness Factor of the condenser improved 10%

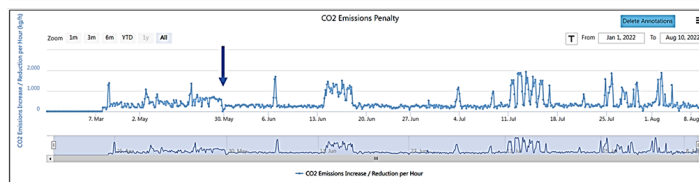
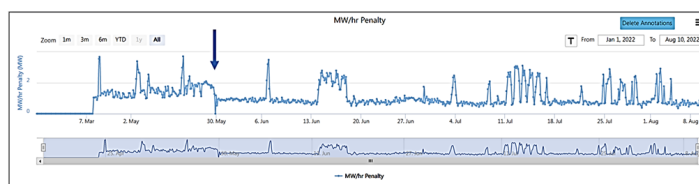


FIGURE 3: CondenserIQ performance data showing MW Penalty reduction of 1.05 MW and CO₂ Emissions Penalty reduction of 370 kg/hour after PURATE treatment