CASE STUDY

OMNI™ for ASU enabled $96,000/yr in energy savings in a major facility

eROI℠ by Ecolab

ANNUAL SAVINGS

ENERGY

US$96,000

Reduced electrical consumption by 2.8KW/ton of air

AIR

Reduced CO_2 emissions by 811 metric tons

TOTAL VALUE DELIVERED

US$96,000

BACKGROUND

A large air-separation facility processes approximately 4.0 Million Standard Cubic feet per hour (MMSCFH) of air, producing nitrogen and liquid oxygen used by local refineries and steel mills. The plant was observing a loss in thermal efficiency, increasing their operating cost.

Two critical systems were identified requiring improvement:

- 4-stage main air compressor processing
- Cooling water system

This unit is responsible for more than 50% of the plant's total air production (output).

Over the past three years, energy consumption was steadily increasing at a rate of 2-4KW per ton of air per year, as shown in Figure 1.

The most important goal for plant operations was to improve the reliability of the facility. The customer had several months of ups and downs and customer demand was increasing.

To meet this need for increasing production, the plant manager was considering two options to recover inter-cooler thermal efficiencies: an on-line inorganic chemical cleaning or an off-line mechanical cleaning. Both options would cost over $100,000 per day and require a shutdown of the unit.

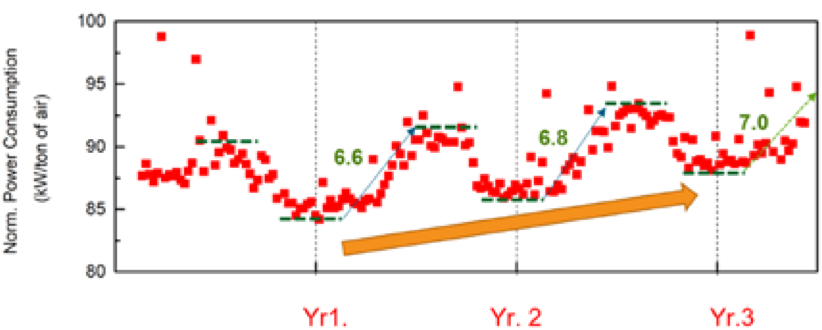

Figure 1. Normalized electrical consumption for the main air compressor over time. Thermal inefficiency cost this plant $140,000 per year.

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Several factors were pointed out as potential causes for the inter-cooler's efficiency variations including inorganic and/or organic fouling. The location of the cooling tower was near the steel mill which increased suspended solids (TSS) in the water. The plant did not have a reliable side-stream filter on site.

The system was operated with goals to minimize water usage and avoid or reduce the use of chemicals, like acid to control pH. Service frequency combined with limited remote visibility of operational leading indicators, (pH, conductivity, approach temperatures and product residuals) did not correlate with process variables. A deeper sensitivity analysis was needed to identify the root cause for the efficiency loss.

SOLUTION

Nalco Water proposed a proprietary, digital service - OMNI for Air Separation Units (OMNI ASU).

OMNI ASU is an innovative platform that includes secure data assimilation, cloud analytics, and a remote expert center—all with unique diagnostic tools that increase visibility and correlate information to critical plant KPIs. The platform ensures the right program decisions are made, thereby improving the reliability of the water-cooled heat exchanger and reducing electricity consumption on main air compressors.

The program enabled implementation of cloud analytics and obtained additional performance indicators, including water velocity, skin temperature, heat transfer coefficient (U value) and cleanliness factor. OMNI ASU models the electrical consumption by compressor stage on a continuous basis and correlates its variations with critical chemistry variables. As a first step, the plant compiled three years of data from the main air compressor and its intercoolers. This allowed the experts to retroactively identify specific events in time where the chemistry variables impacted the overall performance.

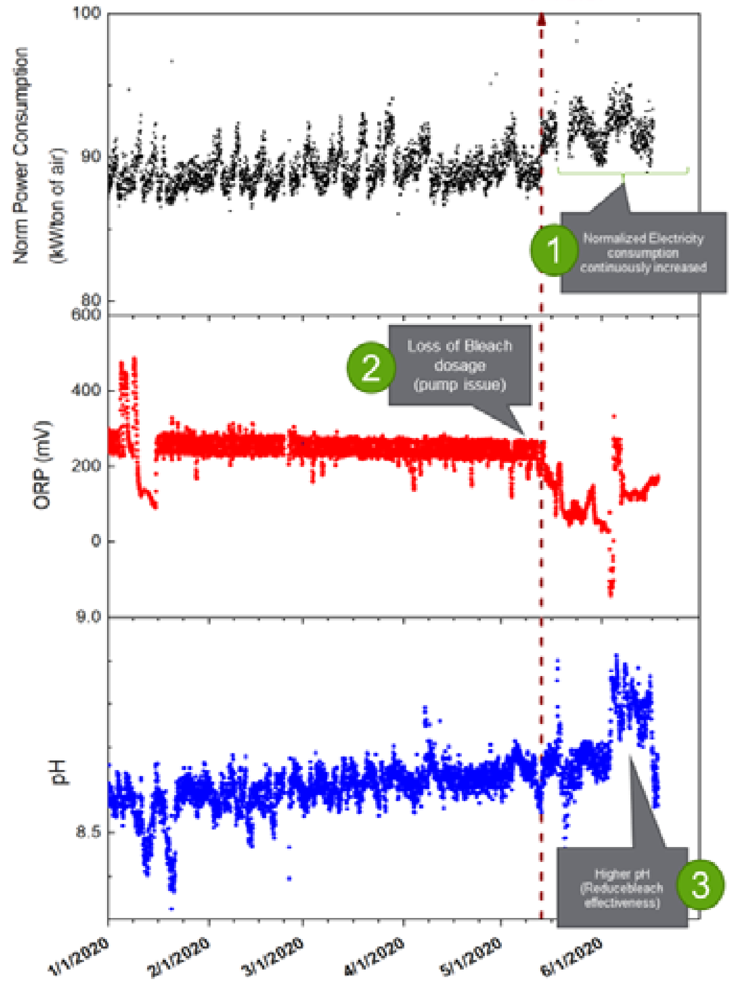
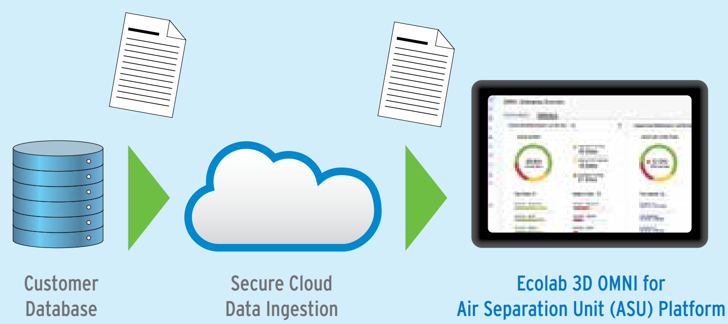


Figure 2. Chemistry variation correlates with overall performance in the main air compressor

OMNI for ASU program



- Energy Consumption (80% of main cost)
- Water Consumption

The ability to "visualize" and create additional correlations between water chemistry variables and process variables allowed the experts to drive specific conclusions about potential causes. It was also observed that intercoolers 1 and 2 were primarily impacting energy consumption at stages 2 and 3, while stage 1 was mostly impacted by operational changes.

By using specific and proprietary modeling within Nalco Water's Cooling Water Optimizer (CWO) in conjunction with OMNI ASU digital insights, our recommendation was to perform an online biological cleaning consisting of slug dosing an oxidant biocide with a bio-dispersant. This had a lower financial impact on the plant than an inorganic cleaning.

The effort resulted in a 3-6% increase in cleanliness factors for all coolers compared to before treatment. Approach temperatures for all coolers decreased between 1 and 3°C, as shown in Figure 3. Changes in cleanliness factors and approach temperatures indicate cooler performance was improved by online cleaning. While a lower ambient temperature was noted during cleaning, comparing previous data at similar conditions with current data confirmed that the improvement was not attributable solely to cooler air and cooling water temperatures.

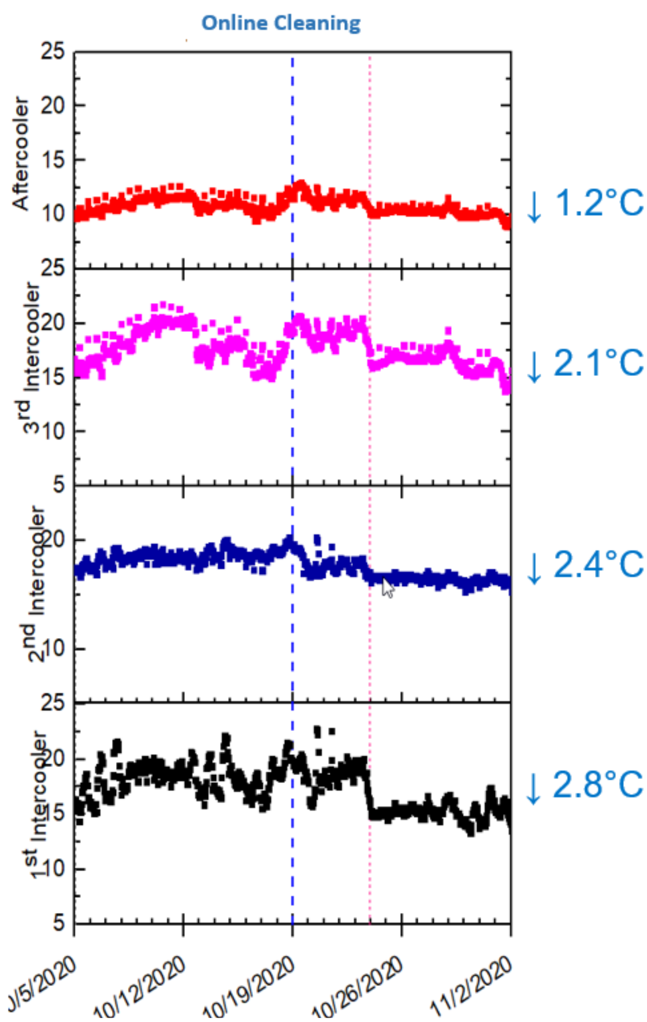


Figure 4. Decrease of approach temperatures at heat exchangers after online cleaning

Figure 3. The difference of approach temperatures between October and December in 2018 - 2020

On average, as shown in Table 1, the normalized energy consumption o f main air compressor on the unit was decreased from 93 kW/ton to 90 kW/ton, which is the benefit of cleaner coolers. Assuming the system will run at this status for the next year, the electricity savings alone is estimated to be $96,000 as a result of the biological cleaning. In addition, there are savings in manpower and maintenance costs for the plant personnel's time/money in maintenance.

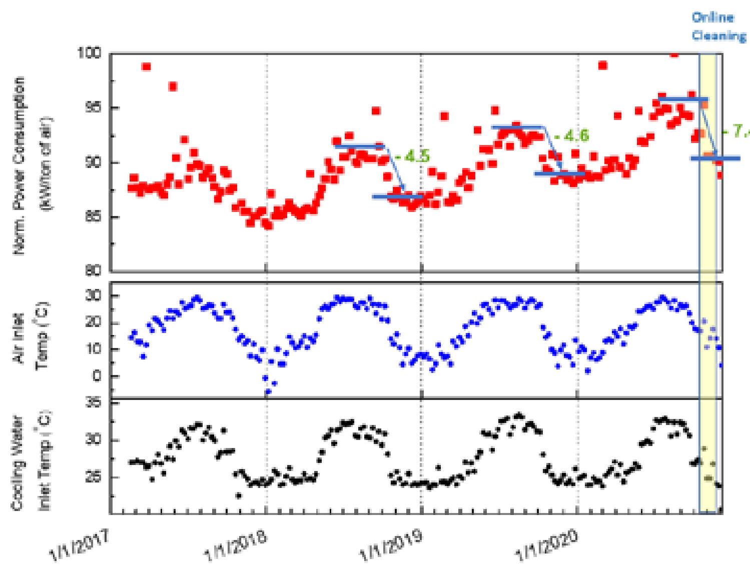


Figure 5. Energy saving of 2.8 kWh/ton of air by online cleaning after considering weather influence (~ 4.6 kWh/ton of air)

Period	Avg. KWh/ton 2019	Avg. KWh/ton 2020	Avg. kWh/ton with vs. without cleaning 2021*
Avg. Nov. - April (cold)	87.4	89.9	89 (vs 92)
Avg. May – October (hot)	91.8	93.5	93 (vs 96)
Avg. Entire Year	89.6	91.7	91 (vs 94)

Table 1. Average normalized energy consumption with and without online cleaning
** Average energy consumption in the parenthesis is estimated by the yearly trending if the cleaning was not performed.*

CONCLUSION

OMNI ASU brought valuable insights to drive a path forward to further reduce the electrical consumption and reverse the adverse effects of operating at higher cost.

As a result, emphasis was placed on biological and operational management with focus on preventive maintenance to avoid future biological issues. The plant has a robust preventative maintenance plan and is now able to operate the cooling system between 3 to 4 cycles.

Potential savings for operation practices were suggested.

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