E.coli Pacing

@ Corvallis Wastewater Treatment Plant

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THE COST OF COMPLIANCE: THE IMPERATIVE OF SAFETY.

Public safety is job #1, reinforced by regulatory permits, but treatment chemicals (including Cl2 and NaBs) are significant cost drivers. Historical tests for E.Coli are slow, and as a result, treatment schedules build in massive safety margins to avoid accidental permit violations.

The historical dosage of Cl2 at our facility in Corvallis Oregon provided assurance of meeting permit requirements under all but catastrophic operating conditions. This level of dosing evolved over time, but was primarily the result of 'flying blind' for 24-hours while waiting for E.Coli test results. Figure 1 depicts E.Coli performance last October at the historic initial Cl2 residual set point of 1.0 mg/L.

De-chlorination with NaBs is used to neutralize the final effluent Cl2 residual (typically 0.4 mg/L). A NaBs residual set point of 0.3 mg/L was maintained to effectively maintain a 0.00 mg/L CL2 residual under all operating conditions and control loop fluctuations. Combined, NaBs demand to neutralize chlorine, plus maintaining the desired NaBs residual, resulted in a typical applied dose rate of 0.7mg/L.

A BETTER WAY? CONTINUOUS MONITORING WITH LIQUID.

Frequent E.Coli monitoring using continuous E.Coli data would allow treatment dosage to be adjusted based on the actual characteristics of the wastewater stream. By treating as needed, chemical usage (both Cl2 and NaBs) could be reduced without elevating the risk of exceeding permit levels of E.Coli. The LiquID Station from ZAPS Technologies features, "a unique hybrid- spectrophotometric design that uses multiple optical techniques—absorption, fluorescence and reflectance—to measure multiple water quality parameters in real time". By utilizing the high sensitivity and specificity of

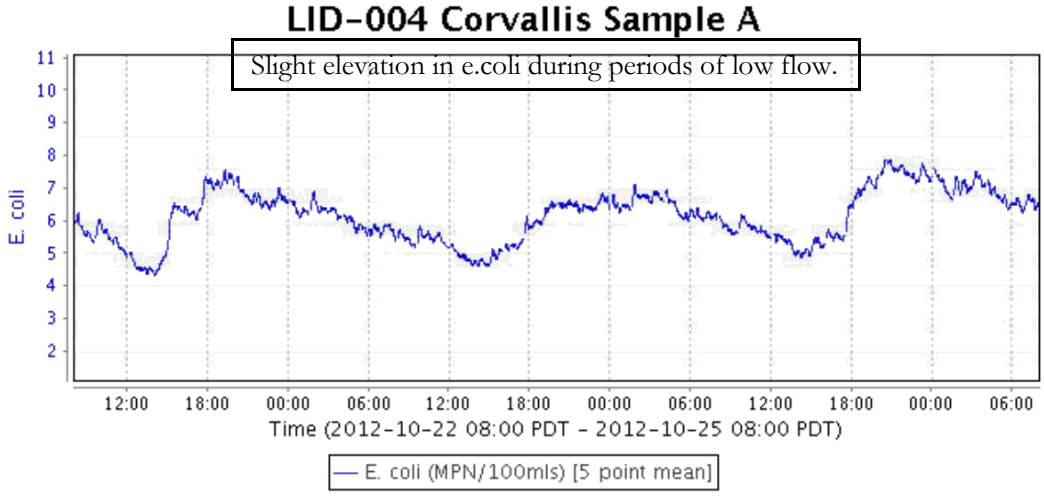

Figure 1: 3-day E.Coli cycles at Corvallis, OR WWTP (10/22/2012 – 10/25/2012)

CORVALLIS WWTP

The Corvallis Wastewater Treatment Plant treats an average daily flow of 37 MLpd and handles peak flow of 113 MLpd.

The existing liquid treatment process consists of an influent pump station, headworks primary clarifiers, trickling filters (TFs), aeration basins, secondary clarifiers and disinfection (chlorination/ dechlorination).

Presently operating as a series hybrid trickling filter solids contact plant, the secondary treatment process has evolved over 50 years to be very energy efficient (7 kWh/MLpd) and have low production of secondary solids (0.3 kg TSS/kg BOD).

ZAPS TECHNOLOGIES

fluorescence measurements for E.Coli detection, the automated LiquID station acts as a real-time, reagent-free process control tool to monitor E.Coli in tertiary treatment streams. Corvallis WWTP was already measuring TSS, cBOD, COD, NH3, Nitrate+Nitrite and TSS using a LiquID station at our final effluent location. We took further advantage of this existing LiquID instrument by using it to also monitor E.Coli concentrations in our final effluent.

THE PROOF IS IN THE PUDDING - VALIDATION

Corvallis WWTP is no stranger to new technologies; being in a college town (home of Oregon State University) we have ample opportunities to test technologies in development and keep an eye towards new instruments in the industry. The LiquIDs would have to make continuous, accurate and dependable measurements in the field to be successful in this deployment.

STEP 1: REDUCED Cl2

In January, with the ZAPS LiquID successfully reporting E.Coli in real time, the initial Cl2 residual was incrementally cut from 1 mg/L to 0.4 mg/L. During low flow days, and especially during low flow periods of low flow days, elevated E.coli counts became more pronounced. The events were attributed to poor Cl2 mixing during low flow periods. Moving the hypo feed location to the secondary clarifier launders for better mixing prior to measuring the initial Cl2 residual resolved the issue. This modification opened the door to further reduction in the initial dosage of hypo.

Again, the NaBs dosage was reduced to neutralize the new, lower final effluent Cl2 residual of 0.1 mg/L, and provide a NaBs residual of 0.2 mg/L. This resulted in an applied dosage of NaBs of 0.3 mg/L.

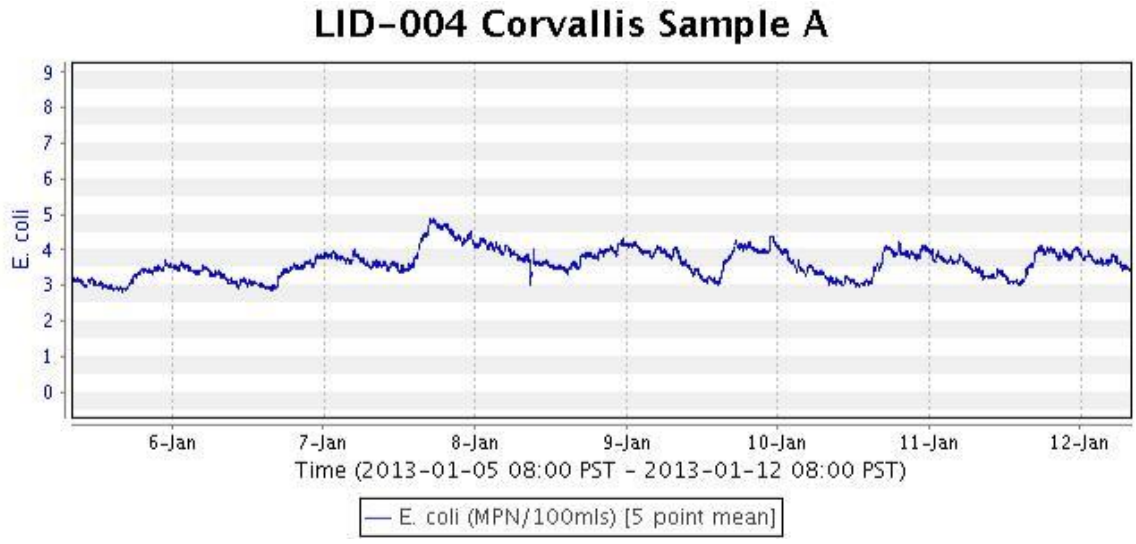

Figure 2: 6-day E.Coli cycles at Corvallis, OR WWTP (01/06/2013 – 01/12/2013)

STEP 2: PROCESS CHALLENGES AND OPPORTUNITIES

Later in January, the initial Cl2 set point was cut to 0.2 mg/L. As a result the effluent residual is almost always 0.00 mg/L before de-chlorination. The NaBs residual set point is 0.1 mg/l, and with no residual Cl2 demand to neutralize the typical applied dosage is 0.1 mg/L. Achieving the low dose rates was not straight forward and required new, low range Cl2 probes and NaBs analyzer recalibration to reliably measure residuals and control chemical feed rates. With further history, NaBs usage may be suspended seasonally or perhaps entirely.

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The trend line below (figure 3) shows the E.coli count response to a February 21 storm event in our community, which has combined sewers. The treatment plant flow had jumped from 32 MLpd to 83 MLpd in less than one-half hour.

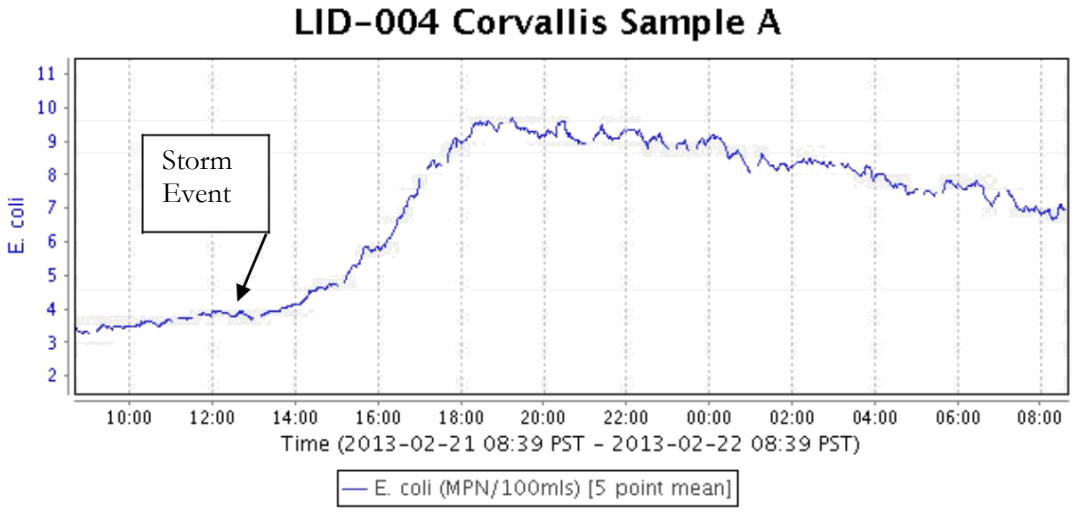


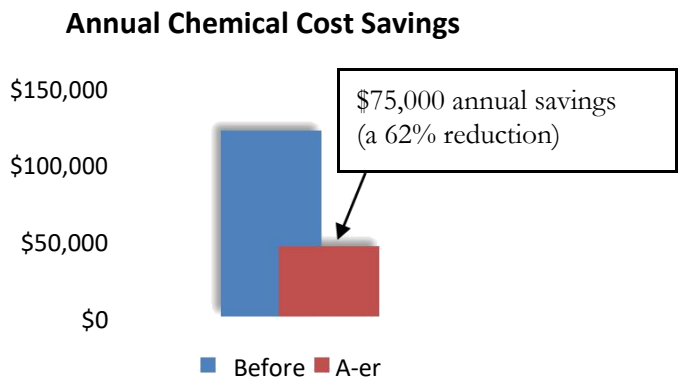
Figure 3: E.Coli storm event at Corvallis, OR WWTP (02/21/2013 – 02/22/2013)

Experience using low chemical dosages has revealed yet another opportunity for chemical savings. Corvallis' two trickling filters are large for a community of 55,000 and are lightly loaded. Heavy and thorough nitrification of ammonia is encouraged during the summer months by operating the trickling filters in series. However, during the winter months the trickling filters operate in parallel mode to discourage nitrification. Previously obfuscated and hidden in the noise of much higher chemical dose rates was the chlorine demand exerted by partial nitrification of ammonia to nitrite. Low concentrations of nitrite in the secondary clarifier effluent are now observable and will more than double the applied dosage to achieve the 0.2 mg/L initial Cl2 residual set point. Under winter conditions, partial nitrification is variable and transient, for which a process control strategy to effectively prevent partial nitrification is being developed.

The Bottom Line – Cost Savings

Annual chemical savings from the changes to the e.coli pacing processes are currently projected to be $75,000 or 62% of the annual chemical budget. Real-time E.Coli data allowed us to fit the treatment process to the actual conditions in the treatment stream while at the same time increasing the oversight of this critical regulatory parameter.

Additional saving may result from the use of ZAPS technology to control disinfection chemicals at the CSO treatment facility.



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