Instrumentation Based
Real-Time Process Optimization

November 13, 2018

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Claros Process Optimization
LOTS OF VARIATIONS IN PROCESS CONTROL

Operator Questions -

• What to measure – and why?
• Where to measure it?
• Is a daily grab sample representative, good enough?
  – Hint: It is not
• Is my plant running as designed?
• Is my instrument giving me correct readings?
• What do I do with the data?
• Do the chemical, power savings matter?
  – Hint: Absolutely
UTILITY MARKET’S BUSINESS ISSUES

- Retiring workforce - Institutional knowledge is leaving the industry
- Grab sample process changes lead to chasing problems & never catching them
- Budget concerns
- Compliance regulations
- Data management

Everyone is being asked to do more with less but how?
RTC – REAL TIME CONTROL.

Feed just enough chemical to meet setpoint.

Add just enough DO to meet the ammonia setpoint.

Feed exact polymer to meet sludge density setpoint.

Calculate & maintain the best SRT for your system.
ILLINOIS (CURRENT STATE)

Daily Flow / Phosphorus Concentration 2017
ILLINOIS PHOSPHORUS LEVELS

Based on 2017 Data

146 days Spent overfeeding Alum

Cost:

22,552 gallons excess used (Actual vs. Target of 0.95 mg/l)

= 5 truckloads of Alum

$27,062
## ILLINOIS PHOSPHORUS LEVELS
### DAILY COMPOSITE TESTING

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**HACH**: Be Right™
OHIO WWTP PHOSPHORUS LEVELS

Based on 2017 Data:

Phosphorus Discharge permit limit = 1.0 mg/l
Average discharge = 0.40 mg/l

(87 days sampled in 2017)

Alum Overfeeding cost
(based on 0.95 mg/l target)

$78,999.60
Beaver Dam, WI
5.6 MGD (Design) Activated Sludge Plant
City of 16,000 residents
Limit of 1.0 mg/L  Set point of 0.9 mg/L
Never deviates outside of 0.85 – 0.95
"If we were high one week, we overfed ferric to make sure the average for the month was below our 1.0 mg/L total phosphorus limit."

The average dose was 300 gpd at 12.5 gph.

Now during months of higher loading, the ferric feed rate may increase from 3 gph to 10 gph.

"Estimated annual savings of $50,000 to $70,000 have more than paid for the system."

Besides affordability, a major benefit was peace of mind. Previously, staff worried about whether the plant was over or at its limit for the month. "Now, the RTC controls the dose and I know we will be within our limit,“

"it has worked flawlessly."

Rob Minnema, Director or Utilities Beaver Dam, WI
RTC1017P MODULE
REAL TIME PHOSPHORUS CONTROL SOLUTION
RTC-P

Components

**PHOSPHAX sc + Filtrax**
- Controls RTC parameters
- Signal validation
- All communication capabilities

**sc1000**
- Calculates set-points in real time
- Interface for dosing pump
- Install in PLC cabinet

**RTC-P**
- Needed to determine loading

**Plant Flow**
- Control pump feed of precipitant based on PO₄ concentration

**Dosing Pump**
WHY HACH’S RTC FOR PHOSPHORUS CONTROL?

- Treatment Process is Optimized
  - Phosphorus load (Flow x Conc.) vs. Chemical effectiveness
- ROI is proven, can be switched between precipitants
- Cost savings can be redirected
- Compliance worries are gone
- Hach offers packaged integration!
PO4-P PRECIPITANT CONTROL MODULE

Chemical Feed: Primary Clarifier

Chemical Feed: Secondary
PHOSPHORUS ANALYZER– COLORMETRIC

- Sample Ranges
  - 0.0 – 2.0 mg/L PO4-P
  - 0.05 – 15.00 mg/L PO4-P
  - 1.0 – 50.00 mg/L PO4-P

- 5 – 120 minute measurement interval
  - Faster the interval...faster use of reagents
The Filtration Module prepares sample through two ultra-filtration membranes (0.15 μm).

Modules are immersed in the process tank.

Peristaltic pump pulls the sample through one filter at a time, allowing for optimal cleaning.

Unit automatically cleans by forcing vigorous stream of air bubbles against sides of the filter modules.
CONTROLLERS/TRANSMITTERS

Standard Features

- Highly configurable
- Up To 8 Sensors
- Plug And Play Functionality
- C1D2 Certification
- NEMA 4x/IP66
- 4 Relays
- Up To 12 Ma Outputs
- Up To 12 Ma Inputs
- SD Card For Data log And Configuration
- Networking
- Allows Up To 32 Devices Per Network

Communication Options

- Modbus Rs232/Rs485
- Modbus TCP/IP
- Profibus Dp
- Hart 7.2
PHOSPHORUS DOSING CONTROL DESIGN QUESTIONS

- Model based or feedback?
- Control or modelling/trending?
- How much Chemical is required to remove the Phosphorus?
- Control the pumps directly, or have a separate SCADA control loop?
- What if something else is limiting reaction?
- How to integrate sensor diagnostics into the controls?
- Who will train everyone on the system?
- How long will it take to write and test the logic?
- What if a sensor fails?
- How to store the data?
- Who will write the O&M Manual?
- Who will fix it if it breaks?
PHOSPHORUS DOSING CONTROL SOLUTIONS

Hach RTC-P Module
1. What to measure & where ✓ Done
2. Can both model and/or control ✓ Done
3. Definition of control algorithms ✓ Done
4. Programming of control algorithms ✓ Done
5. Implementation on hardware ✓ Done
6. Testing of software and hardware ✓ Done
7. User interface ✓ Done
8. User manual ✓ Done
9. Backup stages ✓ Done
10. Communications interface ✓ Done
11. Data stored on IPC ✓ Done
12. Onsite & remote support ✓ Done
13. Setting of the plant-specific parameters During commissioning
CLAROS PROCESS MANAGEMENT
Standardized RTC control modules

- Adapt asset plant operation to varying load situations and plant performance
  - Improved compliance (minimize risk)
  - Reduced OPEX / Short ROI (economically viable)
  - Improved process transparency

All analytical input signals **validated** by Instrument Management / PROGNOSYS®

- High reliability, high uptime
Large number of installations

- **1850 sites** in EU, US, China operating an RTC
  - 70% of plants between 2-8 MGD
- **3150 control modules** in operation
- Growing number of industrial RTC

Experienced Global RTC Team

- Growing team of RTC consultants
  - 28 in EU, 5 in US
- Sales & Service NA: 250 associates
- Centralized (US and EU) RTC Service/Commissioning experts providing remote support & monitoring
Standardized modules for

- Nitrification / Denitrification
  - 10 - 20% aeration energy savings above conventional NH3 trim optimization
  - Improved alkalinity
  - Reduced denitrification in Secondary Clarifiers

- Chemical phosphorous removal
  - Savings on precipitant (10 - 50%) and sludge disposal
  - Process stability by reducing loss in alkalinity

- Sludge treatment
  - Savings on polymer (15 - 20%)
  - Increased gas yield (5 - 10%)
  - Less sludge disposal cost (10 - 15%)
  - Reduced maintenance work
# REAL TIME CONTROL MODULES

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<tr>
<th>Type</th>
<th>RTC</th>
<th>Application</th>
<th>Compliance</th>
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| P             |     | Chemical P-elimination       | $P_{\text{tot}}$ | - Precipitant  
- Sludge treatment /disposal |
| N             |     | Nitrification (plug flow)    | $\text{NH}_4\text{-N}$ | - Energy (aeration intensity) |
| DN            |     | Denitrification (IRC / Ext. C)| $N_{\text{tot}}$ | - Energy (DO recovery, IRC)  
- External Carbon |
| SZ            |     | Swing zone adjustment        | $N_{\text{tot}}$ | - Energy (aerated volume) |
| N/DN          |     | Intermittent denitrification  | $N_{\text{tot}}$ | - Energy (aeration time/volume, DO recovery) |
| OXD           |     | Simultaneous denitrification  | $N_{\text{tot}}$ | - Energy (controlled DO) |
| DO            |     | Aeration                     | $\text{NH}_4\text{-N}$ | - Energy (aeration intensity) |
| SF            |     | Nitrification (step feed)    | $\text{NH}_4\text{-N}$ | - Energy (aeration intensity) |
| MOV           |     | DO Control                   | NA         | - Energy (aeration intensity) |
| Sludge Mgmt.  |     |                              |            |                                                        |
| SRT           |     | Sludge age                   | $\text{NH}_4\text{-N}$ | - Energy (for BOD removal) |
| ST            |     | Sludge thickening            |            | - Polymer,  
- Increased gas yield |
| SD            |     | Sludge dewatering            |            | - Polymer,  
- Sludge disposal |
| Industry      |     |                              |            |                                                        |
| DOS           |     | Nutrient dosing              | $N_{\text{tot}}$, $P_{\text{tot}}$, $\text{NH}_4$ | - Urea  
- Phosphoric acid |
| DAF*1         |     | Dissolved Air flotation      | COD, TSS   | - Coagulant, Polymer |

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*HACH*

*Be Right™*
COMMitted to support you from design to operation