Smart Sampling Systems: Successes and Challenges

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Process Analytical Systems – A Long History

• Late 1930s: First analyzer implemented at I.G. Farbenindustrie in Germany

• 2014: Annual global process analytical instrumentation business is estimated to be $7.9 billion*

Why Use Process Analyzers?

• Make process operations more profitable
  – Closed loop control to meet product specifications
  – Plant monitoring and alarms
  – Emission control
  – Documentation

• Custody transfer
  – Product quality
Process Analyzer Systems

- Process
- Analyzer
- Sample Conditioning
- To DCS
## System Dichotomy

<table>
<thead>
<tr>
<th></th>
<th>Amount of Maintenance Required</th>
<th>Diagnostics and Other Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyzer</td>
<td>Relatively low</td>
<td>Relatively high</td>
</tr>
<tr>
<td>Sampling System</td>
<td>Relatively high</td>
<td>Relatively low</td>
</tr>
</tbody>
</table>

As a result, sampling systems represent:
- Least reliable part of the system
- Least predictable part of the system

- In 2009, Rob Dubois (retired Dow Canada), an early leader in the development of NeSSI, stated:
  - “Sampling systems are one of the last bastions of manual operation left in a modern processing facility. Why does process analytical remain an anachronism in a sea of automation?”
Sampling Systems 2016 – Some Progress
Moore, G., “Crossing the Chasm: Marketing and Selling High-tech Products to Mainstream Customers”, 1991
And Yet...

- Money is spent to upgrade/replace the analyzer, but the sampling system is often left as is.
A Confluence of Challenges & Opportunities

Source: Presented by Rod Spitler of Dow Chemical at ISA-AD Conference, May 2014
Process Analytic Challenge – Analyzer Reliability

- Highly dependent on the sampling system!
- If no flow to analyzer, no feedback to process control system
- How do you know if product is on-spec?
- What would it cost if you have to reprocess that material?
Why Use Process Analyzers?

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Real-time!
Time Value of Information

Relative Value of Information

Timing (point at which received during process run time)

Process Analytic Challenge: Analyzer Credibility

- The analyzer is working fine, but not following the process
- Maybe the fast loop flow is not so fast. Do you know?
- How many unnecessary analyzer calibrations could be avoided?
- How much could plant yield be improved?
Value of Operability Improvements

• 2016 ISA-AD Presentations
  – Tighter control of a gasoline blending operation, yielding an estimated payback of $1.6M/year
  – Satisfy operational requirements on an FCCU regenerator flue gas line with only 1.4% RATA downtime
  – “The ability to monitor the blend in real time and to perform closed-loop control trimming of the butane fraction can lead to improved product quality and profitability.”

• Meeks, J. and Eskridge, D., “Continuous Emission Monitoring on an FCCU Regenerator: A Case Study”
• Arenes, J.C and Simmonds, “A Review of Gasoline Blender Optimization Through Online Analysis of Vapour Pressure”
Process Analytic Challenge: Productivity

- Can only identify if a conventional sampling system is working by visual inspection
- No action is needed 63% of the time!
- How much time could be saved if you knew what maintenance action was needed before going to the site?
- What activities could be accomplished using the time savings?
- Could plant safety performance be improved by fewer visits onsite in the process units?

Source: Shell Global Solutions
Analyzer House of the Next Decade

Analyzer House (Class 1 Div 2)

Control Room, Analytical Reliability Center or Maintenance Center

Intrinsically Safe Comms & Power

Plantwide LAN

Historian software such as:
- Siemens ASM
- ABB STAR
- Invensys AMADAS

continuously monitors analyzer and sample system data enabling predictive maintenance.

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One Minute of Collected Data

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Day/Time</th>
<th>LA_FLOW_SCFH</th>
<th>LA_PTX_UP_P_PSI</th>
<th>LA_PTX_UP_T_C</th>
<th>LA_PTX_DWN_P_PSI</th>
<th>LA_DP_PSI</th>
</tr>
</thead>
</table>
## Turn Data Into Information

<table>
<thead>
<tr>
<th>Sampling Location 1</th>
<th>Sampling Location 2</th>
<th>Sampling Location 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sampling Location 4</td>
<td>Sampling Location 5</td>
<td>Sampling Location 6</td>
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<tr>
<td>Sampling Location 7</td>
<td>Sampling Location 8</td>
<td>Sampling Location 9</td>
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</tbody>
</table>
Go Directly To The Issue
Trends Tell A Story

Liquid Furnace - Analyzer Stream - PTX Differential Pressure

Auto blow-back system engaging once a day

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Insights Into Operational Improvements

Opportunity to do flow-based instead of scheduled blowback

Better understanding of post-blowback operation could yield improvements
Long-Term Benefits

• Improved measurement validity and reliability
  – Validity assured during upsets, bad weather or storm conditions, holidays and other times of lowered maintenance
  – Increases analyzer uptime and credibility

• Maintenance cost reduction
  – Continuous monitoring of system automatically vs. periodic check by human walk-by
  – When maintenance is required, personnel know maintenance situation, parts and tools required before going out to system

• Personnel safety
  – Fewer visits to sampling locations
Lower Total Cost of Ownership

What is Hampering Adoption?

• Payback period is less than 2 years, but...

• Procurement is rewarded for savings on the initial purchase price
  – Do not really care about total cost of ownership
  – ‘Soft benefits’ do not matter
  – Must show tangible cost savings

• We must show how smart sampling systems can improve plant profitability
  – Constant flow to analyzer (increase analyzer uptime)
  – Analyzers follow the process (tighter control)
  – Fewer visual inspections (better use of technician time; improved safety)
Our Role

• We all (end users, EPCs, integrators, suppliers) must look for the “better way” and proactively sponsor change
Summary & Conclusions

• We have made some progress toward smarter sampling systems – but not mainstream yet
• Smart sampling systems provide an opportunity to increase end user profitability
• Challenges remain in adopting smart sampling technology
• We can overcome these challenges through our collective energy, creativity and enthusiasm
• Let’s not allow sampling systems to be an “anachronism”
Thank you for your attention!

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