Pump Optimization using FactoryTalk VantagePoint Plug-in

Rick Hargreaves
Grantek Systems Integration Inc.

Rockwell Automation Process Solutions User Group (PSUG)
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Chicago, IL - McCormick Place West
Agenda

• Session introduction
• Grantek intro
• Brief overview of FactoryTalk VantagePoint
• Pump optimization
  – Benefits
  – How to get them
  – Where do I start
• How do we do it?
• Conclusions
Introduction

- Energy savings are very topical
- Rockwell’s FTVP and Grantek’s Pump Optimization plug-in module
  - Quickly benchmark how optimized their pumping assets are at the moment and also
  - Benefit from continuous optimization
  - Reports through FTVP
  - Once installed, reports are accessible in FTVP.
  - Samples of real-time reports and trends
Grantek Systems Integration Inc.

- Manufacturing automation and information integration since 1980
  - ~130 employees

- Locations:
  - Chicago IL
  - Allentown PA
  - Moline IL
  - Jacksonville FL
  - Burlington ON Canada
  - Barrie ON Canada
  - Montreal QC Canada
Background

- Focus on the manufacturing automation space, specializing in food/bev processing, pharmaceutical, and CPG
- Expanding our Business Intelligence practice; helping decision makers access and extract value from their operational data
- Water / Wastewater industry is one key practice area
Our clients
Pump Optimization

- Real-Time and historical analysis of pumping systems
- Extends FTVantagePoint’s base functionalities, providing value-added capabilities that leverage underlying Operational Intelligence
- Assess/analyze/visualize performance of your Pumping System assets.
Pump Optimization

• Grantek and Rockwell FTVP
  – Plug-in to FTVP – genesis is DOE/PSAT
  – Continuous calculations
  – Historize results
  – Any FTVP user can access via portal
  – Reporting/workflow inherent
Sample Pump #15

Historical View

Summary

Optimization Rating

Annual Energy Cost

Annual Energy

Electric Power

Pump Efficiency
Efficiency testing and analysis indicate that a 300-horsepower centrifugal pump has an operating efficiency of 55%.

Pump curve indicates that it should operate at 78% efficiency.

The pump draws 235 kW and operates 6,000 hours per year.

Assuming that the pump can be restored to its original or design performance conditions, estimated energy savings are as follows:

\[
\text{Savings} = 235 \text{ kW} \times 6,000 \text{ hrs/yr} \times [1 - (0.55/0.78)] = 415,769 \text{ kWh/yr.}
\]

At an energy cost of 8 ¢ per kWh, the estimated savings would be $33,261 annually.
What is FTVP?

- FactoryTalk VantagePoint is an integration platform
- access to all manufacturing/plant data sources
- web-based reports, dashboards, trends, X-Y plots
- combines current and legacy systems
- virtual data source for plant-wide reporting and information visibility
- excels at combining and correlating data from all data sources
- Yellow pages for your data!
Quality Report For: 11Cap
My Company.Site A.Filling_A.Line 1
Current Shift
Report Generated: 2010-12-23 09:10:55

Last 24 Hours Scrap % by Hour

<table>
<thead>
<tr>
<th>Part Id</th>
<th>Total Parts</th>
<th>Good Parts</th>
<th>Scrap Parts</th>
<th>Scrap Parts %</th>
</tr>
</thead>
<tbody>
<tr>
<td>128 oz</td>
<td>349</td>
<td>314</td>
<td>35</td>
<td>10.03%</td>
</tr>
<tr>
<td>328 oz</td>
<td>249</td>
<td>225</td>
<td>24</td>
<td>9.64%</td>
</tr>
</tbody>
</table>
The Challenge

- Pumping intensive businesses
  - Energy cost control
  - Window in to consumption
  - Sustainability
  - Capital preservation
Objective

- Integrate Pump Analysis capability into the Client’s BI tool
- Canned reporting for Optimization snapshot and history
- Pump efficiency and related measurements look and can be treated just like any other property for analysis and reporting purposes
- Current value / point in time value
- Historical value and trending over time
- Comparison or correlation with other properties or pumps
- Cost of operation calculated over rate changes or time of day rate variances etc
FTVP Pump Optimization

- Real-Time and historical analysis of pumping systems
- Extends FTVantagePoint’s base functionalities, providing value-added capabilities that leverage underlying Operational Intelligence
- allows users to assess/analyze performance of their Pumping System assets.

The plug-in
- Calculates current energy consumption and cost
- Derives an Optimization Rating
- Potential energy and cost savings based on comparison of performance versus typical characteristics of commercially available pump and motor combinations for the same application.
Pump Optimization

- Consultant vs FTVP Plug-in
  - Consultant provides a current snapshot
  - Snapshot = no history, point in time calculation
  - Snapshot = no seasonal interpretation or correction
  - Snapshot = no correlation capabilities
• PSAT tool
  – DOE’s Industrial Technologies Program
  – Point in time calculation
  – Complicated, manually run every time
  – Consultant uses this tool and charges you
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The Challenge

• Energy consumption facts
  – > 60% of industrial motor systems involve fluid handling
  – Life cycle costs of 250 HP pump and motor
    • $28,000 initial cost plus ~ $5,000/yr maintenance
    • First year energy cost ~ $69,000
    • TCO for 10 years + $778,000
  – Likely only a few pumps account for most energy consumption
  – Help manage demand costs
Grantek’s Pump Assessment tool

- plug-in for FTVP using industry standard calculations – DOE/PSAT
- assess the efficiency of pumping system(s)
- calculate potential energy and associated cost savings
  - pump performance data
  - Hydraulic Institute standards
  - motor performance data from the MotorMaster+ database
Logical Model for Pump Optimization

Definition of ‘Pump’ updated to also carry PSAT and Efficiency related properties

‘Analyzed Results’ is a collection of output properties
Logical Model for Pump Optimization

- Logical model
Definition of ‘Pump‘ updated to also carry PSAT and efficiency related properties
• Analyzed Results’ is a collection of output properties

<table>
<thead>
<tr>
<th>Item Name</th>
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</thead>
<tbody>
<tr>
<td>Annual Energy Cost Savings</td>
</tr>
<tr>
<td>Annual Energy Usage Savings</td>
</tr>
<tr>
<td>Electric Power Savings</td>
</tr>
<tr>
<td>Existing Annual Energy Cost</td>
</tr>
<tr>
<td>Existing Annual Energy Usage</td>
</tr>
<tr>
<td>Existing Electric Power</td>
</tr>
<tr>
<td>Existing Pump Efficiency</td>
</tr>
<tr>
<td>Optimal Annual Energy Cost</td>
</tr>
<tr>
<td>Optimal Annual Energy Usage</td>
</tr>
<tr>
<td>Optimal Electric Power</td>
</tr>
<tr>
<td>Optimal Pump Efficiency</td>
</tr>
<tr>
<td>Optimization Rating</td>
</tr>
</tbody>
</table>
Solution Approach

1. Collect nameplate and operational data
2. Invoke PSAT-Q engine to compute efficiency properties
3. Allow reporting on efficiency properties

Canned and ad-hoc reporting, trending, and x-y plots

Inventory systems, spreadsheets, other systems of record

1. Collect nameplate and operational data
FTVP Plug-in

- Analysis results are standard FTVantagePoint tags, and can be referenced in any reporting or analysis.
• Look at properties over time
• Examine correlations between properties
• Examine differences between pumps
Ad-hoc Trending

- Examine correlations between properties
- Examine differences between pumps
- Two supposedly equivalent motor / pump combinations yet clearly there is a difference in behaviour at given line pressures
# Sample Pump #15

Niagara Region/District 2/South Street Plant/Low Lift Works/Pumps/Sample Pump #15

## Summary

<table>
<thead>
<tr>
<th>Nameplate Information</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Power</td>
<td>350 hp</td>
</tr>
<tr>
<td>Rated Speed</td>
<td>880 rpm</td>
</tr>
<tr>
<td>Rated Voltage</td>
<td>4160 volts</td>
</tr>
<tr>
<td>Estimated Efficiency</td>
<td>93.8 %</td>
</tr>
<tr>
<td>Full Load Current</td>
<td>46 amps</td>
</tr>
<tr>
<td>Measured Power</td>
<td>237 kW</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pump Information</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid Type</td>
<td>Clean</td>
</tr>
<tr>
<td>Fluid Specific Gravity</td>
<td>1</td>
</tr>
<tr>
<td>Measured Flow Rate</td>
<td>4722 gpm</td>
</tr>
<tr>
<td>Discharge-suction Pressure</td>
<td>56.9 psi</td>
</tr>
<tr>
<td>Discharge-suction Gauge Elevation</td>
<td>47.5 ft</td>
</tr>
<tr>
<td>Energy Cost Rate</td>
<td>0.065 $/kWh</td>
</tr>
<tr>
<td>Duty Cycle</td>
<td>48.5 %</td>
</tr>
</tbody>
</table>

## Optimization Rating

81

## Calculated Results

<table>
<thead>
<tr>
<th></th>
<th>Existing</th>
<th>Optimal</th>
<th>Potential Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Energy Cost</td>
<td>$65,450</td>
<td>$52,283</td>
<td>$12,166</td>
</tr>
<tr>
<td>Annual Energy</td>
<td>1,007 MWh</td>
<td>820 MWh</td>
<td>187 MWh</td>
</tr>
<tr>
<td>Electric Power</td>
<td>237 kW</td>
<td>192.9 kW</td>
<td>44.1 kW</td>
</tr>
<tr>
<td>Pump Efficiency</td>
<td>71.5 %</td>
<td>87 %</td>
<td></td>
</tr>
</tbody>
</table>

## Graphs

### Annual Energy Cost

- **Existing**
- **Optimal**

### Annual Energy

- **Existing**
- **Optimal**

### Electric Power

- **Existing**
- **Optimal**

### Pump Efficiency

- **Existing**
- **Optimal**

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Historical View

What changed?
Conclusions
- Opportunity to reduce cost
- System efficiency
- History
- Sustainability story
Questions

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