Industrial Compressed Air System Energy Assessment

A Case Study of Energy Savings & Cost Reduction.

Critical Elements of an Energy Assessment for Compressed Air Systems.

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Compressed Air System Energy: a leading bare copper & tin plated copper wire manufacturer.

- Leading USA manufacturer of bare copper & tin-plated copper wire products used to transmit digital, video and audio signals or to conduct electricity.

- The culture is one of continuous improvement, and customer satisfaction on the basis of quality, reliability, price, reputation, customer service, and on-time delivery.
Compressed Air System a major energy consumer

- Compressed air
  - is a major energy user.
  - directly impacts the manufacturing process.
  - affects product quality.

- “Air Wipes”
  - compressed air removes process chemicals that clean, etch, and plate the wire.
  - consume large amounts of compressed air.
  - are a critical end use of compressed air.
Air Wipes – compressed air removes liquid between process stages

- Evaluate of the possibility of reducing the number of air wipes.
  - Findings are that it is unacceptable to reduce the number of air wipes.
    - Cross contamination of process chemicals is unacceptable.
    - Replacing spoiled chemicals is expensive.
    - Plating quality can be compromised.
    - Poses an unacceptable risk to strict quality standards.
Compressed Air System Assessment

• Rather than focus only on air wipes perform a comprehensive system assessment to understand actual production requirements of compressed air pressure and flow.

• Requirements include:
  • pneumatic cylinders, tools and other ancillary pneumatic equipment.
  • air wipes are the largest compressed air demand consuming the majority of the plant’s compressed air.
## Compressed Air System Assessment Baseline Performance

<table>
<thead>
<tr>
<th>System Capacity &amp; Operating Pressure</th>
<th>Compressed Air Flow</th>
<th>Electrical Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed Capacity (Qty 5) compressors 125 psig rating.</td>
<td>1,350 acfm</td>
<td>350 Hp / 275 kW</td>
</tr>
<tr>
<td>Measured Performance at 92 psig average pressure</td>
<td>1,120 scfm</td>
<td>223 kW</td>
</tr>
<tr>
<td><strong>Baseline Operation (July 23rd – August 6th, 2010)</strong></td>
<td>Weekday Baseline</td>
<td>Weekend Baseline</td>
</tr>
<tr>
<td>Plant Compressed Air Demand (measured)</td>
<td>995 scfm weekday</td>
<td>969 scfm weekend</td>
</tr>
<tr>
<td>Annual Energy use</td>
<td>1,581,927 kWh</td>
<td>257,218 kWh</td>
</tr>
<tr>
<td>Total Annual Energy use 1,839,145 kWh</td>
<td>Present Energy Cost @ $ 0.080 / kWh</td>
<td>Future Energy Cost @ $ 0.095 / kWh</td>
</tr>
<tr>
<td>Baseline 350 days / year, 15 down days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline energy cost of operation</td>
<td>$ 147,132 / yr</td>
<td>$ 174,719 / yr</td>
</tr>
<tr>
<td>Average cost of compressed air</td>
<td>$ 294 / MMscf</td>
<td>$ 349 / MMscf</td>
</tr>
</tbody>
</table>
Compressed Air Assessment

key findings

• Plant air requirements of cylinders, tools, and other equipment
  • require typical compressed air pressure of 100 psig +/-
  • Are a small fraction of total consumption 80 to 100 scfm
    which is less than 15% of total air demand.

• Air wipes
  • are 85% of total air demand, typically 500 to 650 scfm.
  • the lowest optimum air wipe pressure is 40 psig
Measured Data with Reduced Quantity of Air Wipers

Interpolated Data

Measured Data
Compressed Air Assessment
key findings

• Air wipes lowest optimum pressure is 40 psig
  • Air wipes are being supplied at higher pressure than necessary.

• When operating at the proper supply pressure each air wipe’s consumption is reduced by 45 scfm.

• For all six production lines the total savings in reduced Artificial Demand savings is 270 scfm.
Compressed Air Assessment opportunities for savings

• Create a 2 pressure air generation and distribution system and Maintain 40 psig air wipe supply @ the lowest optimum pressure and eliminate artificial demand.

• Operate base load compressors at the lower “air wipe” system pressure.

• Operate the trim compressor at the higher “plant air” system pressure.

• Implement heat recovery for winter time space heating
Compressed Air Assessment
energy reduction & cost savings

• Original system assessment
  • 1,839,000 kWh Baseline

• Energy Reduction
  • 442,000 kWh / yr.  Two pressure system
  • 200,000 kWh / yr.  New compressors @ 50 psig
  • 300 MMBTU  Heat Recovery

• Cost Savings
  • $42,000 / yr.  Two pressure system
  • $20,000 / yr.  New compressors @ 50 psig
  • $27,000 /yr.  Heat Recovery
Four Critical Elements of a System Assessment

1. System Optimization – anticipated results & outcomes

2. Baseline – parameters measured and methods used

3. Baseline – documentation and reporting

4. Considerations for future measurement & verification
Efficiency Incentives

Energy Efficiency Fund (E2F)

• Measurement and Verification Requirement
  • Baseline measurement
  • Post-implementation measurement

• Adjustments
  • Routine Adjustments
  • Non-routing adjustments

• Investment grade assessment
Efficiency Incentives
Program Challenges

• Time for assessment, approval, design, construction, & commissioning
• Changes to production conditions, equipment, markets, products, manufacturing process

• Baseline conditions
• M&V conditions

Lack of information to adjust for changes.
Energy Management Standard

- GA Tech MSE2000
  - Energy Management Standard

- ASME Energy Assessment Standards - Systems
  - EA-1 – 2009 Process Heat
  - EA-3 – 2009 Steam
  - EA-2 – 2009 Pumping
  - EA-4 – 2010 Compressed Air

- International Organization for Standardization
  - ISO11011 Compressed air – Energy efficiency – Assessment
  - ISO/ASME 14414:2005 Pump system energy assessment

- ISO50001 – Energy Management
System Approach, Proven Savings

- Over 2 decades of experience & results

- Compressed Air System
  - Improve supply efficiency
  - Eliminate pressure loss
  - Reduce consumption
Critical Elements of an Energy Assessment for Compressed Air Systems

Questions

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Critical Elements of an Energy Assessment for Compressed Air Systems

Questions

Thank You!

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History of the Systems Approach

- 1980’s System Review
  - Waste & Maintenance

- 1990’s System Audit
  - Calculate cost / savings

- 1992 First Datalogging
  - Pressure profile
  - Air flow & Power (amps)

- 1995 System Approach
  - Overall efficiency

- 1998 System Assessment
  - Measure & Document
  - Life cycle cost & business

- 1998 DOE formation of
  - Compressed Air Challenge
  - Training & education

- 2000 UNIDO
  - United Nations Industrial Development Organization
  - Industrial Energy Efficiency Programme
1. System Optimization
Anticipated Results and Outcomes
1. System Optimization
Anticipated Results and Outcomes

• When planning and designing the assessment consider possible results / outcomes and plan to clearly define existing conditions.

• Plan to document system conditions that may change.
  • Gather relevant drawings, documents, equipment data sheets and specifications.
  • Take photos
2. Baseline Measurement
Parameters measured & methods

• Document the measurement plan.
  • Can measurements be repeated by someone who was not involved in the original measurement.

• Clearly describe measurements
  • Unique ID tag for each point, parameter measured, measurement device used.
  • Measurement location – drawings and diagrams clearly marked, take photos.
  • Methods & data recording – data source, transducer installation, sample rate, data interval, data logger / recording device.
3. Baseline Analysis
Documentation & Report Content

• Document analytical methods.
  • Does the report with supporting documents allow the reader to understand and duplicate the analysis.

• Describe analysis
  • Outline the steps followed during data analysis.
  • Reference drawings, sketches, charts, graphs, etc.
  • Document sources such as handbooks, texts, journal articles, web sources, and other references used.
Considerations for Future Measurement & Verification

• Consider that M&V will likely be done months or years in the future by a person or team not involved in the original system assessment.

• Plan for M&V
  • Provide a framework and process of M&V recommendations. The best time to plan M&V is when planning the assessment.
  • Clearly identify, define, and quantify relevant variables as discovered during the assessment.
  • Document anticipated changes to the production process, operations, and physical plant that are anticipated to be in place when M&V is performed.
Evaluating the Results of Industrial Energy Efficiency Implementations

- It is often impossible to state with certainty the true energy result for implementation of many industrial energy efficiency projects.
  - Adjustments are necessary to bring the energy use of the baseline and M&V time periods to the same set of conditions (IPMVP).

- Pre & Post-Implementation conditions cannot be aligned
  - Results are unclear because pre-implementation conditions are not well defined.
  - Baseline energy measurement and analysis lack clarity.
  - Analytical methods of the assessment are not reported and cannot be duplicated.
  - Relevant variables necessary for adjustments were not identified nor quantified in the system assessment report.