Often Overlooked but Never Underused, Compressed Air – an Introduction

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Learning Objectives

1. Why compressed air should be considered as part of your commissioning portfolio

2. Understanding the basic compressed air system and its inefficiencies

3. Observations from the field

4. Opportunities for efficiency that positively impact the bottom line and make a case for commissioning
Compressed Air

• Widely used in manufacturing facilities

• Is an expensive form of energy

• Absolutely critical to production
  – Owners need dry, reliable air at the right pressure
  – Production shutdowns and equipment failure cost money, which businesses cannot afford
Compressed Air Systems

• Tend to be poorly designed

• Don’t always provide clean, dry, reliable air

• Are not well understood by plant personnel and maintenance staff

• Are poorly maintained

• Are inherently expensive to operate
  – Even more so due to poor operation
CA can benefit from Cx/RCx

• Significant benefits of Cx/RCx
  – Improves design and performance
  – Provides *clean*, *dry* and *reliable* air
  – Decreases energy costs
  – Avoids unnecessary expenditures
  – Has value to the owner and staff

• CA systems beginning to be Cx/RCx
  – Programs offered by utilities
  – Largely untapped market
Air is Free, Right?

- CA systems are one of the largest users of electricity in an industrial facility.
- A 100 hp compressor can reach $50,000 in electricity cost annually*
- Compressed air systems account for 1.5 billion per year in energy costs**

*Compressed Air Challenge
**Department of Energy

Source: E Source
What Makes Compressed Air So Expensive?

80% Lost as Heat

100% Energy In

20% Useful Work
Where Does it All Go?

- Of the total air produced
  - Only 50% actually contributes to production

- Of the total energy input to the compressor
  - Only 10% reaches the production floor

Source: E Source
Breakdown of Cost for a CA System

• Typical CA Plant Operating Cost Factors
  - Electricity use drives costs
  - Accounts for 75% of total cost
  - Major opportunity for energy savings
Opportunities for Energy Efficiency?

• Department of Energy
  - Estimates that 20 to 50% of the energy used by a compressor can be saved with energy efficiency improvements

• Savings potential
  - $10 K to $25 K for a 100 hp compressor
  - $300 M to $750 M (nationally)
A “Typical” Compressed Air System

Air

Compressor ①

Dryer ②

Air Filter ③

Air Receiver ④

Pressure Flow Controller ⑤

Filter, Regulator and Lubricator ⑥

Pneumatic Tool ⑦

Source: Compressed Air Challenge (CAC)
Observations from the Field

- Plant personnel use air as if it’s free; lack of understanding
- Compressor(s) operates at a pressure that is higher than needed
- Leak surveys and repairs are rarely ever performed
- Controls don’t work or poor schemes
- Poor system design
- High pressure drops
- Maintenance and operational issues
- Moisture in the lines
- Compressors operating on nights and weekends – when not needed
Energy

Cost Saving Opportunities

• Typical opportunities include:
  - Low flow nozzles
  - Pressure reduction
  - Leak reduction
  - Controls
  - Receiver capacity
  - Distribution system design

• Savings generally range from 20-50%

• Immediate to 3 year simple payback possible
Low/No Cost Opportunities for Savings

- **Leak Surveys**
  - Identify and repair leaks regularly
  - Implement a program
  - Maintained savings of **20% - 30%** is typical
  - May potentially allow for compressors to be turned off
Low/No Cost Opportunities for Savings

- **Operating Pressure**
  - Usually set at 100-110 psi
  - Most facilities have never attempted to lower the pressure
  - Higher pressures are needed due to poor distribution systems

- **Major automobile plant**
  - Heavy air user (over 1 M square feet)
  - Decided to lower pressure on their own
  - Previously used 84 psi
  - Now uses 74 psi (lowest observed)
    - Saves $180k/yr

- **Savings**
  - Typically 1% energy savings for every 2 psi reduced
Low/No Cost Opportunities for Savings

Eliminate inappropriate use of compressed air:

- Personal cooling
- Open pipe blow-off
- Cleaning
- Etc.

For energy savings use:

- Electric fan
- Electric blower, or engineered nozzles
- Shop vacuums

\(~ 8 \text{ HP of electrical energy} = 1 \text{ HP of work with CA}\)
From the Field – Air Nozzles

• Facility
  - Used pipes w/ holes for blowing (ex. see right)
  - Always kept air running despite no product on line

• Recommended
  - Engineered nozzles and air knives + solenoid valves and sensors

• Economics
  - Investment: $12,500
  - Savings: $13,400
  - Simple Payback: < 1 year
Capital Cost Improvements

• Improve controls
  - Ensures compressors operate fully loaded + properly sequenced
  - 10% potential savings

• Provide adequate storage
  - Typical range 3-4 gal/cfm
  - Will reduce operation of trim compressor

• VFD compressor for trim
  - Best part load performance

• Heat Recovery
  - 80% of compressor input energy available as heat
  - Can be used for space heating
From the Field - Controls

• Facility
  - Compressor
    o Equipped with energy efficient spiral valve controls
  - Control was observed to not be functioning
    o Operated in modulation mode only

• Recommended
  - Repair control

• Economics
  - Investment: $800
  - Savings: $20,000
  - Immediate Payback
Help the CA System Breathe Easier

• Reduce pressure drops
  - Correctly size pipes, use Y instead T connections
  - Don’t over-filter air

• Compressor inlet air
  - Compressors like cool, dry, clean air

• Maintain the compressor
  - Change filters, etc.

• Reduce moisture in the lines
  - Check dryer, drains, filters and pipe connections
  - Drain the system regularly
Conclusion

• There are many opportunities to increase the efficiency of compressed air systems
  - Good fit for Cx/RCx

• Should be considered for inclusion as part of a Cx/RCx portfolio

• Relatively untapped market for Cx/RCx

• Valuable service to the owner
Additional Resources

• Contact your local utility
  - May have a compressed air RCx program
    o ComEd, www.comed.com

• Compressed air information sources
  - The Compressed Air Challenge
    o http://www.compressedairchallenge.org
  - DOE Compressed Air Best Practices
    o http://www1.eere.energy.gov/industry/bestpractices/compressed_air.html

• Compressed air software
  - AIRMaster+
    o Can be found on DOE CA Best Practices site
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Thank you!

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