Compressed Air System Efficiency, Solutions, and Determinations

Kyle Burns
Joseph Zavodny
Torie Rose
David Kim
Jack Mamiye
Overview

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The Problem

Rutgers University Cogeneration plant was having issues with its compressed air system.

Low Air Pressure
What is compressed air? Who uses it?

- Compressed air is a utility used by over 70% of industry as a resource for operating key components in production and services. It is stored energy in the form of compressed and stored gas (air).

- It is used to perform various functions in industry, the most popular being the actuation of large valves and the operation of pneumatic tools, especially in the automotive industry.
Automobile manufacturers commonly use both pneumatic and hydraulic robots for the assembly of cars and trucks. The automotive repair industry also uses compressed air to fill tires and to power pneumatic tools.
What is a compressor?

A compressor is a device that is typically powered by an electric motor. This motor turns a shaft that, in turn, compresses air in one of three ways.
What is a compressed air dryer?

- There are two different types of compressed air dryers, both serving the purpose of removing moisture/humidity from the newly-compressed air.

- Rutgers in particular needs dry air for experiments that go on and for lower maintenance costs in its use, especially with pneumatic valves and tools.
While tanks are meant to provide area in which the compressed air to reside, they also allow the air to cool, which similarly releases moisture from the air, which is then later drained from the storage tank. Rutgers has three of these for its large compressed air demand.
The Rutgers Compressed Air System
The Rutgers Compressed Air System

- Contains one primary compressor, one backup compressor, and three small start-up compressors
- Contains three large storage tanks
- Contains one large mechanical dryer and several smaller desiccant dryers.
- The system is **centralized** with several buildings using back-up compressors to compensate for pressure-drops due to leaks.
- Currently suffers from leaks, moisture, and breakdowns.
Atlas is primary but breaks down. Ingersall-Rand is backup. Both are in efficient and set-up could be improved.
Data Collection

We worked with engineers from the Center for Advanced Energy Systems to collect data throughout the campus.

Library of Science & Medicine
(Problem Building)

Smithers Hall.
(Problem Building)
Air pressure cycles of operation.

Air pressure drop

Constant compressor and energy usage.
Our Approach

• In order to effectively approach the problem and eliminate unnecessary calculations, we simplified the system into a three scenarios of compressed air systems to determine their cost to operate, and therefore the most likely candidate for the Rutgers system.

• The first scenario is representative of wasted energy by leaks.

• The second two scenarios compared centralized to decentralized systems.

• Because we were not able to isolate a building or turn off the system, we could not determine the rate of leaks. Therefore, we took the industry-accepted value for leak estimate and used the number of 20% wasted energy in compensating for leaks.
Simplified scenario for calculation purposes on the point of compressed air leaks.
Scenario 2-A

Compressed Air = CA

Rotary Screw Compressor
200 HP

Building 1
100 HP worth of CA delivered

Building 2
50 HP worth of CA delivered

Building 3
50 HP worth of CA delivered

Simplified scenario of a centralized system.
Scenario 2-B

Simplified scenario of a decentralized system.
Results

- The Atlas costs $141,200 per year.
- Fixing leaks would save $25,000 per year.
- No leaks allows for lower HP compressor.
- Lower HP saves $15,000 per year.

Total Savings = $40,000 per year
Interpretation of Results

• No significant difference between centralized and decentralized systems in ideal scenario of no leaks.
• Efficiency determined by system application.
• Save more money by simply replacing old compressor and repairing leaks.
Conclusions

• No significant savings through decentralizing the system
• Losing about $50,000 per year on leaks by way of both wasted energy and over-compensation with a larger compressor.
Recommendations for COGEN

a) Replace the Atlas rotary screw compressor with a smaller, more efficient model.

b) Place isolated systems in buildings with long runs.

c) Repair leaks.

d) Communicate.
Sources


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