Compress Your Air Cost

By Jan Hoetzel SIGA Green Technologies

Introduction

Compressed air, often called the 4th utility, is one of the most expensive energy sources used in industrial plants, yet most plants have no reliable way to measure how efficient their compressed air systems are operating and how much it is costing them. In comparison, the owners of traditional utilities such as electricity, gas and water, have highly sophisticated systems in place to assure the demand and supply side match most efficiently.

Problem:

Most compressed air systems run inefficiently and often system owners are unaware of the scale of the problem. The system owners who are aware of the inefficiencies and try to take action to improve their systems are frustrated because they do not have the tools to either verify the improvement projects or monitor the long-term effects of the improvements.

Solution:

Data Logging

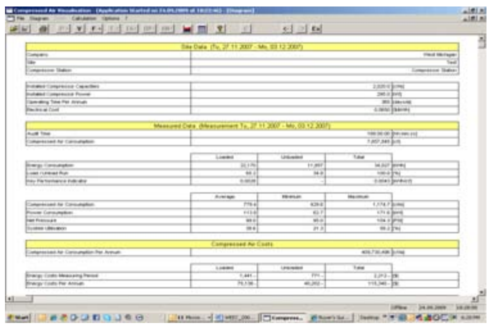
Accurate and precise compressed air system information collected by using a high speed data logger provides the base for compressed air improvement projects.

To start a compressed air improvement project the compressed air system needs to be evaluated. A compressed air high speed data logger designed specifically for compressed air audits is used to gather the status of the compressed air system. Data loggers have the ability to track and record systems using 1 second intervals over 7 day work periods providing the detailed information critical in developing the best strategy possible to improve the compressed air system.

The following example illustrates the effects precise data logging can have on improving compressed air system efficiency. The system has 4 compressors in various sizes (360 acfm, 2 x 520 acfm, and 620 acfm). The 3 largest compressors are turned on to run the plant and are set to run in load/unload.

A 7 day compressed air audit is performed using a data logger, providing charts, tables, performance data and cost information which allows an evaluation for each day of the week, the whole week and by zooming in, to analyze short term events .

Figure 1 contains performance and cost information used to calculate energy saving



potentials for improvement project.

Compressor System Efficiency Benchmarking

Using this approach, the Key Performance Index (KPI) is the "compressed air system efficiency" across all air compressors. Compressor efficiency is measured in kW/100CFM. The efficiency rating for all compressors is available at the Compressed Air and Gas Institute Website (CAGI, www.cagi.com).

To calculate the best case theoretical "compressed air system efficiency" across all compressors in the system, the CAGI data sheets are used to find each ones rated efficiency, allowing us to calculate the total system KPI - in this example it is 16.8 kWh/CFM.

For the actual data based on real life compressor usage, we return to the data logger. In this example the measured "compressed air system efficiency" is 25.8 kW/100CFM from the data logger.

This shows an inefficiency gap between the actual KPI of 25.8 as compared to the best case scenario of 16.8 kWh/CFM.

Calculating The Cost Of Inefficiencies Leads To Rewarding Investment

Compresses air improvement projects are directly linked to energy efficiency incentive programs from the electric utilities and are measured on kWh saved. Capturing the kWh savings and assuring the project has positive long term results is crucial. Since compressed air system do not typically have an energy usage meter or monitoring system built in, this makes the implementation and verification of compressed air system improvements more challenging than other types of energy efficiency improvement projects. Fortunately, the return on each dollar invested per kWh saved makes compressed air improvements very attractive and rewarding, even with the increased complexity, compared to other energy efficiency projects.

Master Control

The simplest and fastest way to improve air compressor efficiencies is to install a Master Controller to ensure that air supply (the air compressors) will automatically match compressed air demand in the plant.

Airleader Master Control and Monitoring System.

The projected effect of installing a master control was calculated by using a simulation program. In this example, the simulation program projected energy savings of 29.1% based on eliminating unload time energy and lowering the system pressure. After the installation of the master control it was necessary to evaluate the actual results for the system over a period of one week.

Figures 2 and 3 provide load/unload information comparing before and after installation.

Figure 2:

Before implementation of a master control

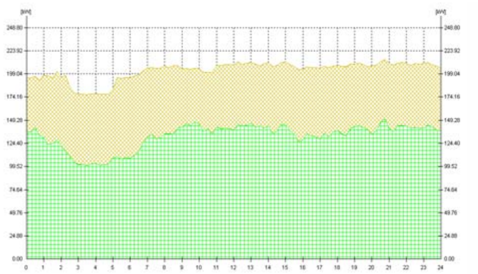
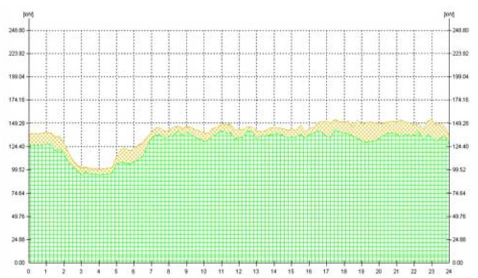


Figure 3:

After implementation of a master control



Compressor System Efficiency Improvement

The KPI is reduced from 25.8 kW/100CFM to 17.8 kW/100CFM, resulting in a relative efficiency improvement of 31% or 8 kWh/100CFM. The master control runs the compressed air system most efficiently and therefore, on average only 2 compressors instead of 3 run, which results in substantial energy savings as well as maintenance and service cost savings.

Absolute savings

The 8kW/100CFM savings result in an overall savings of approximately $40,000.

Figure 4 helps to identify potential savings provided by installing and properly using a master control. It is based on variable consumption levels and power costs and an 8kWh/100SCFM improvement. To find the cost savings go to the row with the appropriate average compressed air usage in CFM and then select the column with the proper energy cost per kilowatt hour and then identify the saving potentials in dollars that can result from installing a master control.

Figure 4

AVG USAGE in CFM	KW/Year Savings	Annual Savings at the rate of: $ 0.05 / kWh	$ 0.075 / kWh	$ 0.10 / kWh	$ 0.125/ kWh	$ 0.15 / kWh	$ 0.175 / kWh
500	350,400	$ 17,520	$ 26,280	$ 35,040	$ 43,800	$ 52,560	$ 61,320
600	420,480	$ 21,024	$ 31,536	$ 42,048	$ 52,560	$ 63,072	$ 73,584
700	490,560	$ 24,528	$ 36,792	$ 49,056	$ 61,320	$ 73,584	$ 85,848
800	560,640	$ 28,032	$ 42,048	$ 56,064	$ 70,080	$ 84,096	$ 98,112
900	630,720	$ 31,536	$ 47,304	$ 63,072	$ 78,840	$ 94,608	$ 110,376
1000	700,800	$ 35,040	$ 52,560	$ 70,080	$ 87,600	$ 105,120	$ 122,640
1100	770,880	$ 38,544	$ 57,816	$ 77,088	$ 96,360	$ 115,632	$ 134,904
1200	840,960	$ 42,048	$ 63,072	$ 84,096	$ 105,120	$ 126,144	$ 147,168
1300	911,040	$ 45,552	$ 68,328	$ 91,104	$ 113,880	$ 136,656	$ 159,432
1400	981,120	$ 49,056	$ 73,584	$ 98,112	$ 122,640	$ 147,168	$ 171,696
1500	1,051,200	$ 52,560	$ 78,840	$ 105,120	$ 131,400	$ 157,680	$ 183,960

Continuous Monitoring Verifies System Performance

Continuous monitoring records system performance and cost information. It illustrates the results of improvement efforts and immediately verifies the savings, e.g. from a leak project. Additionally, different departments can be charged appropriately for their air consumption based on actual flow instead of sqf. This way each department can benefit from their compressed air savings.

An integrated web-based monitoring system is used to easily verify system improvements. This can also provide the information needed to manage a compressed air system, send alerts if set parameters are not met, verify energy efficiency results and provide the base for continuous improvement efforts.

Figure 5 illustrates the results of improvement projects that are made possible through setting a baseline with a data logging system and implementing a master control with integrated continuous monitoring.

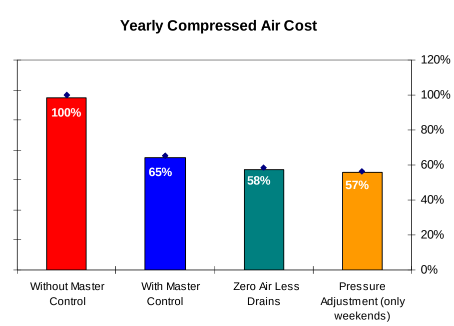
Red: Initial energy cost that is observed during the initial audit

Blue: Energy cost after the installation of a master control

Green: Energy cost after the installation of zero airless drains

Yellow: Energy cost after reducing system pressure for weekend operation

Figure 5



After the initial audit a master control with an integrated online monitoring system can provide all data necessary to verify improvement projects.

Conclusion

Accurate and precise compressed air system information collected by using a high speed data logger provides the base for compressed air improvement projects.

A master control assures that air supply side (the air compressors) will automatically and most efficiently follow compressed air demand in the plant.

Continuous monitoring records system performance and cost information. It illustrates the results of improvement efforts and immediately verifies the savings, e.g. from a leak project.

The compressed air systems can be monitored and different departments charged appropriately for their air consumption based on actual flow instead of sqf. This way each department can benefit from their compressed air savings.

KPI Key Performance Index kW/100CFM will be visible, the system is manageable and alarms will notify system owners of malfunctions or unexpected events.

For more information, about compressed air system efficiency, data logger, master control and monitoring, contact Airleader: Phone (616) 828-0716, E-Mail: info@airleader.us, or visit us at www.airleader.us.