Successful Implementation – Energy Conservation Measure

Measure
Reduction in pressure drop in the compressed air network
Equipment
Compressed Air Network
Industry / Sector
Bulk drugs
Year of Implementation
1999
Cost Benefit Analysis
◊ Type of Measure: Medium investment
◊ Annual Energy Savings: 0.35 lakh kWh
◊ Actual cost savings: Rs. 1.23 lakh
◊ Actual investment : Rs.2.50 lakh
◊ Payback: Two years
Implementation Highlights
Implementation of the measure has resulted in ▭ Reduction in pressure drop ▭ Though the pay back period is two years, plant had achieved associated benefits such as lower pressure settings, reduction in leakage, reduction in compressed air demand, etc ▭ This measure is applicable to all type of units ▭ Easy to implement and can be implemented with in house expertise

Summary

Pressure drop is a term used to characterize the reduction in air pressure from the compressor discharge to the actual point of use. Excessive pressure drop will result in poor system performance and excessive energy consumption.

Background

A leading bulk drug company has three reciprocating compressors located in a centralized compressor house. During the normal operation only one compressor is operated. The peak compressed air consumption in the plant is about 280 cfm and the corresponding power consumption was 58 kW (4.83 cfm /kW @ 7.5 kg/cm^2). The pressure requirement at the user end was only 6 kg/cm^2.

The compressor main line size is of is 2" inch. The main line air pressure near the receiver located next to the compressor house varies from 6.8 – 8 kg/cm^{2}g. Pressure drop survey was carried out to evaluate the distribution system. The survey revealed that pressure drop in the system is as high as 1.5 kg/cm^{2}g.

The pressure drop in the distribution network (from the compressor house to entry to the user divisions) should not have been more than 0.6 kg/cm^2, whereas in this case, the pressure drop is much higher than the optimum values. **High pressure drop in the system was due to under sizing of the piping.**

Moreover, at lower pressures and high volume flow rates, the air velocity and pressure drop is quite high. In order to maintain the required pressure at user ends, the generating air pressure was always kept higher than the compressor rated pressure of 7.03 kg/cm^2. Maintaining higher generating pressure than rated, results in higher power consumption at the compressor and increased stress on the compressor leading to heating of the machine. The latter can be sensed by difference in water temperatures across the inter and after coolers.

Suggestion:

Existing pipe was replaced with 3" line reduced pressure drop by 1.0-1.5 kg/cm^2. There by the generating pressure settings were reduced to 6.0-6.5 kg/cm^{2}g.

Principle

Pressure drop is a term used to characterize the reduction in air pressure from the compressor discharge to the actual point of use. Pressure drop occurs as the compressed air travels through the treatment and distribution system. A properly designed system should have a pressure loss of much less than 10% of the compressor's discharge pressure, measured from the receiver tank output to the point of use.

Excessive pressure drop will result in poor system performance and excessive energy consumption. Flow restrictions of any type in a system require higher operating pressures than are needed, resulting in higher energy consumption. Minimizing differentials in all parts of the system is an important part of efficient operation. Pressure drop upstream of the compressor signal requires higher compression pressures to achieve the control settings on the compressor. The most typical problem areas include the pipe sizing. This particular pressure rise resulting from resistance to flow can involve increasing the drive energy on the compressor by 1% of the connected power for each 2 psi of differential.

Minimizing Pressure Drop

Minimizing pressure drop requires a systems approach in design and maintenance of the system. Air treatment components, such as aftercoolers, moisture separators, dryers, and filters, should be selected with the lowest possible pressure drop at specified maximum operating conditions. When installed, the recommended maintenance procedures should be followed and documented.

Reducing system pressure drop also can have a cascading effect in improving overall system performance, reducing leakage rates, and helping with capacity and other problems. Reduced pressure also reduces stress on components and operating equipment.

Additional ways to minimize pressure drop are as follows:

- **Properly design the distribution system*, ie line sizing***
- Operate and maintain air filtering and drying equipment to reduce the effects of moisture, such as pipe corrosion.
- Select after-coolers, separators, dryers and filters having the least possible pressure drop for the rated conditions.
- Reduce the distance the air travels through the distribution system.
- Specify pressure regulators, lubricators, hoses, and connections having the best performance characteristics at the lowest pressure differential.

Details of techno-economics:

Power consumption before implementation	: 57.8 kW
Power consumption after implementation	: 50.5 kW
Actual energy savings	: 7.3 kW
Operating hours	: 16 h/day
Annual energy savings @ 300 days	: 0.35 lakh kWh
Value of savings	: Rs. 1.23 lakh
Investment for 500 meters of pipe	: Rs. 2.50 lakh
Simple Payback Period	: 2 years

Implementation issues

- Implementation has taken more than 10 days in this case
- Increase in compressed air demand in future requires re-evaluation of the system performance
- Calls for periodic pressure drop surveys in the system i.e., at least once in three months