Take a whole system approach

Each component in a compressed air system should help to deliver air that is fit for purpose and free from pressure fluctuations at point of use. Dean Abbott takes a look at managing energy as a whole system approach.

Each element of the system impacts on another, upgrading to an energy efficient compressor will have a limited impact if the flow is restricted by inadequate or leaky pipework.

An energy efficient compressed air system will be:

- Well maintained – all equipment being regularly serviced and performance tested.
- Designed to minimise pressure drop with regard to fittings, air treatment, piping & connections.
- Require a monitoring program/ energy audit program from your supplier with energy usage calculated.
- Managed and used by trained staff who are aware of effective utilisation practices.
- Have an on-going leak reporting and repair programme.

System management

Appoint a person responsible for the system – pay special attention to the written scheme of examination, the requirement for competent persons and your obligations under the Pressure Systems Safety Regulations 2000 (PSSR). Formulating a compressed air policy is the next step – your current provider / BCAS member should be able to assist with this ensuring you cover all areas from finance to point of use.

Establish current usage and costs. – set a baseline. A compressed air supplier should be able to complete and energy audit using the EN ISO 11011 principles to determine:

- Demand profile
- Off load running time
- Demand peaks and forecast
- Specific energy consumption (i.e. number of kW required to produce each litre of air per second)

Set a target for energy reduction - Having set the base line, opportunities for improvement can then be identified. Set a realistic target of 5 / 15% of the compressor's demand and then review your system.

It usually best to start at point of use as improvement there affects the overall demand for compressed air. The carbon trust have provides a very useful source of reference https://www.carbontrust.com . One last point on management, do not underestimate the effect of regular maintenance on the cost of operation, not all service intervals are equal make sure you are servicing in accordance with manufacturers' recommended intervals.

Compressed Air Wastage

A waste air review can be a low cost way to save energy. A few starting points could be:

- Have you any redundant air-lines due to process change not sealed off?
- Are any manual condensate drain valves left open?
- Look for leaking hoses, valves, couplings, joints and pressure regulators
- Is air equipment left in use when not required?
- Don't run a compressor when not required – i.e. overnight, this increases energy spend and maintenance costs. (it is important not to compromise safety in this area – always seek advice)

Fixing one 3mm leak can save up to £700 per year in wasted energy.

There are a number of ways to detect leaks and no need to shut down production for the survey to take place. In addition whilst it is preferable for a plant to be idle for leaks to be repaired it is not always necessary. Many compressed air systems are now fitted with a permanent flow meter and the level of air production can be measured with no tools in use giving an indication of leakage.

Improving Air distribution

The role of the compressed air distribution network is to deliver air to the point of use minimising leakage, friction, pressure drop and impact on air quality. Loss of pressure can be due to design so sizing, layout and material choice is critical.

When designing or replacing a system the following should be considered:

- Pipe diameter – Smaller diameter pipe can have a lower investment cost but this should be balanced against the possible restriction of pipe size causing a pressure drop and therefore greater energy consumption.
- Fittings and valves – Selected to avoid air flow restrictions for example large flow bends will assist over elbows.
- Support all your piping – avoidance of movement minimises leaks and corrosion.
- Zoning – is it necessary for all of your air system to be pressurised. Splitting the area into zones and only pressurising the required area can save generating costs and leakage.

Improving existing compressor efficiency

For every half bar reduction in pressure drop approximately 3% of electrical power required by the compressor can be saved.

- Air inlet - dust and dirt must be filtered out of the air supply. Have a good inlet filtration system and check the filters routinely to ensure they are replaced before a pressure drop occurs
- Temperature – a 4 degree reduction in the inlet air temperature leads to dryer air at a higher density which can improve compressor efficiency by up to 1%
- Ensure coolers are kept clean

Maintenance regimes are critical and should only carried out by trained personnel

Air Storage

The Role of the air receiver is to;

- Act as a reservoir to be called upon to meet intermittent demands.
- Create a more stable pressure in the system.
- Prevent the compressor cycling too quickly.

Correctly sizing the air receiver is important as it has a direct impact on the reliability, consistent air delivery and efficiency of the compressed air system. The correct size of receiver has an impact on energy saving by allowing the compressor to be sized for average demand rather than for maximum.

- The air receiver should be sized in litres to be at least 6 – 10 times the compressor's free air litres per second output.
- An under sized receiver causes the compressor to cycle in response to small changes in pressure
- An effective control system ensures the receiver volume balances with the demand from the compressor.
- Air receivers can be added close to the process to avoid over sizing the main air receiver.

Remember to speak to your supplier if you think your compressor is over cycling they should be able to advise on receiver sizing.

Air treatment

Although a lot of emphasis is placed on the air compressor, the ancillary equipment for treating the air consumes energy and therefore is an important part of the energy management equation. When looking at air treatment have you considered the right equipment for the air purity required? If only part of the compressed air needs treating to a high standard considerable savings can be made by:

- Treating the bulk air to the minimum requirements and then upgrading air purity at point of use.
- Older equipment can consume more energy and the cost benefits can be considerable by changing out old energy hungry equipment for new energy saving models.
- Replace in-line filters in accordance with manufacturers recommendations – blocked filters cause a pressure drop.
- Fit pre-filters to prolong life and save energy.
- Desiccant dryers can have a dew point control fitted to minimise the electricity used.

Air purity & energy usage requirements should be discussed with your supplier or a consulting company to ensure that the process requirements do not suffer in the drive for energy management savings. When purchasing new air treatment equipment such as dryers consider those with the most energy efficient ratings.

Condensate management

A 30kW compressor with a capacity of 7.5 bar will produce approximately 20 litres of water for every 8 hours running time. The condensate produced is often contaminated with oil and solid particles all condensate must be removed and disposed of in a manner that complies with the water resources act 1988, to prevent contamination of the public water supply.

Condensate is collected by installing drains and there are varying types from manual to level sensing and timed drains, inefficient drains are a major cause of leaks and hence wasted energy. Although manual drains may be cheaper to buy they have high running costs and a life cycle costing exercise should be performed.

- Check manual drains are not left cracked open, thus causing leaks,
- Review the lifetime cost of replacing manual drains with Sensing drain traps
- Check all drains for blockage even level sensing can get blocked causing a pressure drop
- Install an oil / water separator for efficient condensate treatment.

Further assistance

Many BCAS members are able to offer an assessment of your system. This is usually carried out in accordance EN ISO 11011:2013, which sets out the requirements for conducting and reporting the results of a compressed air total system energy assessment. If you require further information about the processes and methodology as published in ISO 11011 then BCAS can provide a half day course, which can be held at your site.

The Carbon Trust is an excellent source of information and practical tools.

For further advice or to source a suitable partner to assist you in your drive for improved energy efficiency in your compressed air programme please visit: www.bcas.org.uk