Modern air system technology saves money

Scaling down the costs

If consumption is high savings can be high, too. Slowly, industry is beginning to realise that up to 30 percent energy savings - in some cases even more - are achievable with modern management of compressed air systems. But generally, the road from realisation to reaction is long. With the help of modern compressed air technology **(Fig. 1)** and system analysis this road can be travelled far easier and quicker than many people think.

A modern compressed air system with compressor internal controllers and master controllers based on industrial computers at an automotive manufacturer's facility

"What does a cubic meter of compressed air really cost?" Only a few production facilities would be able give a fitting answer to this question. The fact is that the costs for energy, personnel, maintenance, their share of general operating costs, the influence of the compressed air supply on production and allied costs are generally unknown. In this respect, it is interesting to

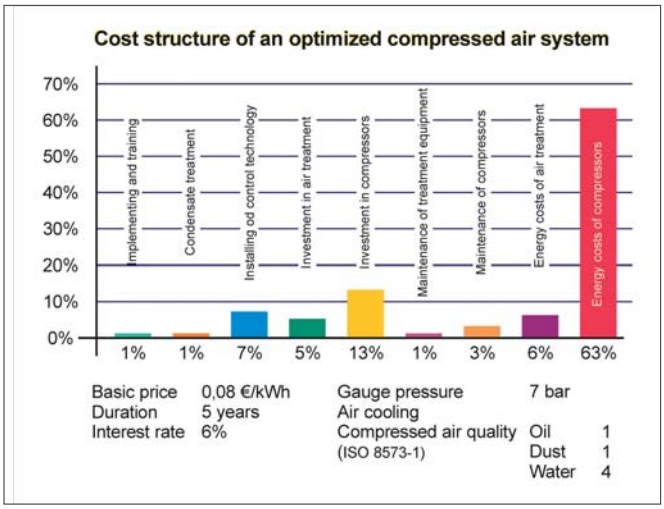

Fig. 2:
Cost structure of an optimised compressed air system

examine the cost-structure of an optimised air system **(Fig. 2)**. The upshot is that energy costs take up the lion's share, even under favourable conditions, being 69 percent of overall costs.

Nevertheless, only a few air systems have such a reasonable cost-structure. The actual overall costs are often higher by 30 percent or more, which is where most of the potential savings lie **(Fig. 3)**.

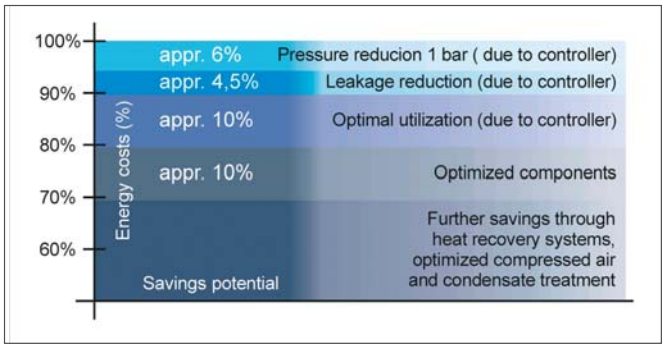

Fig. 3:
Compressed air production savings potential

Reduction of system pressure

If system pressure is reduced by only one bar six percent of energy costs can be saved. This is where industrial computers come into their own, as they are usable as internal compressor controllers and as master controllers of the air system. Appropriate air management systems such as Kaeser's Vesis and Sigma Air Manager use pressure band control to coordinate up to 16 compressors within a pressure swing of only ± 0.1 bar instead of conventional cascade control **(Fig. 4)**. Lowering system pressure has another advantage in that air losses caused by leaks are noticeably reduced.

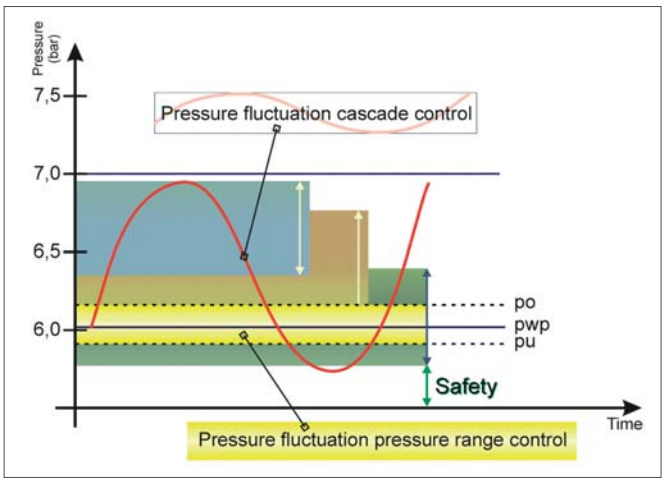

Fig. 4:
The difference in pressure swings and pressure reduction between conventional cascade control (base load sequencing) and modern pressure band control

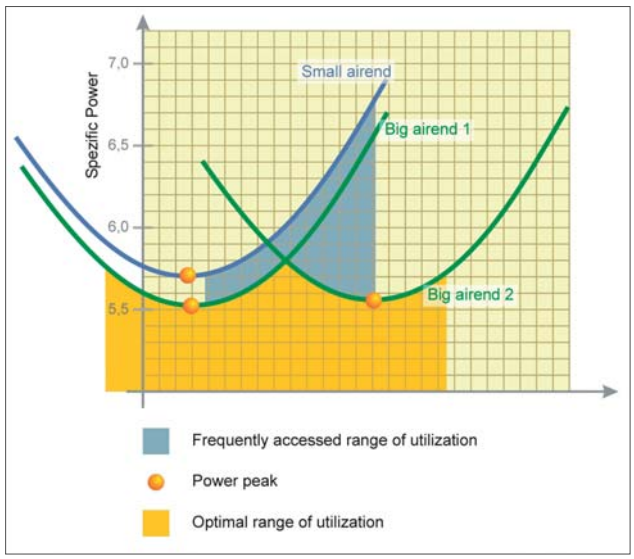

Fig. 5:
Compressors attain their specific optimum at a definite speed, a definite pressure and thus a definite free air delivery

Restricting idling periods

The combination of compressor capacities and their coordination has a considerable influence on the cost-effectiveness. Vesis or Sigma Air Manager automatically select the right combination of compressors and can reduce energy losses caused by idling in offload from around 20 percent to approximately one percent.

Using the right control mode

Control of the individual compressors is another area needing optimisation, i.e. precise matching of its function to the overall system. For example, base load machines require a different control mode than medium or peak load machines. Nowadays there are up to five internal control modes available for displacement compressors. In addition, such controllers must be able to record and store all relevant operational data in order to facilitate preventive maintenance. So-called EPACT or EU-eff1 drive motors1 also contribute to minimisation of energy losses and increased reliability. These motors feature improved efficiency and reduced operating temperatures.

Improving compressor and drive efficiency

Compressor technology itself has a large potential for optimisation. Energy savings of up to 10 percent can be made using airends matched exactly to the required pressure and air delivery **(Fig. 5)**. Gears or belt drives then become superfluous. Because the drive motor and airend run at the same speed they can be directly coupled. This avoids power transmission losses, which are typically around 2.5 percent.

Using the right cooling system

The efficiency of the compressor is also influenced by the method of cooling used. Air-cooling is preferable to water-cooling and compressors should be located in the coolest place possible. The benefits are improved reliability, less energy costs and lower cooling costs.

Heat recovery and air treatment

94 percent of the electrical power fed to a fully encapsulated screw compressor can be recovered in the form of reusable heat.
The choice of air treatment components can also help to reduce costs. Combinations of dryers and filters precisely matched to the application guarantee precisely defined air quality classes. They can also reduce the energy required for air treatment by up to 50 percent.

Computer-aided system analysis and design

Optimisation of an air system to the state of the art is based on computer-aided processes such as Kaeser's ADA (Air Demand Analysis). The operation of an existing air system is analysed for at least 10 days with the help of a data logger. It records all the operational data and transfers them to a PC that then generates a graphic profile of the air demand. Computer systems such as KESS (Kaeser Energy Saving System) calculate the energy requirement of the air system from the data acquired and compare it with an alternative modernised air system.

Automotive manufacturer saves 483 000 kW

A German automotive manufacturer with an air system consisting of a water-cooled rotary screw compressor with a capacity of 22.2 m^3/min and four water-cooled reciprocating compressors each with a capacity of 15 m^3/min **(Fig. 6)** issued a contract for such an analysis. The resulting assessment led to a completely new air supply system **(Fig. 1)**. Four Kaeser DSD 171 rotary screw compressors with computer-controlled on/off control and a capacity of 16.4 m^3/min each are responsible for the base

load. The peak load is covered by three rotary screw compressors from the same manufacturer with full load/idle - on/off control and a capacity of 5.62 m³/min each. All compressors are air-cooled. The compressors are coordinated by a load-dependent Vesis air management system.
Replacement of the air old system brought significant energy savings. Improved duty cycles and reduction of system pressure from 8.7 to 7.5 bar reduced the specific power requirement from 8.19 to 6.19 kW/m³/min. This corresponds to annual savings of approximately 483,000 kW or around □20,000. In addition, savings for cooling water amount to 55,000 per year.

Fig. 6:
Well-cared for but no longer up-to-date; the air system installed in an automotive production facility before modernisation

Effective controlling with information technology

A modernised compressed air system should show an optimised cost-benefit ratio and provide the transparency needed for effective controlling. The basic building block for this transparency at Kaeser is Sigma Control, an industrial computer integrated into the compressor. It collects data, and passes it to a master controller through a data bus. The master controller, Sigma Air Manager or Vesis, not only collects and stores the data but also coordinates the system's components as required to satisfy the air demand. It also evaluates relevant data and makes it available to any PC through a computer network such as Ethernet. Thus, as well as optimised design and continuous system monitoring, compressed air technology makes possible effective controlling of the air supplies, always ensuring that the right volume and quality at the required pressure is available at all times at the most economic price.

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