CADDET energy efficiency
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Compressed air control system

Control system balances industrial compressed air installation

Summary

A new kind of intelligent control system, Sarlin Balance, has been developed to control air compression installations. By monitoring the network pressure the compressor's output pressure can be constantly maintained at the lowest possible level, with the minimum idle running time. The system guarantees a constant network pressure level independent of the air consumption. One of the first systems was installed in 1995 at the Enso Oy Tainionkoski paper and board mill in Finland.

The savings in electric energy amount to 9% or 599 MWh/year. Minimising the pressure level fluctuations also results in smoother production and better product quality.

Highlights

- **Energy savings of 9%**
- **Smoother production**
- **Better product quality**
- **Payback period less than one year**

Board machine at the Enso Oy Tainionkoski mill.

Aim of the Project

Generating compressed air accounts for as much as 8-10% of the electricity consumed by production in the industrialised countries. Poor compressor control is also a major waste of energy.

Industrial multi-compressor systems typically feature individual controls, mainly consisting of one to four adjustable pressure switches. Depending on the discharge pressure level, a compressor runs either loaded or unloaded. The pressure will vary somewhat as a result.

To guarantee the supply of compressed air in changing production situations, the pressure of compressed air systems is kept higher than the actual air demand of the processes and machinery being supplied. This, however, means energy losses.

To eliminate these problems a Finnish company (Sarlin-Hydor Oy) has developed an intelligent control system which varies the pressure settings according to air demand, thus avoiding pressure fluctuations.

The Principle

The Sarlin Balance control system is based on an exclusive software algorithm and microprocessor-based industrial logic. The control unit monitors the network pressure and the discharge pressures of the compressors. The central unit processes the measurement results. By using these processed results and a database of actual measurements based on practical experience, the software is able to maintain the pressure at an adequate level, while keeping compressor capacity as low as possible.

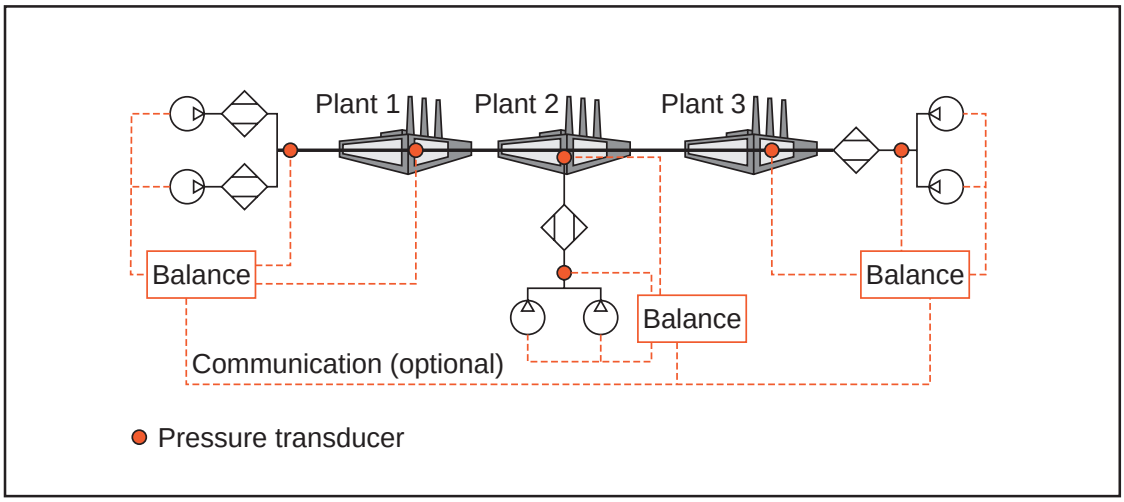
The pressure level required and the deviation allowed are set at the interface. To achieve an efficient solution to controlling air compression plants the system uses real-time measurements of both the system behaviour and the tuning of the controls. The interface settings should preferably be made by someone with a good understanding of compressed air systems and experience in tuning their conditions. Operating sequences can also be set to equalise compressor run times.

The Sarlin Balance includes a comprehensive fault diagnostic system which prevents any drop in pressure if, for instance, a failure occurs in the logistics or sensors.

The basic Sarlin Balance module can be used for up to eight compressors. The number of basic modules, and thus the number of controlled compressors, is not restricted.

The module has an RS-connection and MODBUS communication protocol. Ambient temperature can vary between 5 and 45°C. Dimensions of the control box are 224 x 190 x 79 mm. The Sarlin Balance is easy to install for different types of compressors. The MODBUS RTU

Figure 1: Schematic of the Sarlin Balance system.



protocol ensures that the module can also be connected to a remote PC or control board. A schematic of the Sarlin Balance system is shown in Figure 1.

The Situation

One of the first Sarlin Balance systems was installed at board machine No. 5 of the Enso Oy Tainiokoski mill in Imatra, Finland. The compressed air system includes six compressors of 250 kW. The compressors produce oil-free compressed air for regulating units etc. on the board machine. A certain amount of compressed air is also used in a pulp plant, as well as in a power plant. The average consumption of compressed air is 110 cubic meters/minute.

Before installing the balance module, the operation of the compressed air system and the main piping network was analysed by taking measurements. The parameters of the control system could then be specified, thus optimising the system. After optimisation, the improved operation of the compressed air system was verified by again taking measurements.

With the balance module in full use, the compressed air network was stabilised and loss of production due to pressure drops was eliminated. Figure 2 shows a comparison of the pressure fluctuations with and without balance control throughout one working day. When the system was balanced, these fluctuations were within 0.3 bar. This permits smoother production and higher product quality.

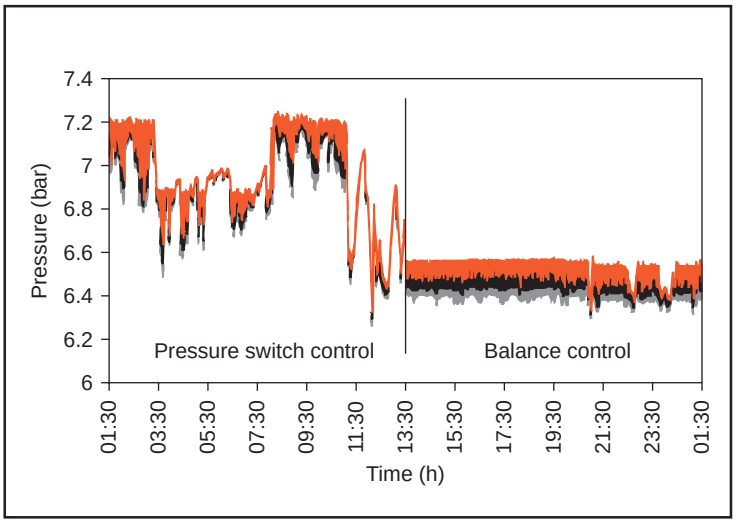


Figure 2: Comparison of pressure fluctuations with and without balance control over one day.

Savings in energy terms were considerable. Before installation, the average pressure level was 6.86 bar and the energy consumption 6,800 MWh/year. After installation, the pressure could be reduced to 6.41 bar with the average pressure differential reduced to 0.45 bar. This had the following effects:

- energy consumption of the compressors was reduced by 213 MWh/year;
- air production was reduced by 5.7%, giving an energy saving of 386 MWh/year.

The total energy savings were therefore 599 MWh/year.

The Company

Enso Oy Tainionkoski is part of the multi-national Enso Oy which produces fine papers, printing papers, packaging boards etc. Turnover for Enso Oy, from August 1995 to January 1996, was FIM 17,199 million (USD 3,739 million).

The company employs approximately 20,000 people.

In the town of Imatra, Enso Oy has three machines which are producing packaging boards for liquid containers. Board machine No. 5, on which the Sarlin Balance is installed, is located in Tainionkoski near Imatra. The machine produces about 200,000 tons of liquid packaging board per year.

Economics

The investment costs of the Sarlin balance control unit were FIM 100,000 (USD 21,740) including all hardware, installation, tuning with real-time measurements and a report of the analysis. With electricity savings of 599 MWh and an electricity price of FIM 190 (USD 41)/MWh, the total financial savings were FIM 113,800 (USD 24,740). Thus the payback period was less than one year.

Sarlin-Hydor are so confident of their product that they guarantee the payback period will be less than one year for other applications . If sufficient savings cannot be verified by measurement, the company state that any sale can be cancelled without further obligation.

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* IEA: International Energy Agency
OECD: Organisation for Economic Co-operation and Development

IEA

The IEA was established in 1974 within the framework of the OECD to implement an International Energy Programme.
A basic aim of the IEA is to foster co-operation among the 24 IEA Participating Countries to increase energy security through energy conservation, development of alternative energy sources, new energy technology, and research and development (R&D).

This is achieved, in part, through a programme of energy technology and R&D collaboration currently within the frame-work of 40 Implementing Agreements, containing a total of over 70 separate collaboration projects.

The Scheme

CADDET functions as the IEA Centre for Analysis and Dissemination of Demonstrated Energy Technologies. Currently, the Energy Efficiency programme is active in 15 member countries.

This project can now be repeated in CADDET Energy Efficiency member countries. Parties interested in adopting this process can contact their National Team or CADDET Energy Efficiency.

Demonstrations are a vital link between R&D or pilot studies and the end-use market. Projects are published as a CADDET Energy Efficiency 'Demo' or 'Result' respectively, for ongoing and finalised projects.

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