

“Efficient compressed air” – a successful campaign for energy efficient compressed air systems in Germany

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Abstract

Compressed air systems are widely used in industry and craft for diverse purposes. Although this special energy form has a lot of technical advantages, it has to be taken into account that the energy consumption of compressed air systems is considerably high. In Germany, these systems consume as much electricity as the *Deutsche Bahn* (German railways) for traction or as 1.3 nuclear power plants. Nevertheless, according to an EU study published in 2001 (Radgen, 2001), approx. one third of this energy could be saved profitably.

The “*efficient compressed air*” campaign addresses these huge saving potentials by providing information about energy and cost efficient compressed air systems for all industrial users, mostly via internet, expert press articles, seminars, conferences, and networks. The results show that the information and the instruments offered by the campaign are appreciated by the target groups.

Above this, companies are invited to have their compressed air systems (the whole range from the compressor to the end use device) analyzed by compressed air experts, in order to detect weak-points and subsequently to show solutions for improvement of both the compressed air quality and the energy efficiency. Due to public and private funding, this analysis can be provided free of charge for about 100 companies until the end of 2002. The results will be

worked out as branch-specific case studies which will be distributed among the industrial users.

Further instruments of the campaign are a benchmarking which compares compressed air systems of different companies, a competition for the best compressed air systems supply and a demonstration plant.

Introduction

Compressed air is widely used for industrial purposes due to various technological advantages, such as high operating speed, force, accuracy and riskless handling. But despite these advantages it has to be taken into account that energy consumption of compressed air systems is considerably high. In Germany compressed air systems account for 7% of industrial electricity consumption. According to an EU study published in 2000, approx. one third of this energy could be saved profitably. In order to exploit these enormous saving potentials the campaign “*efficient compressed air*” was launched in spring 2001. The campaign informs system operators in industry and commerce about energy and cost efficient compressed air systems and offers instruments for analysing saving potentials and improving energy efficiency. This paper gives a short overview about the campaign and its elements with the focus on the analyses’ results.

Energy consumption of compressed air systems

ENERGY CONSUMPTION

The approx. 62 000 compressed air systems installed in Germany in different areas of production consume approx. 14 000 000 000 kWh electricity annually or 7% of the industrial electricity consumption. This is as much electricity as the *Deutsche Bahn* (German railways) consumes for traction or as 1.3 nuclear power plants need for running. Figure 1 shows the importance of energy consumption for compressed air production in different sectors. By far the largest compressed air users are the plastics and the glass industry. Other sectors like the food or the paper industry can also not be neglected.

SAVING POTENTIALS

An EU study published in 2001 revealed that existing compressed air systems often have enormous potentials for optimisation. The economically and technically feasible energy savings lie between 25% and 40% with a usual pay back time of less than two years.

An efficient use of compressed air does not only improve the profitability of companies, but also contributes substantially to climate protection. Up to two percent of the CO₂-emissions caused by whole industry could be avoided by using efficient compressed air systems.

The energy savings potential can mainly be exploited by optimisation of the complete system, ranging from planning, generating, processing and distribution to financing possibilities. Lots of systems are not being operated optimally due to insufficient maintenance and service, but also due to

faults in plant layout and design and mistakes made during procurement. The most common faults are leaks in the system which may result in additional electricity costs of several thousand EURO per year which often go unnoticed. But despite the profitability of technical measures needed for increased energy efficiency these measures are often not carried out by private enterprises. One main reason for this is a lack of information regarding the savings potential and the measures to exploit them. At this point the campaign "efficient compressed air" aims to set in.

Addressing the potentials: The German "efficient compressed air" campaign

The campaign "efficient compressed air" aims to inform system operators in industry and commerce about cost and energy efficient compressed air systems and to motivate them to exploit the saving potentials. To this end a variety of instruments was developed: the internet platform www.druckluft-effizient.de, free of charge measurements of compressed air systems, a benchmarking which compares systems of different companies, a competition for the best compressed air systems supply and many other activities.

The campaign was launched in spring 2001 at the Hanover Trade Fair and is running for four years. "efficient compressed air" is implemented by the German Energy Agency (dena), the Fraunhofer Institute for Systems and Innovation Research ISI and the German Engineering Federation (VDMA). The project is sponsored by the Ministry of Economics and Work and supported by several industry partners.

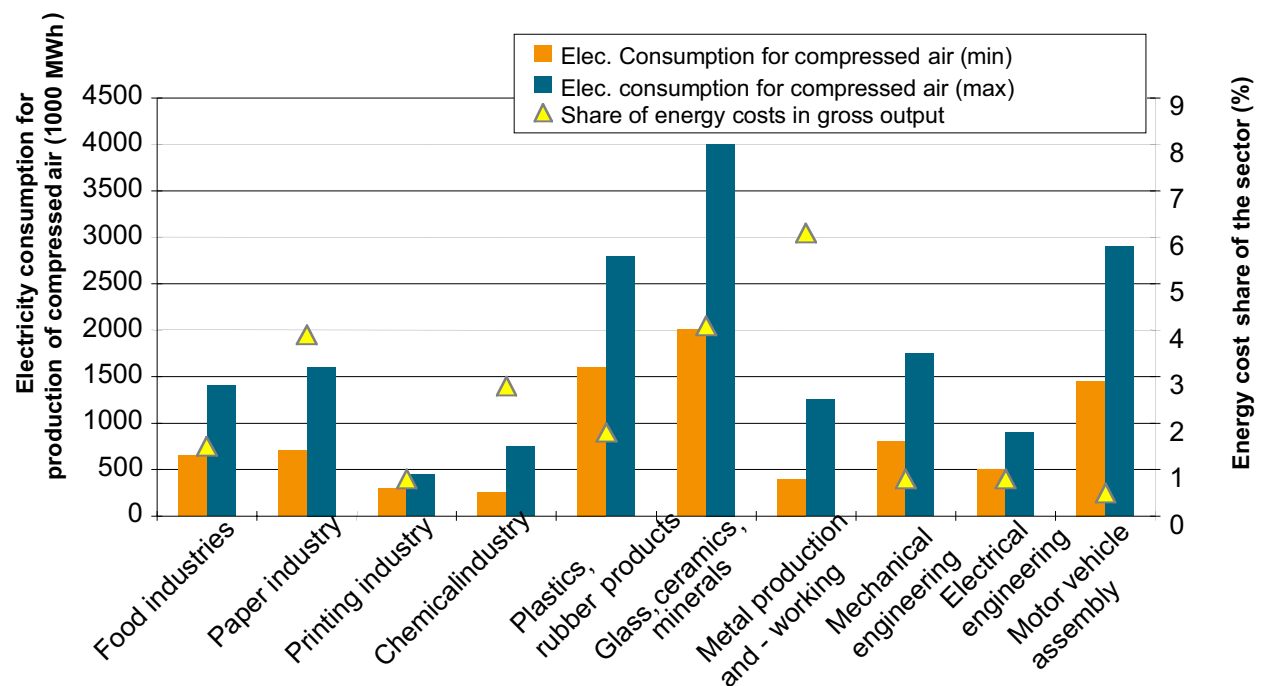


Figure 1. Electricity consumption for compressed air production and share of energy cost on turnover.

In the following the different instruments of the campaign are described in more detail:

INFORMATION BROKERING AND QUALIFICATION

Internet platform www.druckluft-effizient.de

One central instrument of the campaign is the internet platform www.druckluft-effizient.de. On this web site industrial users can find competent and multisupplier information on all questions of compressed air technology. Downloadable factsheets on various topics regarding the techniques of compressed air systems are available on the website as well as national and international studies. The factsheets deal with all aspects of compressed air systems, the production, treatment, distribution and uses as well as questions related to control or the thermodynamic principles of compressed air. The internet platform also provides a discussion forum where questions can be posted and will be answered by compressed air experts. An increasing interest can be also seen for the outsourcing of compressed air systems. However although contracting is well known for its capability to support the uptake of measures to improve energy efficiency, the improvement can be sometimes limited if the contracts are not well designed. The product "Guideline to financing methods of energy-efficient compressed air systems" (Dudda, 2002) describes different financing methods (own funding, operating agencies, contracting etc.) together with their pros and cons for the contracting parties. All documents can be downloaded from the web site free of charge. The web site also provides useful links to relevant contact persons and presents most recent news on the homepage. Furthermore a free regular electronic newsletter informs about new activities and publications.

The Web site will be relaunched in the beginning of 2003 to further improve the compressed air users' needs. As we have received a lot of questions related to copies of information material in other languages, the main webpages and other important materials (e.g. the factsheets) will be translated into English. With this the project also provides helpful information for developing countries.

Seminars

For further qualification of the companies in the field of energy efficiency the campaign offers a multisupplier seminar. The seminar is offered at a very reasonable cost, as the price will only cover the printing of the seminar materials and the lunch and coffee breaks. The seminar was developed by the "Compressed air systems group VDMA" and further optimised by the project group of "*efficient compressed air*". In the seminar the companies learn how to optimise the compressed air systems supply from the planning and generating to the processing and distribution. In order to ensure a good educational quality the coaches had to take part in a three days "train-the-trainer"-seminar which was also offered in the context of the campaign. In 2002 the seminar was offered for the first time. Based on the positive feedback from the participants the seminar will be repeated throughout Germany in 2003. In total about 24 seminars are planned.

PUBLIC RELATIONS

The success and widespread impact of the project is to a large extent determined by effective public relations. To this end, ongoing publicity via the press, presentations on fairs and conferences and other advertising mediums were and are an important element of the campaign. In the beginning of the project the objective of the PR-campaign was to show the significance of an energy-efficient compressed air production for the economic efficiency of the company. Later on press releases focussed on important events and results of the campaign.

At the beginning of the project all relevant multipliers were provided with information about the campaign by e-mail. With this approach special branches which are usually difficult to reach by press could also be addressed. During the whole running time of the project press releases and special articles are distributed to a broad mailing list.

In addition the campaign is presented on various conferences, industry fairs (e.g. Hanover Trade Fair) and seminars. For example in spring 2002 a two day conference was organized in co-operation with VDI (association of German engineers) and the Bavarian Energy Forum. The presentations covered the whole spectrum of compressed air system, ranging from planning, generating, processing and distribution to financing possibilities and specialized applications.

As advertising mediums for presentations a poster in German and English version has been created as well as a project flyer which informs about the project in brief and refers to the website for further information.

MEASUREMENT CAMPAIGN

In autumn 2001 companies were invited to have their compressed air systems (the whole range from the compressor to the end use device) analyzed by compressed air experts, in order to detect weak-points and subsequently to show solutions for improvement of both the compressed air quality and the energy efficiency. Due to public and private funding, this analysis could be provided free of charge for about 100 companies. The audits shall identify the possible saving potential in terms of energy, CO₂ emissions and cost. Typically the energy savings identified were in the range from 10 to 35%. To identify the savings, the compressed air systems have been visited by compressed air experts. Already from this walk through audit savings have been identified. In addition the compressed air systems have been analysed with measuring equipment, looking at the consumption figures and pressures over a period of at least 10 days. Special attention is given to the compressed air leakages, as they are responsible for the largest part of the overall losses (Figure 2).

The graph shows the compressed air consumption on a work free Saturday without any production. Therefore in principle the compressed air consumption should be zero. However if the system is not switched off, the compressors have to provide the air flow, covering the leakages in the network. The leakage program run during the work free period. The leakage rate measured can then be linked to a single production machine or on a shop level.

Leakages in compressed air systems typically range between 25 and 60% of the total compressed air production. It can be seen in Fig.2 that the leakage varies between 0.075 and 0.35 m³/min. The spikes are related to the opening of a

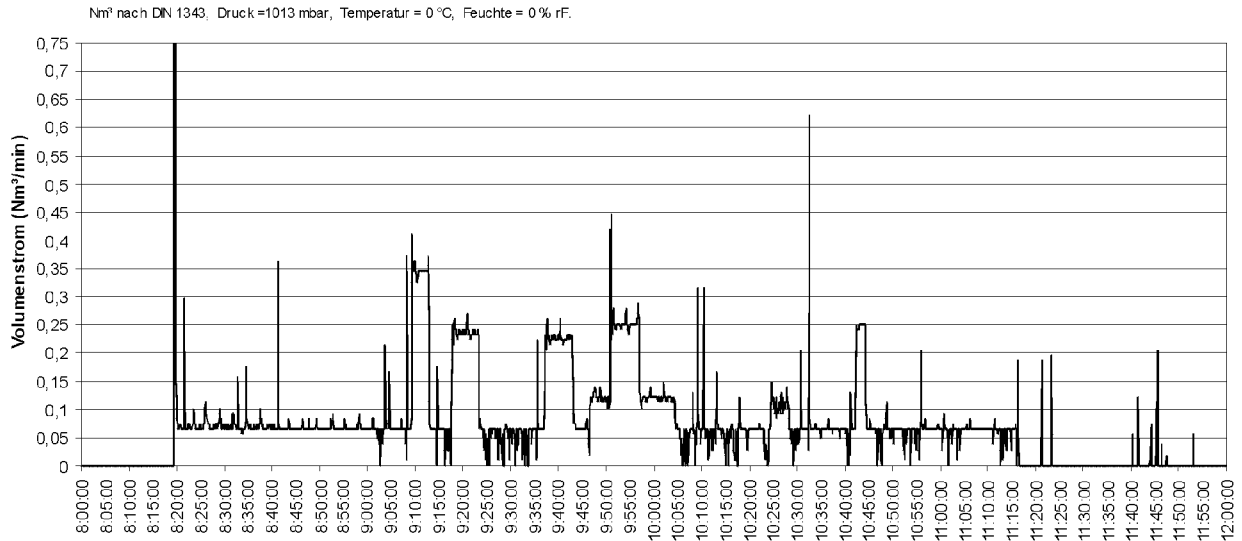


Figure 2. Result of a leakage measuring during a weekend with different parts of the distribution network disconnected from the supply.

valve, as in this case the system behind the valve has to be filled up with air, which shows up as a consumption in the compressor house. As soon as the system is repressurized, the volume flow drops to the leakage rate.

Each company receives a detailed report on the analysis' results. In addition an overall analysis will be made to identify general behaviours and saving potentials.

About 16% of the applicants had an installed capacity of less than 50 kW, 38% between 50 and 300 kW and 46% of more than 300 kW installed. All relevant types of compressors have been covered. However companies with a larger compressed air system tend to be more sensible to the cost of compressed air, even if the share of compressed air costs on turn over is similar.

The industrial sectors over represented have been the metal production, the chemical industry, the food industry and the car manufacturers. This might be due to a high cost competition in these markets but this has to be further analysed in the future.

BENCHMARKING

Many companies do not know how much energy they use for their compressed air production. However even if they know what they are looking for, they are not able to judge on the quality of the results they achieve. Benchmarking is a well known tool to help companies to further improve their systems. The project group is developing an internet based compressed air benchmarking tool. Companies can send their data and will receive information about their position in terms of costs, energy consumption, plant configuration and compressed air costs. Benchmarking will be made on the sector specific basis or for the industry as a whole. Step by step the system will propose possible measures to improve the compressed air system, if a company is falling behind the average values. The benchmarking can therefore trigger further activities and will help to convince high level

management about the importance of compressed air systems. The benchmarking is scheduled to be online for the Hanover Trade fair 2003 which will take place in April and will have a focus on compressed air technology.

COMPETITION

In the end of 2002 a compressed air award was offered for a company which has improved or maintained their compressed air supply very well. The objective of this competition is mainly to attract attention of as many companies as possible. To this end it is planned that the award will be handed over by a Minister of the German Government in a public awards show. The measures undertaken by the award winning company together with the improvements achieved will be published in a flyer and distributed.

DEMONSTRATION PLANT

Information material and information on a web site is helpful and required. However improvement potentials should be made visible to ears and eyes. Therefore a simple demonstration plant was built to show the effects of different measures to reduce the energy consumption of compressed air supply. Effects to be shown are the pressure losses due to insufficient cross sections of piping, cost associated with compressed air leakages, the effect of faulty or outdated condensate traps or the effect of poor maintenance of filters and dryers.

The demonstration plant will be first shown at the Hanover Trade Fair 2003 and subsequently used for training seminars of the project group. The plant will also be made available to vocational schools, which are educating in the field of compressed air systems.

Results

Since the start of the compressed air campaign in the beginning of 2001, the project gained broad recognition from industry. The campaign has produced a lot of helpful information materials and is bringing the numbers of cost, energy and emission saving in compressed air systems to the industrial user.

The measurement campaign did not only reveal huge saving potentials but also motivated the companies to exploit them. At the end of the project there will be a survey among the involved companies in order to show which measures for optimisation have been implemented due to the results of the measurements. This will also allow a quantification of energy and CO₂ savings.

Though the campaign is playing an important role to achieve the market transformation to an energy efficient economy in compressed air systems, market transformation will not take place automatically as long as strong barriers still exist. The project so far showed that many companies do not know their energy costs for compressed air production as these costs are often part of the overhead costs. Furthermore in most of the companies energy costs are only a small part of the overall costs and therefore do not attract the interest of the management. The managers often do not see the fact that the reduction of energy costs directly increases the benefit without necessitating any increase in turnover. Besides that many companies do not have enough information about the saving potentials and the technical ways to exploit them. All this leads to the situation that even measures for optimisation which are highly profitable for companies are not being exploited. In order to reduce these indicated barriers, activities such as the campaign "*efficient compressed air*" are very important.

The multiple actions done so far will be continued and expanded in the future. This will include the expansion into other European Countries and to developing countries. The campaign will also be linked to the European Motor Challenge Program, which has officially been launched in February 2003 by the European Commission (EU, 2003). The Motor Challenge program aims to catalyse the improvements of motor systems (pumps, compressors, fans, drives) on a voluntary basis. So far already a number of well known companies such as Johnson and Johnson, Ferrero, Atlas Copco, Grundfos, VEM, Kühnle Motoren and others have joined the program.

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