Messung des Druckluftflusses in der Produktionstechnik zum Zweck der Leckerkennung in den Luftverteilungssystemen

MEASUREMENT OF COMPRESSED AIR FLOW IN THE PRODUCTION TECHNOLOGY FOR THE PURPOSE OF LEAK DETECTION IN THE AIR DISTRIBUTION SYSTEMS USING ULTRASONIC FLOW METER

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Abstract

During an operation of compressed air stations, the compressors are permanently in operation. During the long-term running of a production, the parts are going wear and this leads to undesired leakages and thus energy losses. Using on-line flow measurement, compressed air leaks from air distribution or internal distribution systems and parts of technological equipment can detect, instantaneously. By defining of proper measurement points, it is possible to locate the leakage quite easily. The following study deals with the application of an ultrasonic flow meter just for this purpose.

Key words: *Compressed Air, Air distribution system, Leakage detection, Flow meter.*

Introduction

Production plants using compressed air have often problem with the compressed air losses caused by leakages on the distribution systems or directly on the pneumatic parts of the machines. During operation of the technology it is almost impossible to find a leakage because of a big noise. Usually the leakages are very small, on valves, pneumatic drives, pistons, actuators, etc. The modern machines have spetial program for sequential switching of the pneumatic systems and such way they can localise a problem. Using ultrasonic flow monitor in proper measuring points configuration it is possible to control system partly and localy, as well.

Compressed air

Compressed air is typically one of the most expensive utilities in an industrial facility. While designing energy saving compressed air systems various methods are applied to reduce energy losses and minimize energy consumption.[1] However, energy efficiency of many compressed air systems is low. Improvements in the range from 5 to 50 % are possible, but a large technical and profitable savings potential is not realised under current market and decision mechanisms.[2] It has been identified as one of the least efficient forms of energy. Only about 10 – 30 % of compressed air reaches the point of end - use, while the balance is lost as heat energy and to a lesser extent from leakage and inefficient usage.[3] A typical compressed air system is comprised of various components such as air compressors, air dryers, filters, coolers, branched pipes, valves, nozzles, and controllers. Each of these components represents a potential for energy loss in the form of flow or pressure loss in the system. At the stage of developing a compressed air system or even in the utilization period, there are many other important factors such as compressor size or control system determination that have great impacts on energy efficiency of the system and these should be taken into account.[4] The direct impact is evident in every-year payments for the supply and distribution of electricity consumed at the collection points, indirectly electricity prices are projected into other commodities and daily consumption items.[5]

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Leakage detection

Leakage is not only a source of energy losses, but also a factor of indirect influence on operating costs. As they increase, the pressure in the system drops, pneumatic tools work less efficiently, which adversely affects the production process. The only solution is to increase the working pressure to compensate for the loss. This is due to the additional consumption of electricity, leading to an increase in the specific consumption of electricity per unit of output of the compressor.[6]

Detection, quantification, and repair of leaks contributes to: reduction of operating time of equipment, which prolongs its operating life; avoidance of unnecessary compressor capacity; avoidance of pressure fluctuations which deteriorate tool operation quality and diminish efficiency of equipment, potentially leading to production breakdowns; avoidance of extra maintenance time, i. e . reduction of maintenance costs, reduction of tied assets, i.e. spare parts, better utilization of maintenance personnel, reduction of noise level in workplace.[7] Since air leaks are almost impossible to see, other methods must be used to locate them. The best way to detect leaks is to use an ultrasonic acoustic detector, which can recognize the high frequency hissing sounds associated with air leaks. These portable units consist of directional microphones, amplifiers, and audio filters, and usually have either visual indicators or earphones to detect leaks.[8]

Another possibility is using a flowmeter to watch a flow of air during non operating section of a plant. A pattern of a production plant using compressed air shown on the Figure 1.

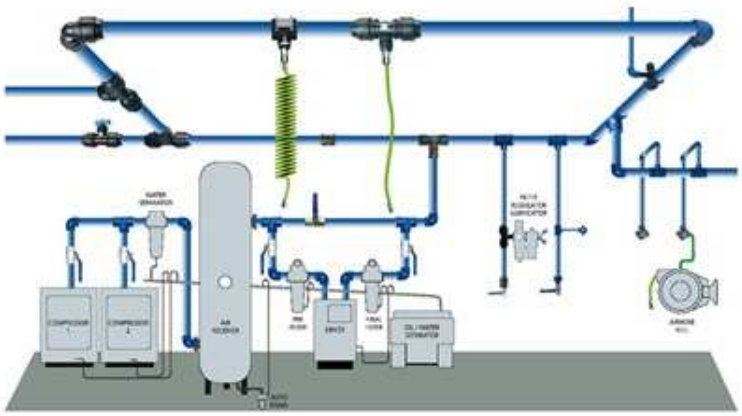

Figure 1 Compressed Air System.[9]

Most compressed air networks work at around 6 to 8 bar. At this pressure level, reliable flow measurement with the ultrasonic clamp-on flowmeter is ensured at all times - the system is even capable of measuring at only 3 bar pressurised steel pipes (at plastic pipes down to atmospheric pressure). By measuring the flow rate, the system determines the current consumption.[10] Using a clamp-on precise flow meter a reliable leak detection is possible. An example of an mobile ultrasonic flow meter is shown on Figure 2. Ultrasonic sensors are mounted on the compressed air distribution system pipes. The control unit consists of a driver to send the sonical signal to the pipe

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and a receiver. The primary value is the information about the speed of the medium. Through a mathematical calculations is the real air flow calculated. All the algorythms are implicated in the control unit. The information about the final value of the flow can be send for further evaluation using unified signals or digital communications as well.

Figure 2 mobile ultrasonic flow measuring.[11]

For automated long time systems are the stationary flow monitors designed. Such stationary flow meter is shown on the Figure 3.

Figure 3 Stationary flow monitor with installed ultrasonic clamp-on sensors. The silber layer is damping material to avoid reflections and nois from the pipe.[12]

An model of the leakage detection using ultrasonic flow monitor is shown on the Figure 4.

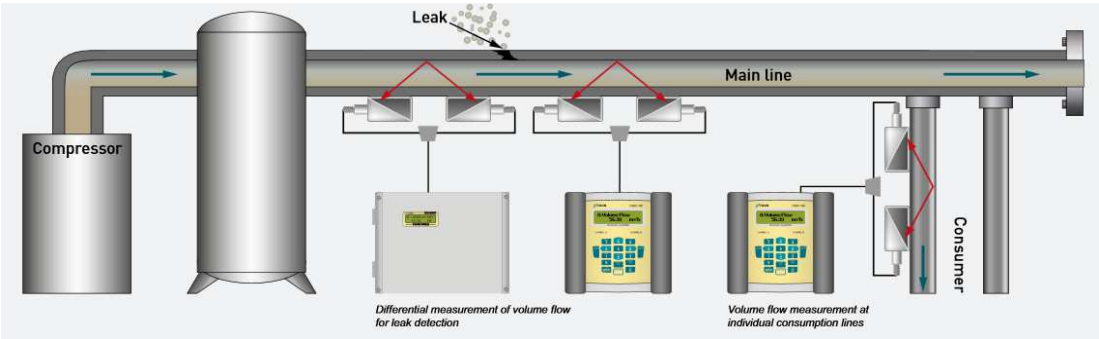

Figure 4 Example of the leakage detection using ultrasonic flow monitor.[13]

[11] FLEXIM. Temporary Thermal Energy and Flow Measurements within Production Processes. - [on-line] available on URL: https://www.flexim.com/en/industries/industrial-and-municipal-energy-management/industrial-energy-efficiency/temporary-thermal-energy-and-flow-measurements-within-production.

[12] FLEXIM. Flow measurement of compressed air. - [on-line] available on URL: https://www.flexim.com/en/industry-solutions/industrial-and-municipal-energy-management/industrial-energy-efficiency/flow-measurement-compressed-air

[13] FLEXIM. FLUXUS CA Compressed air flow measurement solutions. - [on-line] available on URL: https://www.flexim.com/sites/default/files/public_downloads/buca_-_en.pdf

Epilog

Leakages mosty make a low flow increase what is quite problematic to measure. For a precise leakage detection a longer measuring period to be taken. Ultrasonic flow meter provided together with precisely designed mathematical algorithms reliable measuring results for this application. Generaly, there are several days taken for the leakage detection but using such precise devices the monitoring time can be shortened. The shorter monitoring time the lower loses in the production.

Using stationary flow meters and a proper automation and switching valves can be this procedure automated and programmed to be performed during the planned production stand-off periodes. Either the differences in the air consumptions are very low for exact quantification, they can provide just a signal about a discrepancy in the process regarding to normal conditions, at least.