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ENERGY SAVING WHEN USING COMPRESSED AIR AS AN INSTRUMENT OF ENVIRONMENTAL PROTECTION AND ECONOMIC BALANCE OF THE COMPANY

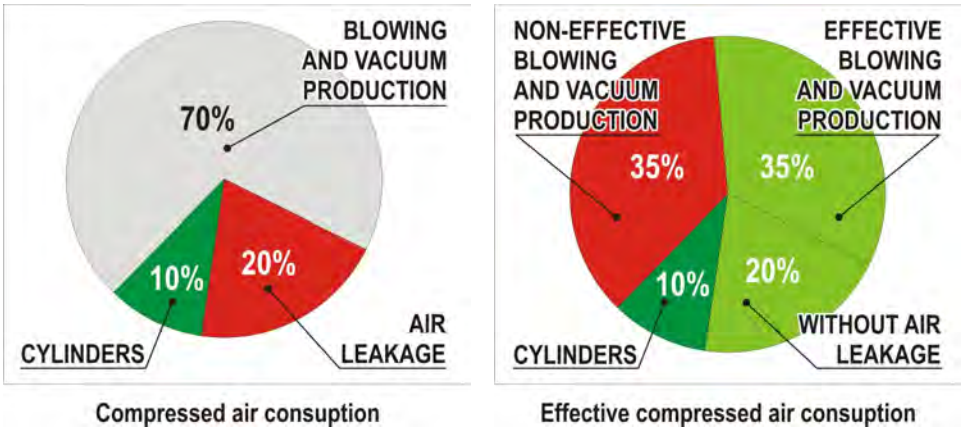
Compressed air is generally considered to be one of the most expensive energy. Its use in technical practice is nevertheless widespread. This is due to its practical advantages, especially its availability, ecologically harmless and many mechanical advantages. As in automated plants so widespread, the need to place its saving. The paper implied a direct correlation between saving compressed air, impact of saving energy and economic balance of the company and the resulting impact on environmental protection.

Key words: *compressed air, energy saving, ecology*

Compressed air energy

Automated production is today without the use of pneumatic components almost inconceivable. Production costs associated with the preparation of compressed air as compared to other energy (electrical, hydraulic) substantially higher. The use of compressed air energy does not allow recycling of energy used. Therefore, it is should be monitored and appropriately reducing the costs of operating the company through reducing consumption of compressed air.

Whereas it can not anticipated fundamental change in the effectiveness of pneumatic components used in automated mechanisms opens space for saving compressed air in particular eliminating the adverse leakage, Fig. 1a.



a *b*

Fig. 1 Compressed air consumption at production company activities

The cost of manufacturing

For a truly effective evaluation of compressed air energy can be considered its use for performing work activities mechanisms (force effect of drives, in operation only 10% of pneumatic energy) and about half of the total consumption of compressed air designed for blowing and manufacturing a vacuum in the ejector (eg drying of the coating, handling tasks using a suction gripper heads) Necessarily, the question arises: "We use the produced volume of compressed air really effective?" Are emerging are other questions: "Why should we be interested in it? After all, it is only the air ... "The answer is the cost of production and treatment of, tab. 1.

Thus, if we are able to effectively use the consumption of blowing and vacuum preparation at least 50% and completely eliminate losses resulting from leakage of compressed air from the circuit to improve the efficiency of energy use compressed air in your business to 65%, so we reduced losses by 55% When we realize that the cost of producing compressed air contained in the price of products, some we found one of the reasons why our products are a little competitive.

Tab. 1

The financial statement of the cost of production and treatment of compressed air

The unit quantity of consumed compressed air [m_n^3/min], with an average working pressure in the circuit 0.6 MPa	**The annual cost of producing and treatment of compressed air at a price of € 0.04/m^3** and at 6000 operating hours/year
1.00	14 400.- €
5.00	72 000.- €
10.00	144 000.- €
20.00	288 000.- €

In my experience, that can be achieved in the loss of several thousand per year as "due to" improper pressure set point in the circuit, or improper use of some components (particularly when using a vacuum)

The energy for the production of compressed air

Compressed air energy is obtained in compressors that compress air for use in most cases electricity There are also cases when the production of compressed air is realized by combustion engines (mobile compressors) What is essential, however, efficiency of the compressor reaches the top versions only about 70-75% (mean about 60%).

Ecological consequences

Whether compressed air produced by electricity or combustion engine, always largely harmful to the environment If we look at the distribution of consumption of electricity produced, Fig. 2, a fifth of the whole world's electricity consumption, is on the production of compressed air.

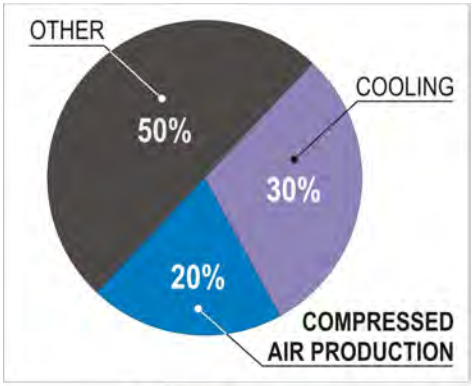


Fig. 2 Consumption of electric energy

If we accept the premise that neither supply of nuclear fuel for the purpose of generating electricity are not unlimited and its use, as well as the use of fossil fuels burden on our environment is in place stronger consider forms and ways of saving electricity (and energy in general).

Kyoto Conference on Climate Change (December 1997) the adoption of the Protocol to the UN Framework Convention on Climate Change (valid from r 2005), brought about a shift in the understanding of ecological approaches in the management of energy in the manufacturing sector. Countries that ratify this protocol (141 countries except the USA and Australia) are committed to reducing GHG emissions. It is estimated that for the full success of the Kyoto Protocol which counteract the global temperature within the range of 0.02°C to 0.28°C by 2050. Nobel Prize in Chemistry (1903) *Swante Arrhenius* (Sweden) in the late 19th century calculated that if the level of CO_2 concentration in the atmosphere has increased two times, the temperature would rise up to 5°C. Based on the then value of CO_2 concentration in the atmosphere, which ranged from 180 to 270 ppm (1 ppm = 0.0001 = 1.10-6% = 0.001 ‰), but

already in 1960 CO_2 concentration reached 313 ppm and in 2012 is already about 394 ppm. This would correspond to IPCC (*Intergovernmental Panel on Climate Change*) on the increase in temperatures between 1.4°C and 5.8°C over the period 1990 to 2100. The Kyoto Protocol should therefore be regarded only as a first step, after which they must be filled set out further targets.

The world, therefore, began to feel the effects of the so-called Global warming due to human activity If we compare only the amount of energy spent on cooling (and fall are the means for reducing the temperature of the working environment), it is clear that the world due to their industrial development and in particular the pace gets into a vicious circle: because of increasing demands on the amount of energy we due to global warming need more and more energy to lower the temperature inside the life and work of the people.

Energy saving

As consumption begins significantly exceed the possibilities of production "classical kinds' energy and production non-standard types is not yet sufficiently developed, Fig. 3, of about best suited through the investigation team which is currently we are able to produce. Positive to save energy in the form of saving consumption of compressed air in automated plants is that it addresses both environmental problems of the country and the economic problems of production companies. In general, each inefficiently consumed m3 of compressed air creates operational loss of production.

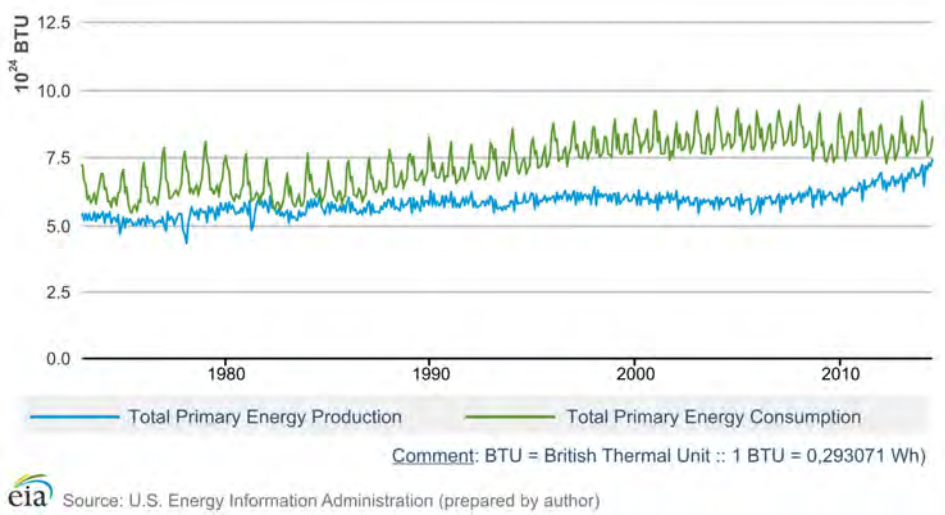


Fig. 3 Evolution of the total consumption of the basic forms of energy in the world

As shown by statistics, Fig. 1a, the total consumption of compressed air in operation the company to 20% are losses incurred leakage of compressed air from the circuits and distribution of pneumatic mechanisms. For the company it represents a fair and mostly irreversible loss tab. 2.

Tab. 2

The financial statement of losses due to leakage in the circuit (source: [1], [2])

Bore diameter (total leakage)		**Quantity of leaked air** [m_n^3/min] at a pressure 0.6 MPa	**The annual cost** by the price of **0,04 €/m³** and by operation 6000 hours per year
Ø [mm]	equivalent place [mm^2]		
1	0.786	0.06	864.- €
3	7.069	0.55	7 920.- €
5	19.635	1.52	21 888.- €
10	78.540	6.10	87 840.- €

If on these losses add air consumption used for various forms of blowing (blowing of splinter during operation, drying of paints, etc.) and for supplying jet vacuum generators (ejectors), getting to the value 90% of total consumption.

Thus, the saving of release of wide scale intervention in the circuit, leading to a saving of compressed air and thus to primary energy saving.

In the project on distribution of compressed air in operation must be complied with the following conditions:

1. **internal diameter of the pipe (cross-section) distribution of compressed air to optimize with respect to the needs of an application flow:** if the compressed air distribution used with a small inside diameter pipe, problems arise with insufficient speed of the drives on the other hand, when too large pipe diameters are required large volumes of compressed air to meet them, thus increasing the load compressor and ordering their supply of energy;

2. **ensure absolute tightness of connections:** if we take the total financial losses incurred by the production of compressed air leakage, regular errands, and instrumentation; Fig. 4, inspection staff in the company will never achieve comparable cost;

a *b* *c*

Fig. 4 Technical solution for inspetion of compressed air distributions for leakage detection
a – Ultra-sonic appliance device for leak of compressed air measuring CTRL UL101 (CTRL Systems, Inc., Canada)
Source: http://www.ctrlsys.com/library/downloads/Datasheet%20UL101.pdf
b - Digital pressure sensor/switch ZSE40A (SMC Corp., Japan); Source: [3]
c - The flowmeter PF3W (SMC Corp., Japan); Source: [4]

3. **pressure of compressed air keep at the level that is necessary for the operation:** if in a circuit with compressed air required to use local pressure in excess of the standard value (0.4 - 0.6 MPa), more preferably the such problems in locally using multiplicators, Fig. 5, as artificially maintain abnormally high pressure and subsequently regulate its value to the required lower level. High pressure in the circuit leads necessarily to the needs of higher load compressor and thus the increase in consumption of other energies (higher compressor power - higher consumption eg. Electricity);

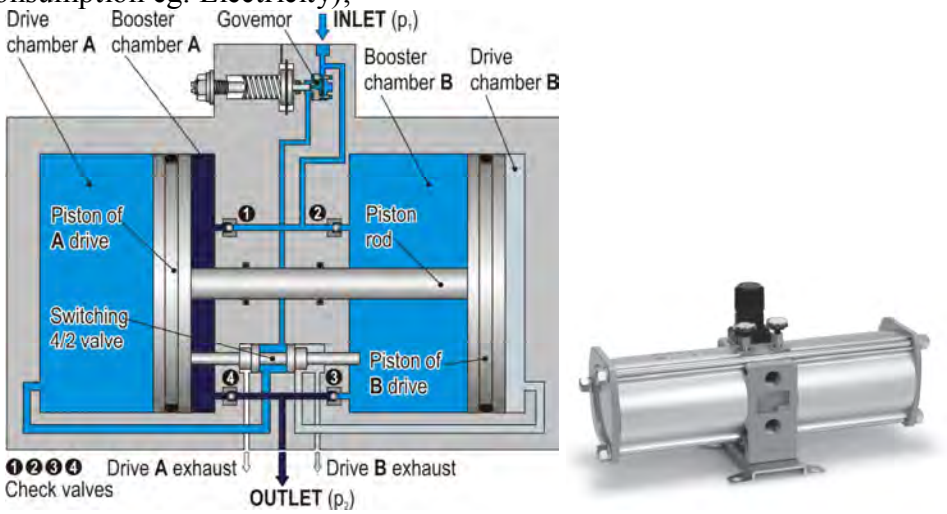


Fig. 5 Multiplicator

4. **location of valves in the divorce must be solved with respect to their ease of maintainability** (replacement, inspection, repair, leak detection);

5. **use of blowing nozzles with high efficiency** (large flow with low consumption), Fig. 6;

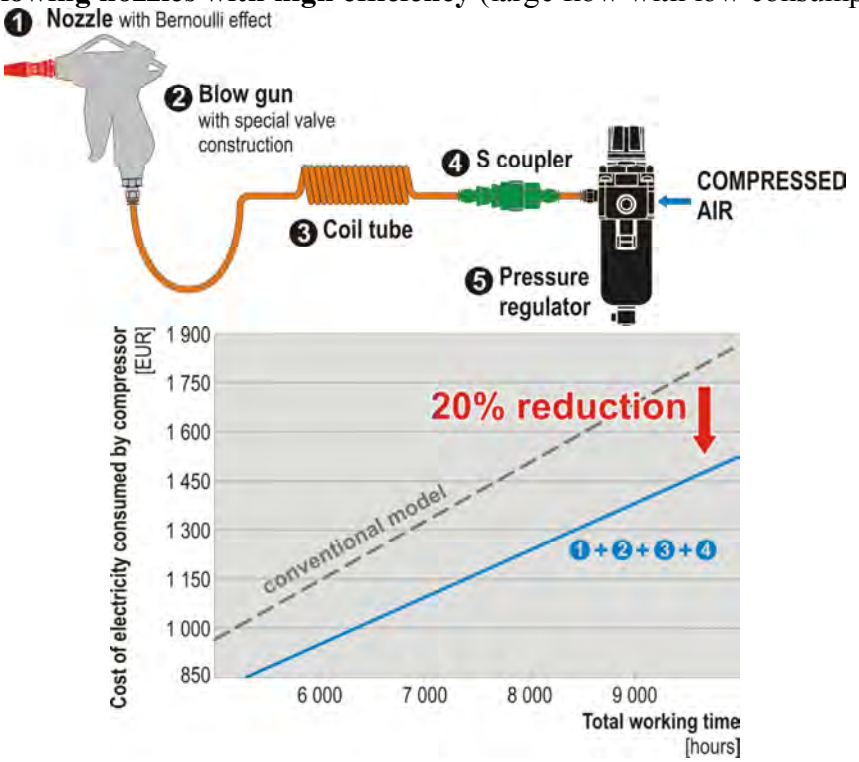


Fig. 6 Savings by valid organise and equipped circuit for air blowing

6. **Correct alignment circuit for use with suction cups gripping effectors powered by ejectors**, obr. 7.

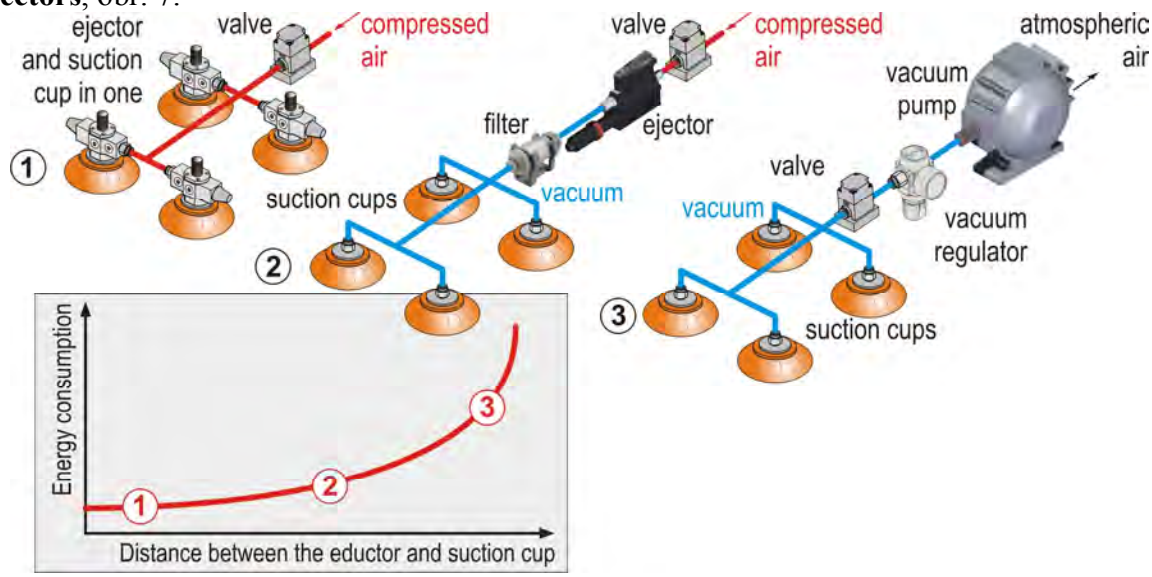


Fig. 7 Energy demand by vacuum used

Technical means for saving

Checking the tightness of joints shall be pay due regard. The first check is carried out after the realization of and first pressurization system before starting the machinery (without air consumption). Following the pressure loss (e.g.one hour). This information provides us peace leakage circuit after assembly. Consequently, it must be done repacking detected leakage and the test repeated. When leaks divorce suits, the test is repeated after the expiry of such one month. Similarly, the leakage test carried out on themselves pneumatic mechanisms.

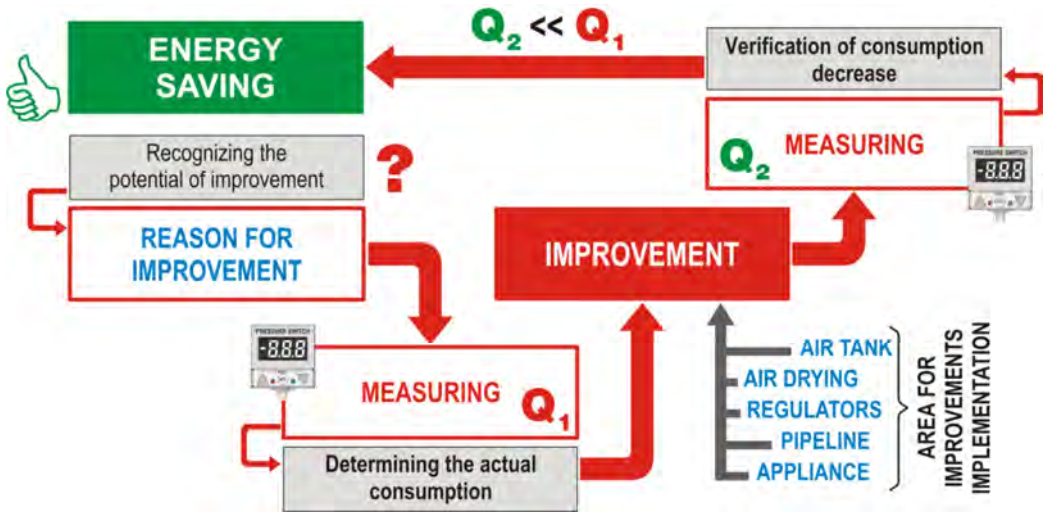


Fig. 8 Procedure for the application of the system for energy saving

(Source: [7], [8] – prepare by author)

This process is relatively lengthy and requires a degree of experience, therefore leading producers of pneumatic components come with developed systems for energy saving (Energy Saving Systems). Them on the basis of knowledge of opportunities for savings in air consumption endeavor to improve customer awareness of energy saving (awareness of the costs). All these systems work with the fundamental condition which consists in recognizing the need to carry out in a circuit changes bring about energy savings. For each field of implementation of the vehicle, resulting from the Fig. 8, there are many products and methods of treatment (see Fig. 4), to a greater or lesser extent to reduced consumption of compressed air and thereby to reduce the size of losses the company in this area to a minimum.

CONCLUSION

If the industry does not attempt to reduce these costs, consumption of basic energy (especially electricity) will continue to grow and not necessarily result in an increase in emissions in the atmosphere of our planet. Therefore, an extensive system of growth necessarily need to replace its intense form, because of the risk that the factory will produce products for humanity a dying as a result of environmental disasters.

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Contribution has arose with advancement of project: Applied research of systems for intelligent manipulation of industrial robot with non-orientable 3D objects / co-resolving with MIA Engineering Ltd., (ITMS: 26220220164).