The energy-efficient utilization of extraction and filtration technology

How manufacturing companies can sustainably reduce their energy costs through clever and forward-looking system design

The energy crisis is the great spectre for the European economy. Rising electricity and gas costs coupled with rising prices in the supply chain are pushing many a company to the brink of survival. However, as we all know, every crisis also offers opportunities - especially regarding the energy-optimized use of production technology and accessories.

Extraction and filtration technology

The utilization of air pollution control systems has become standard for the majority of manufacturing companies. On the one hand, there is a company requirement to protect employees, manufacturing equipment and products from the influence of airborne pollutants and emissions - and on the other hand, there are legal requirements and regulations. However, in times when the demand for energy savings is increasing, the use of extraction and filter systems seems to be more of a necessary evil. Yet this is precisely where the opportunity lies to save significant amounts of money over a longer period.

The approach to saving energy is not to reduce the performance of the systems. In order to eliminate a maximum of emissions such as laser or soldering fumes, dust or vapors, the extraction systems must perform at full capacity. The key to success lies in the design of the overall systems.

Image 1: Mobile and stationary use – LAS 260.1 filter system for laser fume extraction

System design

An extraction and filtration solution usually does not just consist of a device, but also includes capture elements, extraction arms, air lines, etc. This is an overall concept, adapted to the technical work situations in a production hall or workshop. An extraction system can be used as a mobile solution for changing workplaces. It can also be used as a central extraction system for several workstations or for automated material processing.

The possible applications are incredibly diverse and depend on a wide range of parameters. Looking at these individually would go beyond the scope of this article; and yet they have one thing in common: an ideal design can save money, a lot of money.

Several criteria are crucial for efficient system design and help to save significant costs. These will be explained below.

Distance of the extraction system from the source of the pollutant

It is already intuitively understandable that smoke can ideally be extracted directly at the point of origin. It is important to note that thermal effects or cross-flows can cause turbulence that makes almost complete extraction impossible. In addition, certain speeds are necessary for the transportation of airborne pollutants in the air. This means that four times the volume flow is required even at twice the distance from the point of origin. The volume flow is directly proportional to the energy consumption - four times the energy costs would have to be used.

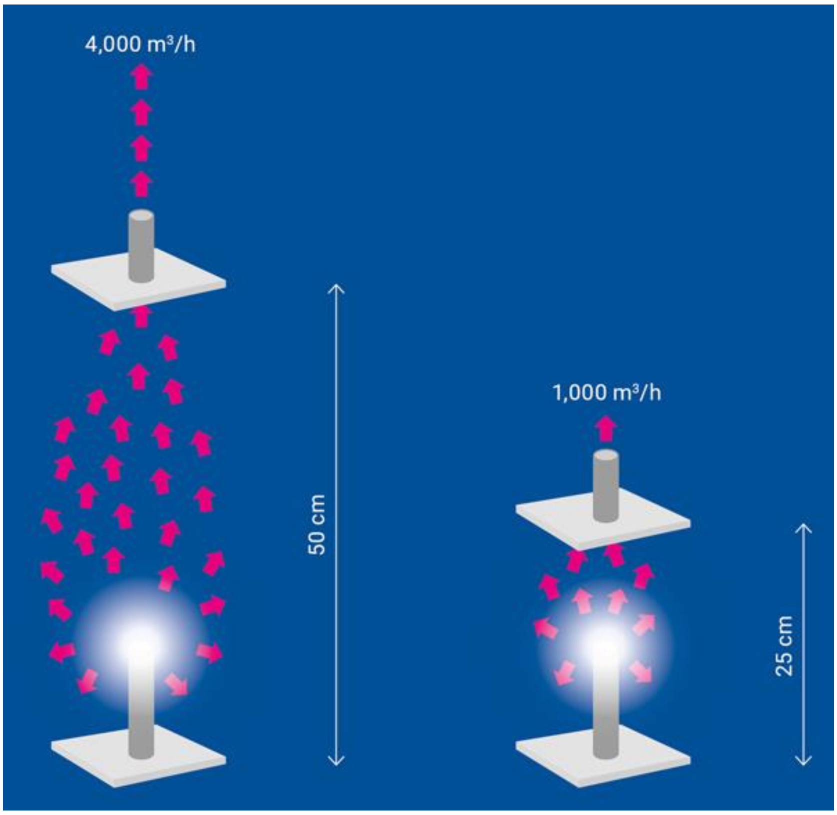

Image 2: Distance between capture element and pollutant source

Dimensioning of the pipeline

The piping essentially determines the transportation of the suction material. In general, the heavier the material to be extracted, the higher the transport speed. The flow speed is even factored into the energy consumption to the cube of the power. This means that the choice of transport speed - i.e. the cross-section of the pipeline - should be made with the utmost care, as it exponentially determines the energy consumption. In addition, the pressure loss of the pipeline is crucial. Kinks, branches, rough inner walls, etc. can lead to high costs, which can be avoided if these pipes are carefully designed at an early stage of development.

Filter design

As with the previous components, the pressure loss is the decisive factor for filter elements, because pressure is linearly influenced by energy consumption. There are filters with very low pressure loss, e.g. cartridge filters and so-called pleat storage filters. These have a large surface area and can be built very thin. In comparison, rigid body filters and simple filter mats can quickly have up to ten times the pressure loss. Here, too, experts must select the right filter system for the filtered material. In principle, each type of filter has its uses, but a focus on future energy consumption can save a considerable amount of money.

Incidentally, cleanable filters can be automatically freed of filter material at regular intervals, thus ensuring a low pressure loss in the system again. This saves operating costs.

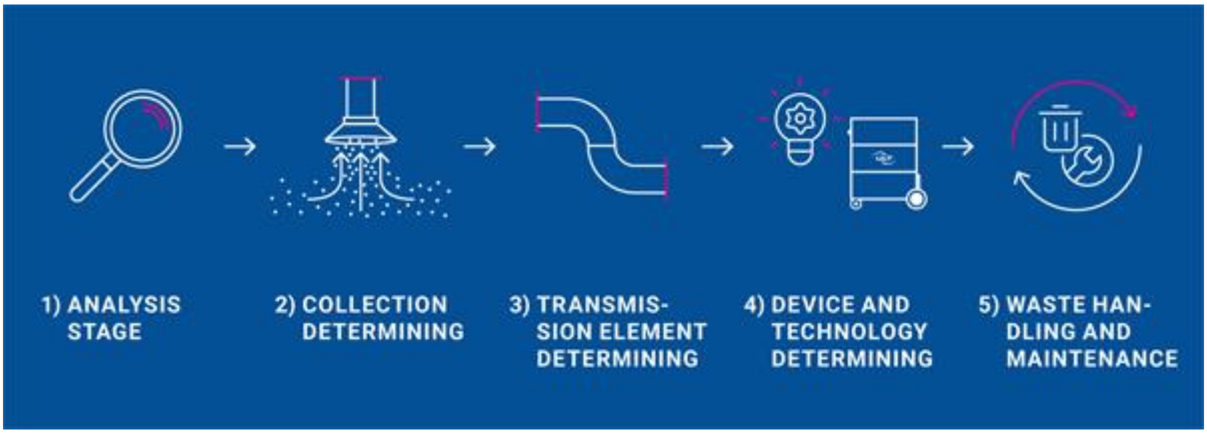

Image 3: Design of an extraction system

Fan selection

The speeds of modern fans can be controlled, for example using EC technology (electronically commutated motor − a brushless DC motor version) or frequency converters. Such systems are highly recommended because, for example, the system can always be operated at the optimal, i.e. most energy-saving point, even while the system is in operation, thanks to intelligent control.

In addition to the improved efficiency, the greatest savings aspect is the possibility of keeping the volume flow constant. In this case, only as much is extracted as necessary, which significantly reduces energy consumption. Coupled with intelligent machine-to-machine

communication, which also adapts the volume flow to the current machining process, there is enormous potential for saving both energy and the compressed air required for filter cleaning. This optimization also extends the filter service life by reducing the average filter surface load per time.
Modern drive units combine the savings potential of efficient EC fans with the performance of a housing fan.

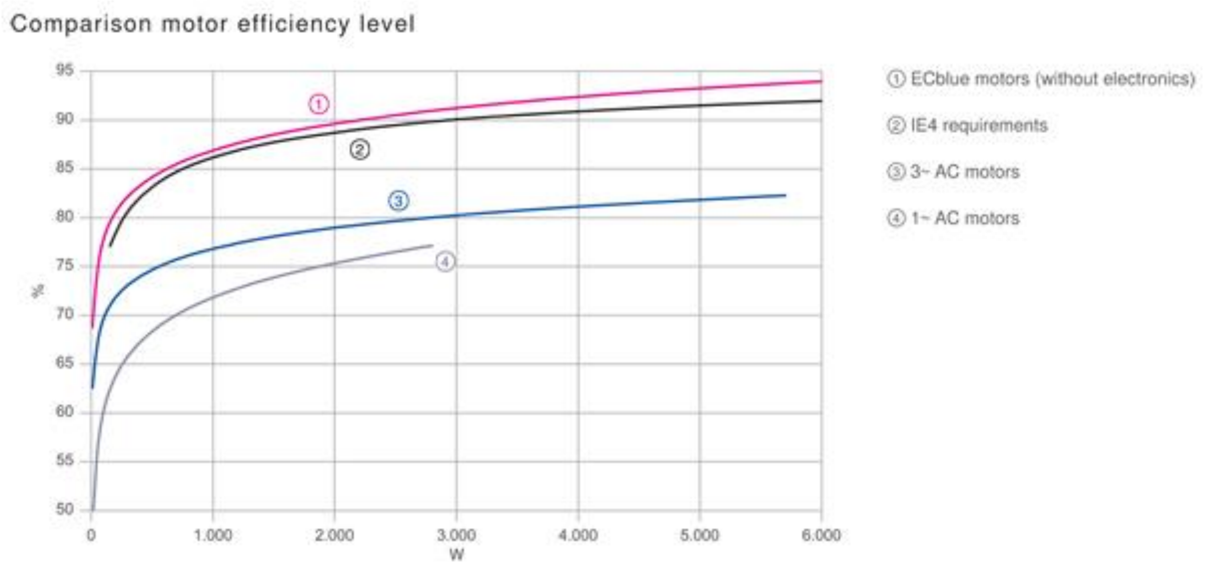

Image 4: Comparison of EC vs. AC fan efficiency (source: [Ziehl-Abegg](#))

Operation of the extraction and filtration system

Regular maintenance, replacing blocked filters and checking the system for blockages etc. also help to minimize operating costs.

In many plants, the ventilation system can be the highest or second-highest consumer of energy. Compared to choosing a system “off the shelf”, a system design with a focus on energy efficiency can quickly save two thirds or more of energy. For example, an extraction and filtration system for a machine tool would only consume 3 kWh instead of 11 kWh. Given current electricity prices, this would mean money savings in the five-digit range.

Conclusion

A forward-looking and intelligent design of a complete extraction system offers manufacturing companies the opportunity to achieve considerable energy savings. Experts should deal with the design – together with the customer. Half-knowledge or cheap goods are the greatest dangers to a positive energy balance, because the energetic effects of an overall concept can only be optimized through expert knowledge.

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