Why Extraction and Filtration Technology is important

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Capturing and Filtering of airborne Substances is anything but simple

There is something in the Air

Occupational health and safety in manufacturing companies have become increasingly important in recent years. Today it should be seen as a part of the job rather than an annoyance. Manufacturing processes have gained in complexity, and resulting pollutants have become smaller and particularly more exotic. “From chipping come chips” is a popular saying. Today, the chips cannot be seen with the naked eye any longer since particle sizes of occurring dust and smoke have arrived in the nano range.

Pollutants of any size always have influences on humans, machines and products. In addition to social and human components, a high absence rate among sick employees has economic influence on a company just like malfunctioning machines due to pollutions. Maintenance work, postproduction and finally image loss and falling demands are predominant negative effects.

All these factors lead to increasing necessity for extraction and filtration technology, which protects equipment and employee health, and furthermore, takes account of changing process parameters.

Today, extraction and filtration technology covers a wide range of airborne substances. Nearly all processes found in manufacturing industry are supported. From connection and separation technologies, surface processing such as marking, drilling, sintering and milling, the utilisation of fluxes, up to production processes such as 3D printing or rapid prototyping by means of laser, soldering and gluing – all these processes generate harmful substances that potentially have extreme health impacts.

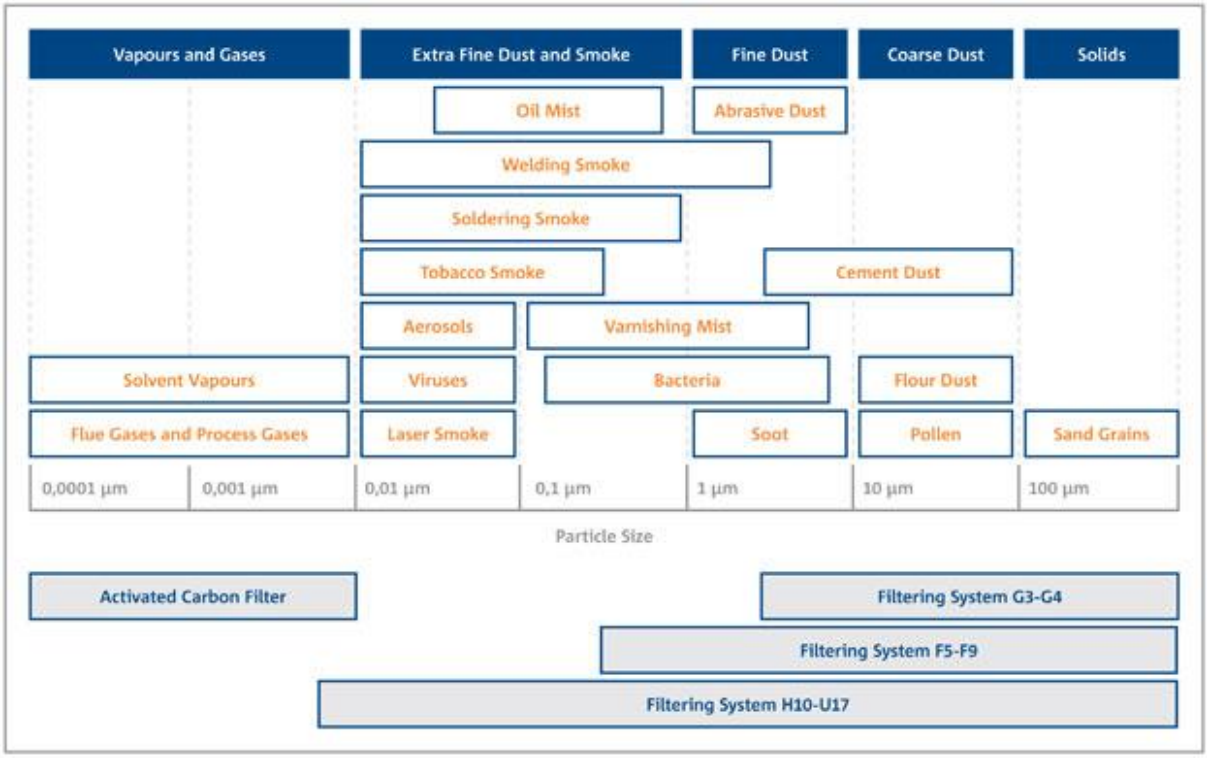

Figure 1: Overview about dust particle sizes

Laser Smoke as an Example of hazardous Substances

Lasers are increasingly utilised in metal and plastics processing, e.g. drilling, welding, cutting, engraving, sintering etc. For example, in metal processing dusts containing heavy metals are released that may accumulate in the human body. In processing alloy metals, part substances such as nickel, cobalt and chrome are released. The pyrolysis of organic materials may generate dioxins or hydrogen chloride. Moreover, laser smoke contains fine dust that may lead to respiratory diseases, cardiovascular problems and an increased cancer risk in a worst-case scenario.

Apart from poor air quality by permanent smoke and odour emissions, there can be an impact on machines resulting from pollution and chemical reactions to their products. In particular, in the case of finest precision mechanical works any kind of impact by particles must be avoided.

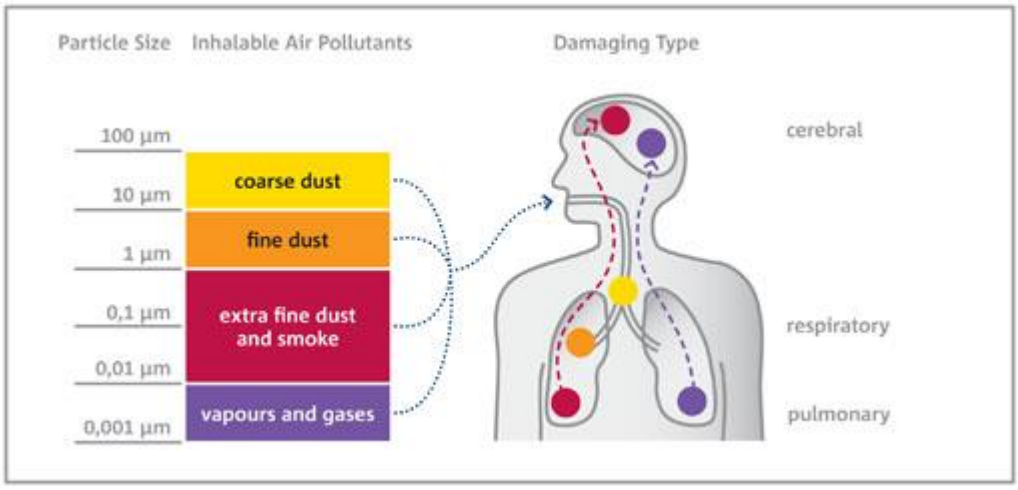

Figure 2: Impacts of hazardous substances on the human organism

Legal Provision

In many countries, there are clear regulations and laws to remove hazardous substances in the atmosphere. In Germany, for example, there are the Ordinance on Hazardous Substances, Technical Guideline for Air Pollution Control and Technical Rules for Hazardous Substances. Those standards require that “all dust produced must be completely captured and safely disposed ...”.

There is a four-level protection concept from minimising dangerous substances (level 1), substitution of hazardous substances and extraction devices (level 2), closed systems and access limitations (level 3), demarcation of risk areas and respective limitation in clean air return. In addition to the regulation on contaminant capture by closed and opened systems, it is specified that dust and gases must be filtered to a high degree (>99,95%).

Users of air filtration plants don’t necessarily have to know about these regulations, but vendors of extraction and filtration systems need to be aware of them. They need up-to-date expert knowledge on the full range from checking the medium to be filtered, particle size distribution and characteristics (adhesive, subliming etc.), up to tests of hazardous substances and flammability.

Clean air replenishing is not regulated by law but strengthens economic and ecological acceptance and interests. From the point of view of a healthy air balance and heat-loss avoidance, extraction and filtration technology should be utilised in the most efficient way possible.

What Extraction and Filtration Technology must do

What do users of extraction and filtration systems expect? Primarily, such systems must meet various requirements to guarantee minimal maintenance effort, health protection and high quality of work. This includes:

- Complete removal of all dust, smoke, vapours, odours and gases.

- Incremental filtration: Utilisation of prefilters for coarse particles (sedimentation dust > 10 µm) to avoid premature saturation of fine dust filters (for particles < 10 µm) and adsorption filters.

- Adaptation to occurring contaminants: An extraction system must absorb all particles, vapours and gases. Therefore, capacity of the filter media must be adapted to the emitted amount of particles. For example, a large amount of coarse dusts requires high-capacity filters to avoid changeovers too frequently. Too low saturation conditions lead to extremely high maintenance efforts for the extraction system. On the contrary, if fine dust is largely produced, coarse filters may have low capacities.

● Adaptation to work places: In large production plants, attributes such as ‘space saving’, ‘mobile’ or ‘silent’ does not matter. However, such characteristics are welcome at individual and handicraft workstations. Filter technology must not be annoying – it should never disturb work routines, neither physically nor acoustically.

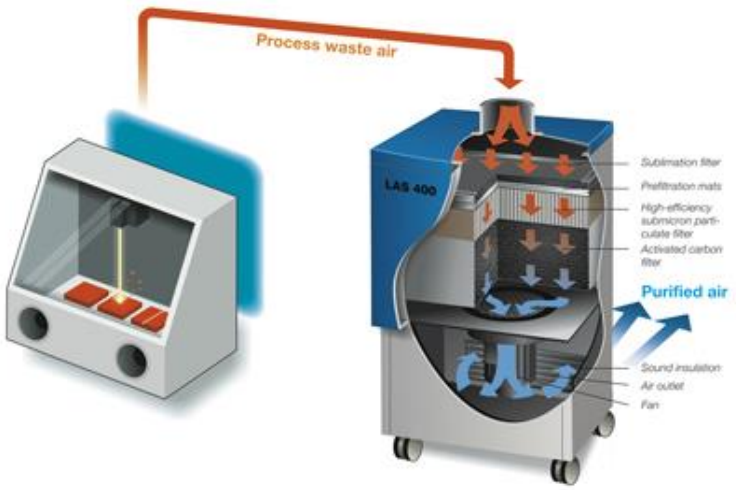

Figure 3: Example for combinational filter in an extraction and filtration system for laser processes

Capturing hazardous Substances

The capture of contaminants is regulated by law in various countries. These regulations determine categories of danger for specific hazardous substances, e.g. in terms of fire and explosion risks, or in types of health damaging effects (carcinogenic, mutagenic or toxic for reproduction).

Requirements for particle capture at the point of origin make sense, because:

● Large quantities of pollutants can be captured
● There are relatively low capture efforts
● Good filtration opportunities are given
● Low energy demands occur

Basically, the right filter element can make a decisive contribution to the quality of the extraction and the efficiency of the filtration device

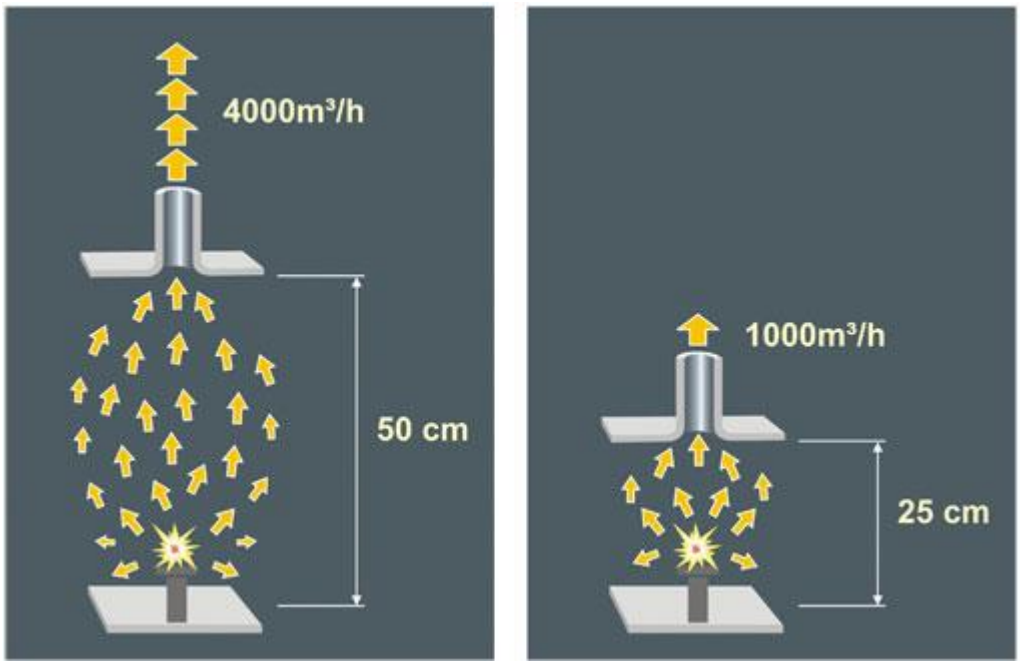

Figure 4: Influence of distance to the required airflow

Additionally, the position of capturing plays a decisive role. A general rule says that twice the distance between emission source and capturing element requires four times the exhaust performance in the extraction and filter system. That gives an exponential conclusion to the energy requirement – in terms of energy transformation, this is a remarkable aspect ratio.

Figure 5: Extraction arm for pollutant capturing at work place

Conclusion

Extraction and filtration in industrial environments goes far beyond the vacuum cleaner principle. It is not just a case of dirt removal but to eliminate hazardous substances in the air that may cause more than a dust allergy. The precondition for users is

knowledge about their materials and processes. Vendors of extraction and filtration technology can recommend a suitable system. They have knowledge of the legal regulations, chemical and physical characteristics of the media to be extracted and filtered, and they can adapt a system for air purification to fit the circumstances and situations in a facility.