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Dust Extraction
Five ways to achieve long life with minimal expense

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Five ways to achieve long life with minimal expense

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Is it worth it?

Buried deeply amongst all your production or materials handling costs there may lurk, unwatched and uncontrolled, a persistent drain on your resources. In constant use and with an energy requirement of possibly more than half that of your total production, your dust extraction system should be a prime target for the "energy police" – but can serious money really be saved either by initial design or even long after installation?

Ducting design matters

It is odd how often you may see expensive but expertly designed process machines served by an equally well designed dust collector/filter, but connected by ill-sized inappropriate ducting snaking tortuously around the building, with no thought given to its own energy sapping requirements. Moving air along a duct requires energy and every acceleration or change in direction adds to the power needed.

Careful design, with slow bends in place of tight ones, illustrated here with seven segments, and smooth aerodynamic branches and transitions will reduce fan power requirements – continuously. Incorrect air velocity in ducting can be expensive, not only in energy costs but also in maintenance and replacement costs. If it is too high, then fan power requirement can increase markedly; but also the rate of attrition will increase. This may cause the ducting - particularly bends and branches - to wear out unexpectedly quickly. If duct velocity is too low, then dust may be deposited in the ducting resulting in weaker airflow ultimately causing severe congestion or even a fire hazard. In fact it has been known for a ducting system to collapse completely under the weight of material lying within it.

To illustrate how energy can so easily be wasted by inefficient design or use of ducting, let us consider a typical duct with a resistance of 2000Pa per 100m at 30m/s. If the velocity were lowered to 20m/s the resistance would reduce to 700Pa, whilst at 15m/s it would be only 330Pa, just one sixth of the resistance at twice the speed! A typical 90 deg bend would have a resistance equivalent to 6 to 10m of straight duct, but more if

very tight. Most collected dusts will remain buoyant at 18 to 20m/s, with lower velocities possible for very lightweight materials.

Moving air is expensive work – so lighten the load if you can. A typical fan, if driven faster to double the airflow, will require eight times the energy to do it. Furthermore a typical motor will cost as much to run as it did to buy in well under one month of operation; just a few days if running continuously. Let the air flow freely if you can.

So, efficient ducting design should consider the whole system layout, minimising the need for sharp bends and branches. Progressive changes in diameter as branches converge with the main duct and attention to air velocity may cost no more to install and indeed their lower energy requirement may even enable a smaller extraction fan to be employed.

Drives - speed control or dampers?

Of course it is obvious that a few duct dampers will cost much less than sophisticated inverter driven speed control – but don't be so sure...

The purchase price of inverter controls may be offset to a large extent against the cost of an indirectly (belt) driven fan, as the inverter requires only a directly driven unit. Factor in the cost of additional volume control dampers and the purchase price argument diminishes – but the compelling argument for inverter drives relates to running costs.

By varying its speed to suit airflow requirements, the fan can be set to operate always near its maximum efficiency. Controlling the airflow volume by means of dampers adding resistance will lead to the fan operating point moving away from that of maximum efficiency. If we consider a fan operating near its peak efficiency of 80% and with a power requirement of say 85kW, then reduce its output by 10% by partly closing a damper, then it will reduce the efficiency by typically 2% and reduce the power required by approximately 9.7kW Using an inverter drive the efficiency of 80% would be maintained and in this example the power requirement would reduce by approximately 15kW, that is, over 6kW of power. The energy wasted by the damper, at a typical tariff of £0.09/kWh would therefore amount to £0.54/hour. For a 16 hour five day week the excess cost would be more than £43, or over £2000/year from just one drive!

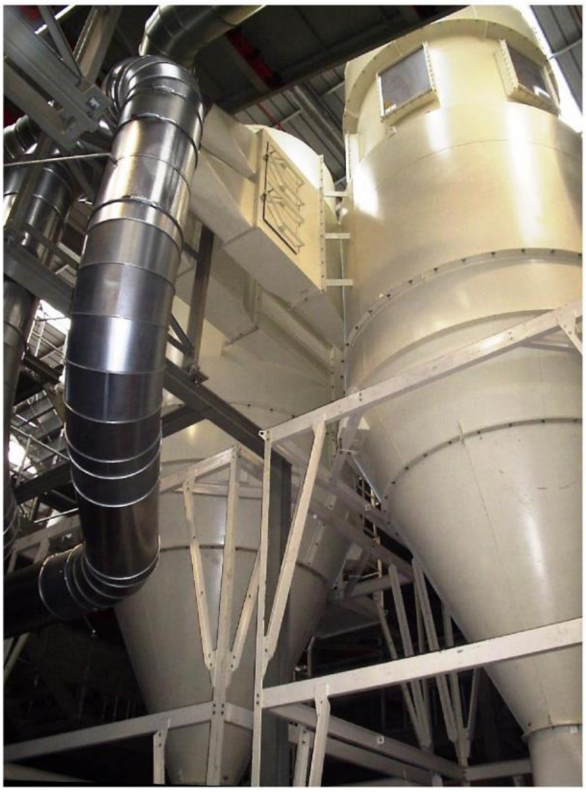
Continuous modulation of the fan speed using an inverter drive could easily save in excess of £3000 every year in this example, without even taking into account the power losses of 5% or more incurred by belt drives.

Dampers may have their place, however, in a larger centralised dust extraction system with many extraction points, where there is some diversity of use. By automatically closing dampers when individual machines or conveyors within the total plant stop

and then adjusting the fan speed proportionately, further energy savings may emerge. It is important, of course, to maintain duct air velocity to prevent precipitation of dust within the ductwork, but thoughtful design can overcome this risk.

A comfortable filter saves cash

A dust collector or filter working within its comfort zone will offer less resistance to the airflow; the filter material, if properly selected, will last longer as it will suffer less stress and it will need less auto cleaning, again saving energy. Many orientations of dust collector are available, depending upon available floor space or height, the type and quantity of dust to be collected and whether the waste itself is a valuable resource or merely waste.



For example, cyclonic filters as illustrated occupy very little floor space, have a large dust capacity, but may be rather tall. Of course, there is a natural tendency to buy the smallest filter unit possible, to save space and initial cost. However, during its lifetime, the energy consumed by the extraction fan alone will probably cost more than ten times the capital cost of the entire installation. So, even small energy savings are well worth having and should be planned into the whole scheme.

For applications where dust loading may be quite high, including conveyor transfer points, mixing, silo filling and processes such a shot blasting, the filter body should be large enough and designed specifically for good pre-separation, to reduce the average resistance at the inlet, across the filter material and at the outlet. There should be generous spacing between the filter elements to facilitate auto cleaning. Alternatively partial or phased off-line cleaning should be considered, in which the elements are isolated from the airflow during the cleaning operation. The filter material type should be appropriate and not over-specified. For example, if a surface treatment such as glazing is not needed for the application, it should not be considered as it will increase the airflow resistance, albeit only by a small amount, but nonetheless will lead to noticeably greater energy consumption over time. Filter unit design is of course a subject within itself, but applying the old adage "If she looks right she'll sail right" it is easy to see whether the airflow through the unit is unnecessarily obstructed.

Commissioning is more than just switching it on...

A statement of the obvious, obviously! However, for a dust extraction installation, as for any bulk handling installation, care in setting up really will pay dividends in the long term – or perhaps even in the short term. Particularly for a dust extraction system, its real purpose in view of COSHH and personnel health and safety, should not be lost. However, once all initial mechanical, electrical and general condition checks have been made, the airflow volume should be set initially as low as is practicable. New bags or cartridges will offer little resistance and if airflow is too high, then accelerated death may (and probably will) overtake the filter elements.

Therefore commissioning, or "putting into service" becomes a two stage process, with adjustments to be made after an initial settling in period to restore airflow volume to the design value. This will also offer an opportunity to check the settings of on-line filter cleaning mechanisms and adjust if necessary for economic stable operation. Of course, an initial Thorough Examination and Test in compliance with COSHH regulations will be required for a new installation and this visit would provide the ideal opportunity for this process, providing that the installer has the competence to offer such a service. Indeed, it will demonstrate that the dust extraction system has been correctly designed and is actually capable of removing particulate from all operator breathing zones and machines as appropriate; in short, the ideal time for the new owner to accept ownership.

Complete and proper commissioning is vital for successful, economic operation of a dust extraction system. Setting up properly initially and checking once settled to ensure correct airflow volume and operation of the cleaning system will pay for itself many times over. Energy costs will be optimised and the filter material, itself an expensive item, will perform effectively for much longer. Benchmark performance figures obtained during commissioning are in any case required to enable subsequent regular examinations to be performed, in accordance with COSHH regulations.

...and it's also worth looking after

A well designed extraction system and filter installation will require relatively little maintenance, but if neglected it will become less efficient and more costly to operate. Its total life time will probably be shorter resulting in increased depreciation costs. More importantly, an inefficient system may lead to a deterioration of air quality in working areas leading to, at the very least, poor morale amongst the workforce. Regular checks on the cleaning system and in particular compressed air quality and pressure, will serve to maximise filter bag or cartridge life. On a larger installation the cost of filter elements alone may account for up to one third of the whole unit cost – so well worth a little attention. Apart from normal checks and lubrication, a regular service by an engineer experienced in dust extraction will identify any signs of mis-use or impending failure as well as ways in which to improve efficiency. Worn diaphragm valves can persistently leak compressed air, itself an expensive commodity to produce. Over-cleaning, for example by setting the pulse cleaning time interval shorter than it needs to be, can shorten filter life, cause unnecessary emissions and again waste compressed air. Mandatory regular testing to comply with COSHH regulations may be incorporated into planned maintenance provided that the service provider is trained and equipped to do this.

In the long run therefore, good quality regular servicing will save money, improve staff relations and may also improve product quality.

Benefits all round

The requirement for general cleaning will be minimised and the risk of cross-contamination from other parts of the production may be eliminated. In many processes, it is necessary to remove dust from the material to enhance the quality of the primary product. A simple but graphic example would be agricultural seed cleaning. Properly cleaned seed will achieve the best prices. No farmer will be particularly happy about paying for a lot of dust with his seed! An effective, well maintained dust extraction system will minimise ongoing contamination, delivering the product to the next process in better condition. In addition, if the workplace is free from dust contamination then operators and other personnel can work to a higher standard and will be happier and more willing in their tasks, thereby improving productivity.

Customers will be supplied with better quality product, maybe also of a more consistent quality - but that is not all! Buyers are human also and will appreciate their suppliers more if they are seen to be responsible companies with an ethically secure future. They will appreciate low prices arising from genuine efficiency and not by ill judged corner-cutting. A dust extraction system that reflects the care and planning that is a prerequisite of any successful process, will indeed turn a cost into an investment.

Duct design, efficient drives, a well engineered filter installation, proper commissioning and effective servicing – just five steps towards long term satisfaction.

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