Four Dust Collection System Design Improvements That Can Yield Significant Annual Energy Cost Savings

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The design and location of a dust collection system's hood, ducting, collector and fan can collectively add sufficient static pressure requirements to the point where larger, more expensive to operate motors are necessary to maintain effectiveness. Optimizing these areas can make it possible to use smaller, more energy efficient brake horsepower motors. The electrical savings potential for a simple dust control system can be at least $2,000 per year, and significantly more for larger systems.

SYSTEM DESIGN IMPROVEMENT AREAS

Hood Design/Location

"Bell mouth" shaped hoods (Figure A), with an entry loss coefficient factor of 0.04, are ideal for energy savings. In comparison, plain, or raw edge collection orifices (Figure B), have a factor of 0.93. At a velocity of 4000 feet-per-minute (fpm), the Velocity Pressure (VP) of a plain opening has a factor of 1.0. With a bell mouth hood, the water gauge static pressure (wgSP) is 1.04", or 1.00 + 0.04 x 1.0. The plain opening design requires 1.93" wgSP, for an increase of 0.89" wgSP.

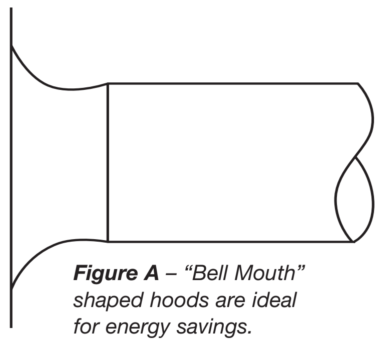

Figure A *– "Bell Mouth" shaped hoods are ideal for energy savings.*

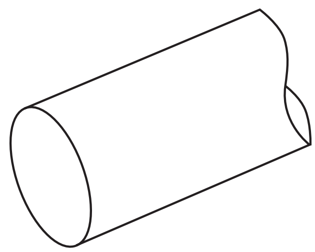

Figure B *– Plain, or raw edge collection orifice.*

Additionally, the collection hood should be located as close as possible to the point of dust generation to reduce the volume of air required to collect the dust. If the dust generated is 12 inches from the hood opening, a volume of 1000 cubic feet per minute (cfm) might be required. But, if the hood opening is 24 inches away, the required cfm volume increases as the square of the distance to 4,000 cfm.

Duct Design

The air velocity needed to carry collected dust is an important consideration. If the collected dust can be conveyed at 3500 fpm (where VP = 0.76), it would be a mistake to convey them at 4500 fpm (where VP = 1.26). At 3500 fpm, the duct friction factor is 0.018 VP per foot of duct (0.018 VP x 100-ft = 1.8 VP x 0.76 = 1.37" SP). At 4500 fpm, the duct friction factor is 0.02 VP per foot of duct (0.02 x 100-ft = 2.0 VP x 1.26 = 2.52" SP). The slower speed saves 1.15" of wgSP.

Ducting with a well-designed branch entry of 30° has a factor of 0.18, whereas a 45°-branch entry has a 0.28 factor. At 4000 fpm, VP = 1.0 (1.0 x 0.28 = 0.28 wgSP) for the 45° branch. In comparison, the 30° branch entry only requires 1.0 x 0.18 = 0.18" wgSP for a savings of 0.10" wgSP.

Duct elbows with a 1.5 diameter radius can have a factor of 0.24. A 2.0 duct elbow radius can have a factor of 0.19. Using the same factors as above, the 2.0 diameter radius will save 0.05" wgSP.

Added up, the total savings gained from well-designed ducting for a simple dust collection system is 1.15" + 0.10" + 0.05" for a total of 1.30" wgSP.

Dust Collector Operation

If the dust collector can operate with nominally dirty filters at 4" wgSP, instead of the more common 5" wgSP, a savings of 1.0" wgSP can be achieved.

Additional savings can be obtained using a Photohelic® gauge to control the pulsejet cleaning cycle in place of the traditional Magnehelic® gauge that keeps the compressed air “on” all of the time. Controlled cleaning with a Photohelic gauge not only saves compressed air and its associated energy costs, it also extends filter media life.

Fan Ducting

Bad things can happen if the ducting in and out of the fan is not properly designed and installed. Poor design is to install a two-diameter 90°-radius duct elbow right at the fan inlet. This serves to add 1.0" VP. With inlet velocity at 4,000 fpm, 1.0" wgSP is added. Best design is to have 7 to 10 duct diameters of straight ducting into the fan inlet.

POTENTIAL ELECTRICAL ENERGY SAVINGS

The extra-accumulated SP losses from poor design on a small cfm system can add approximately 4.20" SP.

Specifically:

HOOD	0.89"
DUCTING	1.30"
COLLECTOR	1.00"
FAN	1.00"
TOTAL	**4.19" SP**

If a small dust collection system has a system static pressure (SSP) of 9.0" wg, poor design can add an additional 4.19" SSP for a total of 13.19" wg. Assuming 2000 cfm, the brake horsepower (BHP) requirement for the 9.0" wg system would be 5.43. At 13.19" SSP, 7.65 BHP would be required.

Assuming the use of motors having the same efficiency, operating 8,760 hours per year, and electrical costs of $0.11 per kilowatt-hour, the annual operating cost of the larger 7.65 BHP motor would be $6,706. In comparison, the annual operating cost for the smaller 5.43 BHP motor in a simple dust control system would be $4,760 for an overall electrical energy cost savings of approximately $2,000 per year. Note that the energy cost savings potential increases in direct proportion to the size and complexity of the dust collection system.

HAVE QUESTIONS?

The annual amount of electrical energy cost savings to be gained will depend on individual dust collection situations and requirements. For this reason, it is recommended that an expert be consulted to evaluate dust collection system requirements and the design approaches that will make the most economic and energy savings sense.

The application engineering team from United Air Specialists, Inc. has significant experience in the many ways dust collection system design can be tweaked to reduce electrical energy usage and add the cost savings back to the bottom line. Questions can be directed to **sales@uasinc.com**.

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