



When dealing with reverse-pulse cleaning cartridge dust collectors, there are three major categories to be evaluated when considering the Total Cost of Ownership (TCO). The first major category is obviously related to the amount of energy required to operate the piece of equipment from day-to-day. The second major category is consumables or the items that are replaced from time to time throughout the life of the equipment. The third major category is maintenance and disposal or the time it takes to service the equipment and costs of disposing the consumables. Below is an outline of the above categories and the components that define each of them.

Total Cost of Ownership

- **Energy Category**

- Electrical Cost
 - 4 Premium Efficient Motors
 - 4 Variable Frequency Drives
- Compressed Air Cost
- CO₂ Emissions Cost

- **Consumables Category**

- Cartridge Replacement Cost
- Transportation Cost
- Inventory Cost

- **Maintenance and Disposal Category**

- Labor Cost
- Disposal Cost
- Downtime Cost

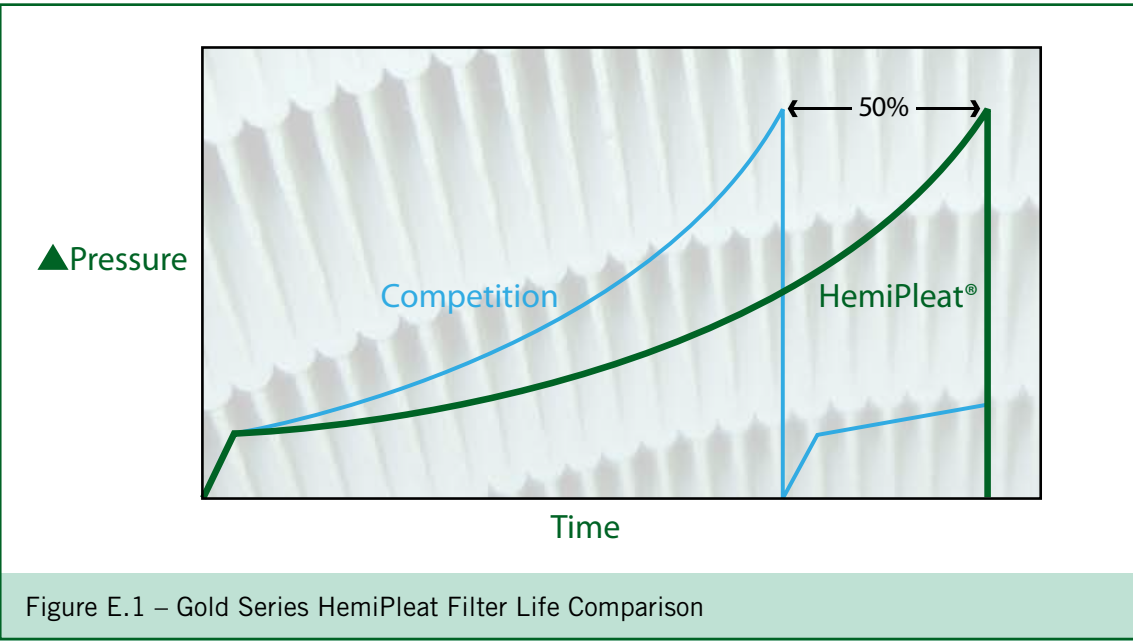
Discussion and Definitions

Electrical Cost – The amount of electrical energy consumed, in dollars, while operating the dust collector. Although there can be several electrical loads associated with a dust collector, timer boards, rotary airlock motors, etc., the largest portion of the electrical load is related and calculated from the blower required to move the air in the system. The largest opportunity for savings is in consideration of this device and all others are considered insignificant in potential cost savings. It must be understood that differential pressure losses in the system are directly related to the amount of electricity consumed by the dust collection system. Although ducting should be considered at the time of installation to reduce the amount of pressure loss, the choice of dust collectors, filters, and energy control devices are what will be focused on in this report due to the fact that they are varying losses throughout the operation of the dust collection system.

Information is preliminary and subject to change.



It should also be understood that when operating a typical dust collection system, the amount of energy consumed by the blower is directly proportional to the amount of air being moved through the system. As the amount of air being moved through the system is decreased, the amount of energy required to move it is decreased as well. For this reason, the amount of savings in terms of electricity used, is usually small when comparing a Gold Series® HemiPleat® filter to a competitor over the life of the system. When there is no energy control device (Variable Frequency Drive), the amount of savings by choosing a HemiPleat filter is best defined, and significant, when evaluating the other components in the Total Cost of Ownership. This is graphically explained in Figure E.1. Note that the vertical lines within the graph represent a filter change where consumable, and maintenance and disposal fees are applied.



Because differential pressure is directly proportional to the amount of air being moved through the system, and because the amount of air being moved throughout the system is directly proportional to the amount of energy being consumed by the blower, there are significant cost savings to be had when a VFD is part of a system operating with Gold Series HemiPleat Filters that maintain a smaller differential pressure throughout their service life. This will be further explained in the “VFD Operation” section later in this report, but some of the most important items to remember when evaluating the potential savings without a VFD is that the amount of air being moved through the system is not consistent and that a Gold Series HemiPleat filter has proven time and time again to last 50% longer when compared to any of the competition.

Compressed Air Cost – the amount of compressed air, in dollars, while operating the dust collector. Due to the patented HemiPleat and Gold Cone design, the amount of compressed air required to clean the filter efficiently and maintain a lower pressure drop is reduced significantly when evaluated throughout the life of the filter.

CO₂ Emissions Cost – Although there are no tangible cost savings calculated in the Total Cost of Ownership, the amount of CO₂ emissions from the operation of a Gold Series dust collector is significantly less and should be considered and stated as a cost impact on the environment.

Cartridge Replacement Cost – When changing filters, the amount of money spent on the replacement filters alone.

Transportation Cost – The amount of money required to have the replacement filters delivered to the operation site.



Inventory Cost – Typically, replacement filters are not received the day they are replaced in the system. This component is the amount of money required to carry inventory of replacement filters.

Labor Cost – The amount of labor required for maintenance personnel to physically change the filters.

Disposal Cost – Depending upon the type of material being filtered, there is a cost associated with properly disposing filters laden with process dust.

Downtime Cost – The cost of this component varies from facility to facility, but this cost is directly proportional to the amount of time in lost product due to having to make a filter change.

Variable Frequency Drive (VFD) Operation

It was briefly discussed earlier in this report that when operating a dust collection system without a VFD, that the amount of air moving through the system was variable throughout the life of the collector. As the filters become loaded with material, the static pressure through the system is increased and less air is moved because of it. When designing a system, and choosing a blower for it, there is typically 4 to 5 inches of water considered for the dust collector with loaded filters. With new filters, where the differential pressure is low, more air is being moved than required which has negative effects on energy consumption. When comparing a Gold Series HemiPleat filter to a competitor’s filter, life cycle costs are found more in the compressed air component of the energy category, consumables, and maintenance and disposal categories. This is due to the filters allowing more air to flow through the system.

The filters will use more energy in the early stages of the cycle and less in the latter stages. Over the life of the system, when comparing only the electrical component of the energy category, savings and/or costs are nearly equal in comparison. Again, this is explained in Figure E.1 when you consider the area above the curve as the amount of energy being used at any point in time.

Typically, a damper supplied at the outlet of the blower is used as a mechanical means to vary the static pressure in the system. When the filters are new, the damper is more closed to obtain the desired air flow. As the filters become dirty, the damper is opened more to increase air flow. When used properly, the energy costs of using a Gold Series HemiPleat filter has proven to save an average of 1” w.g. of static pressure over the life of the filter. This is based off of a blower that operates at a constant speed throughout the analysis that has one relationship to define the amount of energy being used. A typical relationship for a constant speed fan and the energy relationship by means of mechanically controlling the static pressure of the system via an outlet damper can be viewed by the graph in Figure VFD.1.

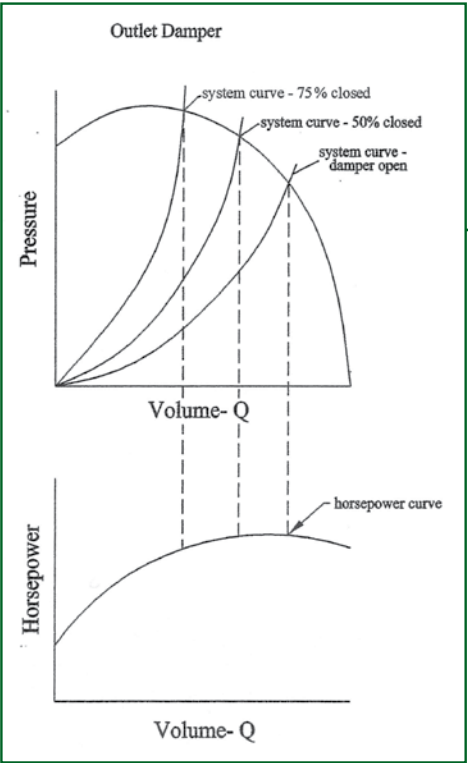


Figure VFD.1
Energy
Relationship
of a Constant
Speed Fan.

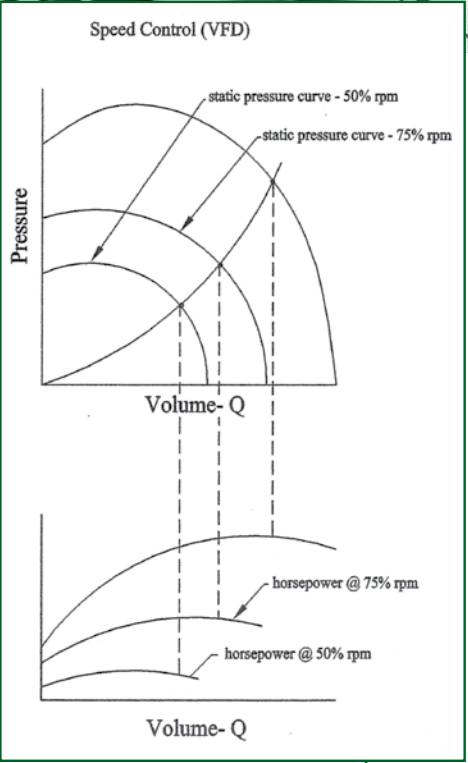


Figure VFD.2 – Energy
Relationship of a
Variable Speed Fan

Consider the use of a variable frequency drive as a means to electrically control the speed of the fan which in turn controls the amount of air moving through the system. When the filters are new, the speed of the fan is decreased to obtain the desired air flow. In contrast, when the filters become loaded, the fan is sped up to keep a consistent air flow throughout the system. The electrical control is much more efficient in keeping a desired air flow and the amount of energy consumed is greatly decreased. With a speed controlled fan, there are multiple relationships to define the amount of energy being used at different speeds. Figure VFD.2 provides a graphical representation of these

relationships. (Figure VFD.1 and VFD.2 were acquired from the 26th edition of the Industrial Ventilation manual of recommended practice for Design, figure 7-9b). With the use of a variable frequency drive, it has proven to save an average of 4” w.g. of static pressure over the life of the filter. Depending upon specific application variables, the additional capital cost of installing a VFD on a dust collection system will vary. However, the return on investment is typically under a year.



TOTAL COST OF OWNERSHIP (TCO) CALCULATOR

Data Collection Worksheet

How many days will this system operate in a year?	365	days/year
How many hours will this system operate in a day?	24	hours/day
What is the volume of air required to operate the system?	10400	cfm
How much does a Kilowatt-hr cost?	0.10	dollars per Kwhr
What is the cost of no production for one hour?	500	dollars per hour
What does a HemiPleat filter cost?	120	dollars
What does a Brand A filter cost?	90	dollars
How many filters are there in the dust collector?	16	cartridge(s)
What is the expected shipping cost per filter?	10	dollar per filter
What is your labor and overhead rate for one hour?	80	dollars per hour
How much does it cost to dispose of a filter?	10	dollars
How much does a Variable Frequency Drive cost?	2600	dollars
What is the current interest rate?	4.5	%
How many minutes does it take to change a HemiPleat filter?	5	minutes
How many minutes does it take to change a Brand A filter?	10	minutes
Will there be a Variable Frequency Drive operating this system?	Yes	Yes or No

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