Variable Frequency Drives in Air Conveyed Trim and Dust Collection Systems

Are Variable Frequency Drives on supply blowers worth the investment? Puhl experts explain.

We often get the question: Do Puhl-systems include supply blowers with Variable Frequency Drives (VFD's) in order to save energy?

Our answer is almost always "no" unless the blower is a return air balance blower in an air-conveyed trim and dust collection system.

Before we explain why, let's review some basic definitions.

1. A Supply blower is the blower that conveys material from the production machine TO the separator or filter.

2. A Return Air / Balance blower is the blower that conveys clean air FROM the separator back to the building or to the atmosphere.

3. VFD is a Variable Frequency Drive used to change a motor's output RPM which in turn changes the blower speed and output.

The supply blowers of the system must maintain **minimum material conveying velocity** in the trunk lines (main ducts) to avoid material laydown and plugging of the system. Slowing a supply blower down with a VFD to save electricity can lead to material laydown in the trunk line, jams at the machines or scrap/trim left in the finished product. The energy savings created by a VFD usually doesn't justify the resulting down time. It's also important to note that VFDs also increase the drive loss on the blower as all VFD's have slippage (inductive power losses).

The CFM (cubic feet per minute) required of the blower is constant due to the constant duct volume and resulting conveying speed. Once the supply blower speed is optimized using the correct drive pulleys and belts, there is almost never any need to change it in paper or corrugated applications. There are exceptions, but they are rare if the system is maintained and designed correctly.

One other thing to note is that the static suction produced by the blower quickly drops off when the RPM's are reduced. This can be a source of jams and scrap in finished product. The static suction is proportional to the square of the blower RPMs.

Fan Law #2 states that Pressure 1 / Pressure 2 = $(\text{RPM 1}/\text{ RPM 2})^2$

This means that a small percentage slowdown in blower shaft speed results in a much larger percentage decrease in suction.

Example:

At 7,800 CFM a 17" blower produces 20" static suction at 2,120 RPM and requires 41.5 Horsepower.

Reducing the RPM by 10% to 1908 RPM results in a **20% reduction of static suction** to 16". The horsepower (electric consumption) goes down 27% but the electric power savings is no good in most cases since the 20% reduction in suction will result in system plug ups as well as scrap in the finished product. Most machines require at least 4" of static suction as a minimum to get the air and scrap into the hood (duct inlet) of the system. Losing 4" of static suction on most systems will result in a noticeably lower material conveying reliability.

This shows that the shaft speed window for material conveying blowers is relatively small and slowing down the shaft speed for the sole purpose of electric power savings does not typically result in a savings in power cost. You can accomplish the same goal by changing the drive pulleys. The up-front investment will be less, as will maintenance costs and power slippage.

Keep in mind that there are exceptions to the above. For instance, on a **balance or return air blower**, the air conveying load varies greatly depending on how many of the supply blowers are running. On balanced systems, we do recommend the use of VFD's in combination with pressure transducers and a PLC to automatically adjust blower speeds. A PLC controlled VFD with real time feedback results in the best dust control AND power savings. This type of system also results in the best filter, cyclone or screen separator performance.

In conclusion:

VFD's for the supply blowers are nice to have to tweak the system at installation, but in the long run, they end up set at a specific speed (not varying) and cost more money than they will return.

We've even seen facilities buy and install their own VFD's only to put the VFD controls under lock and key in a fixed position so that they don't get left in the wrong position and cause plugging in the duct.

If you want to increase the efficiency of your air-conveyed material handling system, the following actions will almost always deliver better results than VFDs for the supply blowers:

- Monitor your dust filter pressure differential and change the bags or cartridges when the differential is high, usually over 4" of water column. The higher the resistance across the filter, the higher the electric bill and the lower the suction at the machines.

- Make sure blowers have belts and drive pulleys that are in good condition with belts tightened to manufacturer's specifications.

- Grease blower bearings to manufacturer's specifications. Follow the instructions on grease type and interval.

- Have your air-conveyed material handling ductwork evaluated by a qualified engineer to optimize the suction distribution and conveying velocities. In combustible dust applications, having a qualified engineer design the ductwork layout and sizes for proper material control is an NFPA 654 requirement (NFPA 654-2013 4.5). Without a qualified engineer doing the design work it is very likely that your system does not meet the codes and is also wasting electricity and/or causing machine downtime.

For companies looking to cut costs, installing VFDs on the supply blowers may seem like a good idea. But most companies that install them, especially those who take the DIY approach, end up regretting it. A qualified engineer who specializes in air-conveyed material handling systems can help you make a decision that balances the short-term savings with the long-term costs. If you want to chat about your situation, just give us a call at 615.230.9500 or email us at sales@gfpuhl.com.