

VFD Application in Onion Storages

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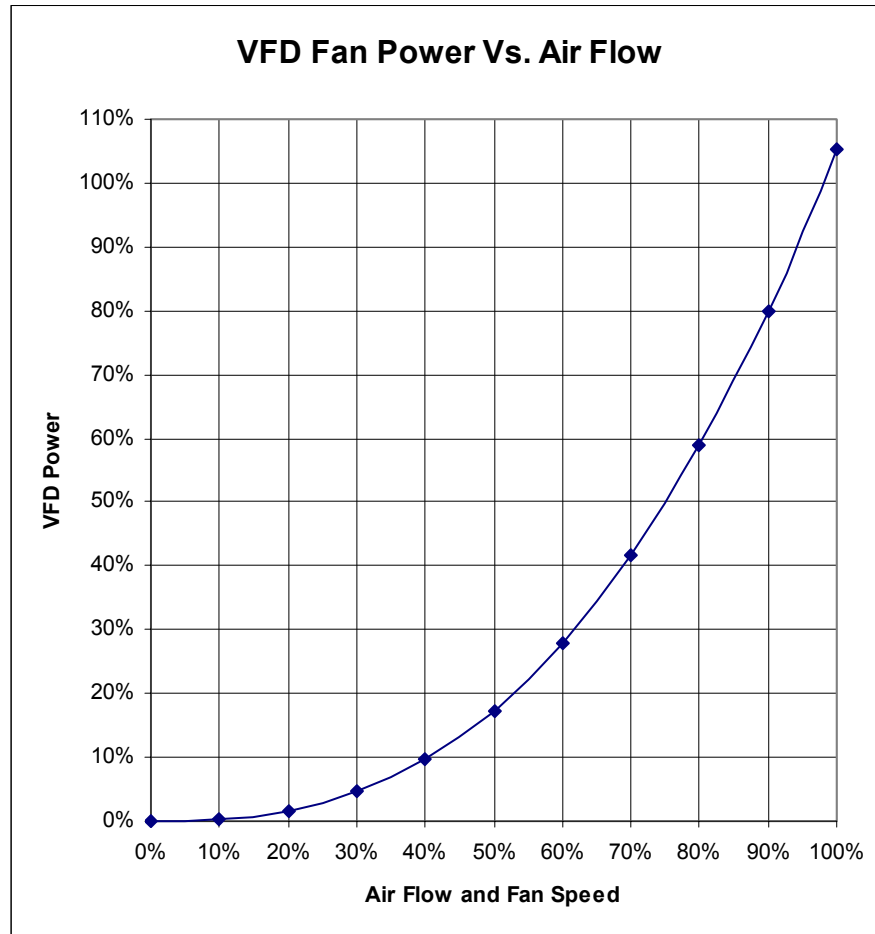
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Variable Frequency Drives (VFDs) can be installed on existing onion storages and save energy in some cases. The proper application of VFDs for onions is highly dependent upon the site details, and would need to address the following issues to be successful:

- **Variety & Storage Manager.** Onion storage practices are highly varied and storage manager dependent. The storage manager would need to be comfortable with modest air flow reductions for the variety in storage.
- **Design Air flow rate.** The building would have to be designed with enough air that some flow reduction is possible during winter holding without sacrificing product quality. Some newer onion storages have air flow rates of 1.25 CFM/ft³. This corresponds to about 65 CFM/ton. These storages may be able to reduce flow rates to 70%-80% flow during winter holding periods, which is the design flow rate of some older storage facilities.
- **Refrigeration.** Storages without refrigeration may not hold onions long enough to accumulate sufficient annual energy savings to justify VFDs. Storages without refrigeration likely need 100% flow whenever Outside Air (OSA) is available.
- **Refrigeration system design.** Most onion refrigeration systems are not designed for operation at reduced air flow. Refrigeration system designers are probably not comfortable with air flows below 75% of design, and some may specify minimum flows greater than 75%. This is a critical aspect, as onion storages operate with refrigeration much of the time due to low holding temperatures (33°F-37°F) and humidity requirements (70%-85% RH). Modifications to existing refrigeration systems to allow reduced flow operation could be prohibitively expensive.
- **Storage Season Length.** The storage season needs to be long enough to allow for at least 4 months of winter holding, when reduced fan speeds are possible and 100% refrigeration capacity is not required.
- **Coil Tarping.** Existing storages, not designed for reduced air flow through the evaporator coils, can use VFDs to operate at reduced air flow during winter holding by shutting off a compressor and tarping over its evaporator coil. This keeps air velocities up through the remaining evaporator coils.

In constructing new energy efficient onion storages, the following criteria should be considered:

- Install VFDs on ventilation fans. During winter holding conditions (November – March), manually reduce fan speeds based on daily inspections of crop and storage conditions. Depending on the variety in storage, design ventilation rate, and crop condition fan speeds of 70% to 80% should be achievable during winter holding. At 70% fan speed the fans produce 70% air flow, but only use 42% power as shown in the chart below.



- Avoid hot gas bypass (HGB) controls. Unload or shut down compressors during low load, and use fan cycling for head pressure control.
- Design with low head pressure limits in mind (ideally 60°F saturated pressure), and set condenser fan controls to target these low pressures. Select expansion valves accordingly.
- Select a condenser that is larger than “bare minimum.”
- Design evaporator coils to allow for operation at 65% air flow. Inform the owner of the minimum flow requirement.