VARIABLE SPEED EXHAUST FANS FOR POULTRY: PROS AND CONS

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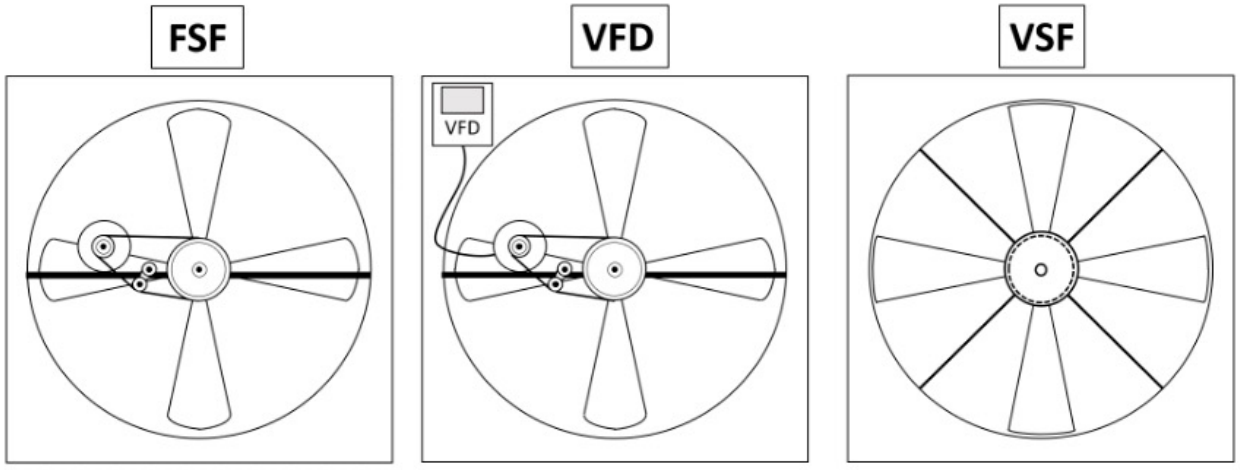
We get a lot of questions these days about modern technologies and if they should be implemented. One technology that is gaining popularity is the use of variable-speed exhaust fans. As with any new technology, it takes some time for the industry to decide if it "works for poultry." Yes, a select number of companies and producers are successfully using this technology today, but success has not been consistent.

Before we start, we need to get a good understanding of the fan options available today. For the purposes of this article, we are categorizing ventilation fans into three categories. Definitions and illustrations are as follows.

FSF – Fixed speed fans are the most commonly used fans today and are ON/OFF. For example, a 54" fan running at 100% is rated at 25,000 cubic feet per minute (cfm) for a 0.10" static pressure. The fan cfms and cfm/watt are reduced as static pressure increases.

VFD – Variable-frequency drives, not a new technology. A VFD can be installed on FSF to reduce the speed of the fan to fine tune ventilation rates, to potentially save money on electricity and to provide a cost-effective method to convert current FSF on the farm to variable-speed capabilities compared to installing a manufacturer-designed turnkey variable-speed system. Most FSFs are not designed to be used with VFDs. Fans designed to be used with VFD have three-phase inverter duty type motors. Taking the same 54" fan with previously stated performance outputs as an example, the addition of the VFD to this fan would allow the fan speed to be reduced to lower the total cfm and increase the cfm/watt efficiency. Several manufacturers have a BESS-Lab test for a few fans fitted with a VFD. To use the stated values for cfm and cfm/watt, you must install the exact VFD with the exact fan. If you install a random VFD with a random fan, you will not be able to dial in your target cfms with confirmed numbers.

VSF – **Variable-speed fans** are designed by the manufacturer specifically to be used as true variable-speed fans for ventilation purposes. They typically are not belt driven and are designed to be used with new or existing controllers to vary the speed of the fan prop. A 54" variable-speed fan with a cfm range of 10,000–25,000, a speed range of 50% -100% and pressure range of 0.04-0.20" static pressure or more and improved cfm/watt data to go with it is an example.



Fixed Speed Fan (FSF)

Variable Frequency Drive (VFD) added to FSF

Variable Speed Fan (VSF)

Variable-Speed Technology Pros and Cons:

1. **Energy Savings: Are variable-speed fans more energy efficient than the typical FSF commonly used today? Pro:** There are multiple brands of VSF on the market today, and each yields a different energy efficiency at different speeds and pressures. Con: The problem is that many of these fan technologies show attractive energy efficiencies (as much as 50% electrical savings) at slow speeds (below 50%) and low pressures (below 0.10"). To capture significant electrical energy savings, many fans simply cannot keep the fan shutters open at the fans' most efficient target speed, and this results in insufficient air exchange rates.
2. **Less Maintenance: Is there a maintenance benefit for converting to VSF from FSF? Pro:** For many VSF technologies, the fans will have no belts or tensioners involved. They will require cleaning, fine tuning and maintenance with respect to the control systems. Con: If the system is a VFD added to FSF, there will be additional maintenance due to the VFD. If you are not comfortable troubleshooting and working with VFD or new VSF controller technology, then external maintenance (paid) of the equipment would need to be taken into consideration. Fan screens and shutters (butterfly dampers or equivalent) still require maintenance and cleaning.
3. **Constant Ventilation: Is a constant level of ventilation with VSF better for poultry than ON/OFF ventilation during minimum ventilation? Pro:** Yes, there are improvements that can be captured when everything is working properly and the house can be operated in a constant mode. Constant mode with adequate air flow is showing better air quality, better moisture removal and better bird activity in the field. There may be environmental benefits like being able to "dial in" a ventilation rate that is between the traditional levels of staging fans ON/OFF. This sounds great, but no formal research has documented the actual benefits of constant ventilation over traditional ventilation methods in modern poultry houses. Con: In many cases, a producer must be on the farm to make the decision and to be able to capture that benefit, as the window of opportunity may not be all day. We have witnessed growers using VSF when the birds were too small, the in-house temperatures were too low and the house was locked in VSF just to save electricity. In this situation, neither the birds nor the farmer benefited from variable speed,. It would have been better to be in FSF minimum ventilation mode and running a traditional ON/OFF cycle.

Field Experiences:

4. **Visit #1:** A VSF system was installed on a broiler farm, and the producer could not decide which lower level of variable-speed ventilation was best for his newly placed flock. The producer was having trouble balancing fan speed with the vent openings and pressure during minimum ventilation. The lowest level of VSF was too much air exchange for young birds in cold weather, and the producer had trouble maintaining adequate target temperature.
5. **Visit #2:** A VFD system was installed on a pullet house, and the producer was finding it difficult to keep the fan working properly. The local equipment installer could not repair or troubleshoot the problem. The grower complained that the VFD was too expensive to replace, and he could not justify the cost of maintaining the VFD system. This producer lost the use of one tunnel fan in each house as a result of the failed variable-speed application.
6. **Visit #3:** Another VFD system was installed on a new pullet farm. When the minimum ventilation fan was called to come on, the shutters did not open while the fan was running. Sometimes the shutters did open but then quickly shut back once the fan dialed down to the lower speed. A VSF should not be installed on pullet houses because of the additional pressure strain on the fans from the varied air flow restriction caused by light traps. The VSF speed was too low at 60% and should only have been allowed to run at 80% or 100% to correct the problem. Unfortunately, no one knew how to make the adjustment to correct this problem.
7. **Visit #4:** A new VSF was installed on new broiler farm, and this system was saving the producer money on electricity. The producer

was sold on the idea that a low level of VSF ventilation was best for day-old chicks compared to ON/OFF cycles of traditional minimum ventilation, but the chicks inside this VSF house were huddled and obviously not comfortable. The producer was not comfortable adjusting the VSF controller to make the necessary adjustments. The adjacent house was using FSF in minimum ventilation and cycling ON/OFF in the traditional manner. The birds were comfortable and spread evenly throughout the house. Sometimes the lowest level of VSF will be too much air exchange for chicks, especially during cold weather.

8. **Visit #5:** A new broiler farm had VSF installed for minimum and transitional ventilation only. The producer and company had studied VSF technology and were comfortable troubleshooting, adjusting settings and working on the equipment. This producer only grows chickens for a living, so he is on the farm to make the necessary adjustments throughout the day and understands the limitation of the equipment. He explained to us how and when the system works and when it does not work and how he makes the necessary adjustments to correct the problems. The producer and company are both happy with the VSF system. The producer manages it for optimum bird performance first and electrical savings second. There are locations, companies and growers that can make it work successfully.

Areas for Improvement:

9. **Negative Pressure:** Pressure, fan speed and vent opening must work in unison to achieve bird comfort. VSF can work, but the vent doors must be coordinated to provide good in-house air flow. This can be difficult to achieve and keep coordinated. Low pressure (0.04" static pressure) and minimum ventilation does not work well because the air will typically land on the feed and water lines, chilling the birds. Most VSF fan manufacturers recommend operating VSF around 60% minimum and higher. This keeps fan shutters open and allows the fan to operate under at least a 0.10" static pressure or more (0.15" in wider houses) for proper air flow in minimum and transitional ventilation. Given that most houses use 0.10" as a minimum pressure and go up from there, if the manufacturer does not recommend using its variable-speed fan over a 0.10" static pressure, it should not be used.

10. **Electrical Efficiency vs. Air Exchange:** Maximum electrical efficiency is harvested at the fan's lowest levels of fan speed for many manufacturers. Low speed also means low air flow, low pressure and a low rate of air exchange. If this is what the house needs for environmental control, that's great. However, we never want to promote electrical efficiency using VSF when it will not provide the flock with the correct amount of air exchange. Too little or too much airflow is not satisfactory. We do not need to get into a situation where we are in a conflict of interest between doing what is right for the birds and saving money on electricity. The two must work together. Again, air flow and pressure for the optimum bird environment comes first, electrical savings second.

11. **Maintenance of VSF:** When VFDs and other controls fail or are damaged, it often requires replacements that range in the $300-$600 range. Some systems require routine VSF calibration to ensure that the fans are dialed in, and the grower is getting the calculated CFMs through the house at each setting, percentage and stage. The addition of a VFD to an FSF increases the importance of belt maintenance and further complicates figuring fan output of each fan due to belt wear.

12. **Coordinating VSF with FSF:** There is often a steep learning curve required to make VSF and FSF work together. For example, if a VSF fan is running at 50% capacity and a FSF is programmed to come ON, the additional pressure may close the shutters of the VSF. This takes routine monitoring and adjustments to make sure it does not happen. Most VSF manufacturers have recommendations on how to stage fans, and this must be carefully studied and used in the field as a guide.

13. **Using VSF With Existing Controllers:** VSF controls can be added to existing farms and used with some existing controllers, but it might not work on all of them. Do not purchase a VSF system without consulting your fan manufacturer, company representative and controller manufacturer to

make sure the system will work successfully. These systems must be engineered to work together, and this take dedication, communication and troubleshooting involving the controller company, fan manufacturer, producer and company representative.

VSF can be adopted by producers and companies successfully. Those that succeed understand the pros and cons of the technology, how it works, how it can (and cannot) be used and how to adjust it and also know this technology's limitations and have good company technical support. Fan companies are spending time and money on newer VSF technology and fans that will be more efficient, more durable and easier to adapt in the future.

Bottom Line: At this point, VSF technology is still in the initial stages with respect to implementation and adoption for the masses into the integrated poultry industry of today in most broiler and hen houses. We are not recommending installing any type of variable-speed technology on pullet houses due to the varying restriction that light traps place on the fans. There may very well be a place for this technology in the future, but it is simply not for everyone at this point. **We must not let electrical savings alone take priority over static pressure settings, adequate air exchange, moisture removal, bird comfort and other environmental control parameters.**

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