

Variable Frequency Drive Fan Control for Potato Storage

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Abstract

Potato storage ventilation systems are capable of keeping potatoes in marketable condition for several months, but the electrical cost can add up. In most storage facilities, tuber temperature is controlled by manually setting fan run times providing the outside air temperature is not either too hot or too cold. Nathan Oberg and Gale Kleinkopf at the University of Idaho Potato Storage Research Facility in Kimberly are testing the effect of using variable frequency drive (VFD) fan control on potato quality in a commercial potato storage facility.¹ A VFD allows a fixed-speed fan to operate at any speed from 0 to 100 percent. Because less airflow is required for the majority of the storage season, VFD fan control may allow for significant energy savings. Data from two years of research indicate that VFD fan speed control can reduce energy use by up to 50 percent compared to conventional fan control—fans being turned on and off by the storage manager—with no reduction in raw or processed product quality. An added benefit of VFD use is that shrinkage was also reduced in this study.

While listening to the radio in the morning getting ready for the day, every now and then I hear an advertisement about how to conserve electricity. Suggestions include a lot of small things you can do like not leaving lights on when not in use, washing full loads of laundry, and using energy-conserving light bulbs. Each suggestion may not save a substantial amount of electricity, but collectively it adds up. Unlike household energy use, the electrical cost of storing potatoes each month makes an individual household bill pale in comparison. Producers must run the potato storage ventilation system to keep potatoes in marketable condition, but can the electrical cost for storing potatoes be reduced while maintaining quality? We'll explore the answer to that question in this article.

It wasn't so many years ago that storing potatoes for more than a few months was almost impossible. Now, developments in storage technology allow for successful potato storage for almost a year, which is critical to all segments of the potato industry. However, long-term storage does not come without

a cost; therefore, growers need to maximize their returns from the stored crop.

To help growers maximize their returns, Nathan Oberg and Gale Kleinkopf at the University of Idaho Potato Storage Research Facility in Kimberly are conducting research to evaluate the impact of ventilation system management on the potato storage environment.¹ The major components of this research focus on evaluating the use of variable frequency drive (VFD) fan speed control and its effects on raw and processed potato quality, shrinkage, and calculating savings on electrical energy usage. The end result of this research will be the development of best management practices for ventilation system operation to maintain a suitable storage environment. But, just what is a VFD?

Basically, a VFD allows a fixed-speed fan to operate at any speed from 0 to 100 percent. The big advantage of reducing fan speed is the energy savings. Granted, operating a fan at 50 percent of maximum speed provides approximately half the airflow as 100 percent, but the motor consumes only about 15 percent as much power. This may sound unbeliev-

able, but fan laws—these laws are called affinity laws—dictate this relationship (Figure 1).

Many modern potato storage facilities were designed to provide airflow rates of about 18 to 25 cubic feet per minute per ton (cfm/ton). While these high airflow rates may be required immediately following harvest or if rot problems develop later, much less airflow is typically required through the remainder of the storage season. Because less airflow is required for the majority of the storage season, VFD fan speed control may allow for significant energy savings.

Now that you know the theory of VFD operation, does it work? Oberg and Kleinkopf have tested a VFD fan control system in a commercial-size potato storage facility using a 200,000 cwt. double-bay storage that has a split plenum. Each bay is equipped with its own independent bank of fans, control panel, and humidifier. Oberg and Kleinkopf manage one bay using a VFD fan control system

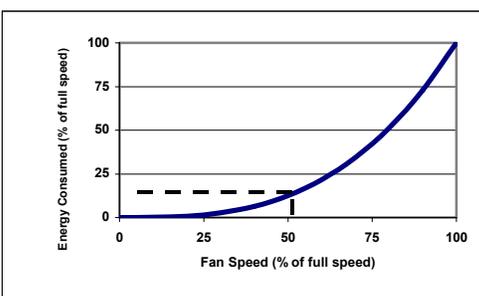


Figure 1. Relationship between percent of full fan speed and percent energy consumed at full speed.

while the grower manages the other bay by turning off one or more fans during the storage season to control pile temperature. The VFD is linked to a control

panel that automatically adjusts the fan speed based on the temperature difference between the plenum (supply) air and return air. Data from two years of research indicate that VFD fan control can reduce energy use by up to 50 percent compared to conventional fan control—fans being turned on and off by the storage manager—with no reduction in raw or processed product quality. An added benefit of VFD fan speed control is that shrinkage was also reduced.

Using a VFD fan control system can add up to big savings in potato storage electrical charges. For example, let's say your average electrical energy bill for storing the potatoes is \$575 during November through June. By using a VFD fan, you could reduce your monthly energy charge to approximately \$287.

Using a VFD fan to store potatoes has many potential benefits. Energy consumption is decreased resulting in higher returns from the stored crop, product

quality is maintained, and there is a potential for less shrinkage. VFD installation is best suited for storages with an airflow volume of at least 15 cfm/ton. Storages with less airflow may not be able to reduce fan speed and maintain potato quality. Also, the payback for VFD installation is favored by a long storage season and high electricity costs. Keep these points in mind when considering a VFD fan control system for your potato storage facilities.

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Did You Know?

A storage facility with a capacity of 50,000 cwt. would contain 10,000,000 tubers if the average tuber weight were 8 ounces.

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