VARIABLE SPEED DRIVES

As the cost of electric power continues to increase, variable (adjustable) speed drives are becoming more popular in the car wash industry. New technologies and designs within these drives have made adding VSD's a reliable and cost effective option for electric motors within the car wash. In fact, adding variable speed drives to a car wash dryer system can often provide a return on investment within 14 months in electrical energy savings.

Definition

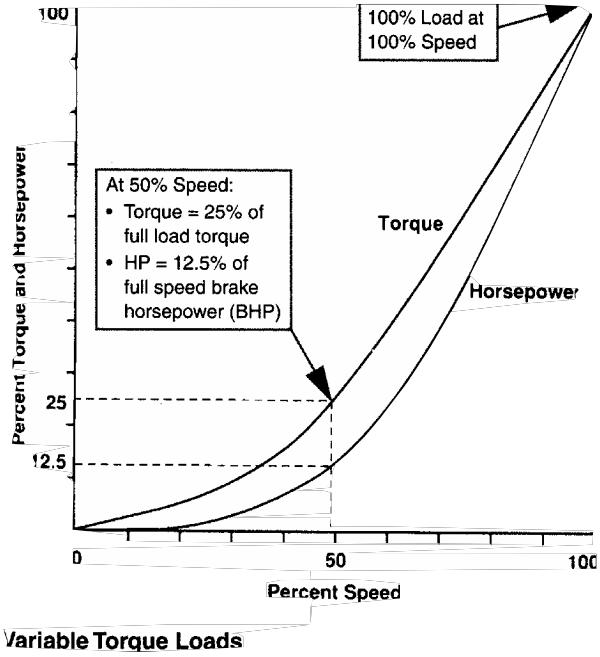
A variable speed drive is an electronic device that changes the speed of a motor's rotation by changing the frequency of the power being fed to the motor.

The relationship between a motor's speed and the frequency of the power fed to the motor is linear. For instance, a motor that is designed to turn at 1,800 revolutions per minute (RPM) when connected to a standard 60hz power supply will turn at 900 RPM when connected to a variable speed drive supplying 30hz of power.

Uses Within the Car Wash

Any poly phase motor can potentially benefit from a VSD. Hydraulic and water pumps will start and stop softer, with less impact on their system components. Blowers and dryer motors are a variable torque load, and benefit most from being controlled with a variable speed drive. Fan systems are generally designed to use a full speed motor to drive a mechanical air mover. The outputs of these systems are controlled by mechanically constricting the flow with damping vanes or plates. Although constricting the airflow reduces the load on the motor and therefore the power required to run the motor, flow constriction is not very efficient. Running a system this way is like driving a car with the accelerator pressed to the floor while controlling the speed with the brake.

A variable speed drive allows precise control of motor output, and the power used. In the case of centrifugal fans, there is a significant



At 50% of the Full Load Speed, only 25% of the Full Load Amperage is required to operate the motor

reduction in the power required to handle the load at a slower speed, or reduced frequency. This power reduction is due to the fact that a fan is a variable torque load.

Variable Torque Load

In a variable torque load, the torque required to drive the load changes according to the speed. As the speed of a load is reduced, the torque required to drive it is decreased as a square of the speed. For example, at a 50 percent speed only 25 percent of the torque required at full speed is needed to turn the load.

Affinity Laws

The effects that reduced speed has on a variable torque fan are summarized by a set of rules known as the Affinity Laws. The basic in-

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terpretation of these laws is quite simple:

1. Flow produced by the device is proportional to the motor speed.
2. Pressure produced by the device is proportional to the motor speed squared.
3. Horsepower required by the device is proportional to the motor speed cubed.

For instance, a variable speed drive running a variable torque load at 50 percent speed needs to deliver only 12.5 percent of the horsepower required to run it at 100 percent speed. The reduction of horsepower means that it costs less to run that motor. When these savings are applied over the yearly hours of operation, significant savings can accumulate.

Applications In The Car Wash

A common setup to control dryer motors is with across-the-line starters, and to bring them up to full speed as quickly as the motor would allow. This method of starting creates large amounts of inrush currents, as high as six times the running amperage, increasing electric consumption and demand. Then, rather than inefficiently stopping and restarting dryer motors between cars, the dryers were left to run at full speed, or dampers controlled airflow. Dampers will reduce airflow into the fan, and lower electric consumption, or currents, but not as efficiently as variable speed drives. A recent study completed at a car wash in the northeast concluded that on a typical day, the dryers were operating idle with no car under them over 50 percent of the time they were on, waiting for a car to move down the conveyor. The installation of variable frequency drives on dryers systems will reduce the total fan electricity consumption and demand, especially during standby or idle times.

An independent study made at the before mentioned car wash documented that operating the dryers at 90 percent of their rated capacity while actually drying a car, and dropping the speed to 50 percent while waiting for a car to move down the conveyor would ***reduce the electric power consumed by over 42 percent***. Additionally, variable speed drives can control the starting of a motor, allowing it to "ramp up" to it's designated speed with out allowing inrush current to raise beyond the set point, usually the rated running amperage. Motors can then be "ramped down" to a stop. This precise control adds years of life to bearings and impellers, while at the same time significantly reducing the demand factor many power companies use in their rate calculations.

The same study, calculating the annual electrical cost of a dryer system utilizing 14 - 15hp motors found that the savings in energy alone would pay for the cost of a variable speed drive system within 18 to 24 months. Add to these facts that a typical installation should last up to 15 years and the savings are tremendous. It is important to also keep in mind that these savings are based on each individual motor, and that each motor stands alone. So even if a car wash has only several dryer motors, the saving percentages are still the same.

Conclusions

As costs in the car wash industry continue to increase, new ways must be found to protect the bottom line. Energy costs are increasing and will continue to increase. But new technology, and innovative ways to use it can help manage these costs, and perhaps even come out ahead. Adding variable speed drives to a dryer system is a cost effective and profitable way to conserve resources.

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PO Box 4054 Akron, OH 44321
(877) 825-0916
Fax (330) 745-3648