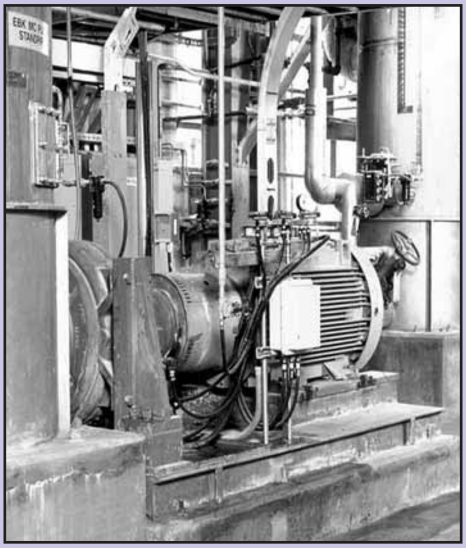
Tech Talk cont'd



Model 3500 medium consistency pump Installation.

permitted standpipe level control throughout a wide range of operating conditions without upsets due to high level alarms and trip out of related equipment. The efforts of the operators were focused on the training and start up of the new equipment and process for this mill.

The second installation involved a Model 3500 pumping to a HD storage tower with a long pipe run to the tower. A range of production rates was desired which translates into a range of flow rates for the pump. An additional requirement for the future was a 10% additional production rate. Meeting the current production rate variations and having the capability to meet the future increase of 10% was satisfied by the use of the PumpSmart drive. The PS200 drive allowed the pump to operate at speeds above synchronous 1800 RPM when necessary.

For this service, production rate ranges for the current requirements were from 900 BDSTPD to 1300 BDSTPD. At 12% consistency, this gives a flow range of 1250 GPM to 1800 GPM. The drive size is 500 HP. As the mill shifted production requirements between the different rates, HP savings as much as 75 HP result.

Pump protection features similar to the first example were also invoked in this application as well. Additional capabilities include low flow torque protection. This can signal an alarm when the standpipe level has dropped to a very low level and air may be pulled into the system. This large influx of air can result in severe pipeline vibration if the root cause is not corrected.

The nature of the Model 3500 medium consistency pump makes a variable speed application somewhat different from a conventional centrifugal pump. In order for the Model 3500 to separate air properly for removal through the degas system, the pump must operate at or above a minimum speed. When the pump operates below its minimum speed, the air is not adequately separated and the pump performance deteriorates. This results in loss of level control and pump operation becomes unstable and erratic. To prevent this from occurring, the control scheme must take this into account. Several control schemes have been used for medium consistency pumps with success. Each allows the pump to vary its speed but also incorporates a control valve for those situations when the pump speed is at or near the minimum. The control schemes described below are normally done through a DCS with a speed signal sent to the PS200 drive. The pump protection features and inherent benefit of a variable speed drive result in an overall economical package.

Examples of control schemes used:

- Level control valve is primary level control device with variable speed secondary
  This method incorporates a control range for the opening of the valve – for example from 55 to 65% open. When the valve opening becomes less than the lower value (55%) the pump speed is reduced. When the valve opening becomes greater than the upper value (65%), the pump speed increases. In both cases the valve position then moves back into the target range.

  Should the valve opening continue to decrease and the pump speed decreases to the minimum speed, then the pump speed stays at the minimum and the control valve assumes full control for level.

- Level control and speed control operate in concert

  This method involves again setting a range for the control valve to operate such as 40 to 70% open. As the control valve modulates to control level, the pump speed also changes to respond to the level control valve position. This typically involves a linear speed relationship to the valve position. At the minimum speed the valve is open at the minimum of 40% and the maximum speed corresponds to the maximum valve opening.

  Again, when the valve opening is less than 40% in this case the pump speed remains at the minimum RPM until the valve opens above the 40% point. This control scheme can be done with the variable set point option of PS200.

- Speed Control to maintain a fixed valve opening

  This scheme does not occur often but may be used in long pipelines or for booster pump (series) operation.

  In this situation the valve position is the parameter being controlled. The valve position becomes the set point and the pump speed is varied to maintain the set valve position.

Combining the Model 3500 with a PumpSmart drive provides the type of operating flexibility often desired in pulp mills or bleach plants, pump protection features and the reliability required for these critical services in the Pulp & Paper Industry.

Variable Speed Pumping: Myths and Legends

"Overcoming Perceived Barriers to Implementation"

By Mike Pemberton
PumpSmart™ Performance Services

"Therefore, even the lover of myth is in a sense a philosopher; for myth is composed of wonders" – Aristotle

In common language, a myth is a fiction – something that is untrue. A legend is a story from the past about a subject that was, or is believed to have been, historical. So, myths and legends encompass beliefs that may or may not be true. And legends are often so embellished that it is hard to discern how much of the story is factually true.

When considering the application a variable frequency drive (VFD) for centrifugal pump control, one often encounters myths and legends. How much is fiction and how much is fact. Today, it is increasingly important to sort through the misinformation in order to realize the significant benefits through application of this technology.

Traditionally, a fixed-speed pump and control valve has been used to regulate process flow. Even though VFD technology has grown rapidly in acceptance, the technology and benefits are often poorly understood. As such, there is uncertainty surrounding its use for pump control. There are any number of reasons for this confusion including:

- Lack of knowledge about the hydraulic performance between fixed and variable speed pump control
- Lack of knowledge concerning control and failure modes, especially for mission critical applications
- Perception that a VFD is always more expensive than a control valve

Tech Talk cont'd

- Concerns about the reliability of the electronics platform

Many of these concerns stems from bad experiences before VFD technology matured. These legacy issues can be put into perspective by relating them to the evolution of PC technology. The cost of low voltage VF drives continues to drop while reliability and functionality increase. As a result, VFD technology has become a highly-reliable, cost-effective alternative to using fixed-speed pumping systems.

There are compound benefits through implementation. These include energy and maintenance savings, pump and process reliability improvements, better process control and less fugitive emissions. Also, on new projects, VFD application can reduce overall capital cost by eliminating valves and starters plus the associated wiring and pneumatic lines. In many cases, smaller pumps with lower horsepower motors can be used. In terms of piping, smaller diameters often suffice and by-pass lines can be eliminated.

Scope of Opportunity
It is estimated that 20% of all electrical power is used to drive industrial pumps. Around 20% to 50% of the power consumed can be saved through variable speed operation.

Opportunities to improve pump performance are often overlooked for the following reasons:

- Low awareness of motor energy-efficient technologies
- Financial and operational benefits are often not well understood
- The Initial capital cost to employ motor-efficient technology may be higher (purchasing decisions are typically made on first-cost)
- Energy-saving projects are often ranked below other process-related capital expenditures

How Does the VFD Works
A variable frequency drive (VFD) is an electrical system (i.e. inverter) used to control AC motor speed and torque. It provides a continuous range of process speeds compared to a discrete speed control device such as multiple-speed motors or gearboxes. Industry has standardized on the IGBT (Insulated Gate Bi-polar Transistor) based PWM (Pulse Width Modulated) design.

A VFD controls motor speed by varying the frequency supplied to the motor. The drive also regulates the output voltage in proportion to the output frequency to provide a relatively constant ratio of voltage to frequency (V/Hz), as required by the characteristics of the AC motor to produce torque. In closed-loop control, a change in process demand is compensated by a change in power and frequency supplied to the motor, and thus a change in motor speed.

Latest VFD Improvements

- Microprocessor controllers eliminate analog, potentiometer-based speed adjustments with precise digital control capability.
- Advanced circuitry to detect motor rotor position by sampling power at the terminals, which keeps power waveforms clean and sinusoidal while minimizing power losses.
- Soft-start capabilities with higher starting torques at lower speeds
- Built-in power factor correction and short-circuit protection.
- Digital bus communication to the DCS, PLC or CMMS for transmiting real-time information on equipment health.
- Radio Frequency Interference (RFI) filters to protect process equipment

Application Issues and Benefits
It is widely recognized that the VFD can introduce harmonic distortion of voltage supplies caused by the non-sinusoidal currents drawn during the power conversion process inside the drive converters.

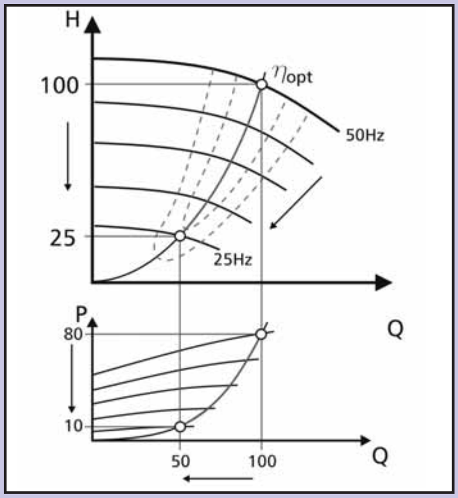
Because of the fast switching frequency of the IGBT drive and impedance mismatching between the motor and transmission lines, a reflective wave occurs which results in spikes that are sometimes two to three times rated bus voltage. These occur on every pulse of the output and travel unevenly through the coils of the motor. The following are considerations in addressing this issue:

- Induction motors used with inverters to supply adjustable frequency power should include inverter grade insulation.
- Inverters produce steep fronted voltage spikes which can damage the stator winding insulation.
- Part 31 of NEMA MG-1 requires the insulation of inverter duty motors to be capable of handling 1600 V spikes for supply voltages up to 600 volts.
- Most standard induction motors meet this requirement, but always consult with the motor supplier if there is a question on suitability for inverter duty.
- Use inverter duty motor power cables with a continuous corrugated armor sheath; i.e., provides low impedance to high frequency.
- When the distance between the drive and the motor exceeds the recommended lead length, added protection is required, i.e., add a line reactor at the drive and RFI filter at the motor.

It is important to specify the technical performance of the VFD and make sure that proper electrical practices are followed during installation. It is equally important to realize these technical issues are well understood and can be successfully mitigated. Often, the concerns over these potential side effects has slowed acceptance of the technology. While this concern is valid, the technical issues can be addressed. The economic benefits are too compelling to delay implementation.

Energy Savings Potential
Energy savings are possible with VFD control due to the affinity laws that govern the operation of centrifugal pumps. Compared with throttling valves and bypass systems, speed reduction provides significant energy savings at partial load. The reduction of speed provides:

- Flow (Q) reduction according to a linear function
- Head (H) reduction according to a quadratic function
- Power (P) reduction according to a cubic function



Graph 1: Affinity Laws in Action

Medium vs. Low Voltage Motors
It is common practice in industrial plants to switch from low voltage to medium voltage motors above 200 Horsepower. The primary reason for switching to medium voltage is to reduce the amperage required to start and continuously operating fixed-speed motors. For example, the full load amps for a medium voltage 200 Hp TEFC motor @ 1180 rpm is four or more times less than an equivalent low voltage motor.

VFD pump control often results in operation at 50 – 75% of full-speed to deliver the same flow rate. Subsequently, the horsepower and associated current draw is significantly reduced. For example, a low voltage 200 Hp TEFC motor at 60% of full speed requires about 30% of full load power. Therefore, the amp draw required for variable speed pumping at partial load is typically only one or two greater than is required for a medium voltage motor at full speed.

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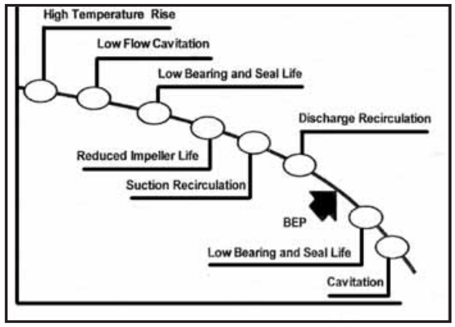
In addition, the VFD has a soft-starter built in to prevent over-current and over-torque conditions on start-up. The inherent soft-start capability avoids pressure spikes (water hammer) and reduces pipe fracture. Repeated pressure spikes can reduce the lifetime of the pumping system.

Reliability Savings Potential
Variable speed operation contributes to reliability improvements by allowing the pump to operate at slower speeds, near the best efficiency point (BEP) with a 25% trimmed impeller. Operation more than +/- 10% away form the pump's BEP significantly lowers its reliability.

Although often overlooked, the excess energy in fixed-speed systems is being dissipated into the infrastructure and can lower equipment life. This energy may transmute into vibration that can damage the pumping system including the pipes, instruments and valves.

Intelligent Pumps
In recent years automation suppliers have introduced smart instruments and valves.



Graph 2: Reliability Issues vs. BEP

Pump suppliers now offer a "smart" pump, i.e. a standard VFD with embedded pump intelligence. This advent represents the next logical step in the evolution of intelligent field devices. With the growing use of digital field buses to communicate between smart devices and process control system, equipment health can be sent to asset management software in real-time. An intelligent pump can be seamlessly integrated into the process control system architecture.

The perception may exist that a VFD with pump intelligence is highly customized and complicated to implement and use. Yet, the opposite is true. An intelligent pump is a standard VFD with embedded algorithms to monitor the pump's health and to provide protection from process upsets. The operating manual is written in easy to understand language with the pump operator in mind. The intelligence is only enabled if you choose to do so. Similar to a cell phone, there are many useful functions that are only employed if and when needed.

Conclusion
In spite of the operating and economic benefits, there are many hurdles to implementing VFD technology. Among these constraints is the lack of awareness among plant engineering, operating and maintenance staffs of this approach for pump control. The myths and legends surrounding VFD technology and its application further exacerbate the situation.

There is one overriding issue to understand. Pump and valve performance can make or break your bottom line. For the most part, the enormous cost of inefficient pump operation and valve throttling goes unnoticed. It's time to sort thorough the myths and legends surrounding variable speed pumping in order to reveal its wonders and transforming power.

Personnel Moves

Marketing Appointments Announced

Dave Flinton

John Manna, Vice President of Global Marketing, announced the promotion of two marketing executives to key positions in his organization. **David E. Flinton** was elevated to the position of Product Marketing Manager for the Seneca Falls Operations and **Erik Torseke** has been appointed Director of Performance Solutions.

Flinton joined ITT A-C Pump in 1997 and has held several positions of increased responsibility including Double Suction Product Manager and Water & Wastewater Industry Marketing Manager. Dave holds a Bachelor's Degree in Mechanical Engineering from Worcester Polytechnic Institute and an MBA from the Simon School at University of Rochester.

John Manna stated, "To improve our global marketing coordination and effectiveness, I am consolidating the Seneca Falls based product marketing organizations. Dave will be developing and leading this important organization."

Manna continued, "As we continue to develop products that incorporate new-age technologies, it is important to have one person focused on planning and implementing successful development and launch strategies. Erik Torseke will lead these exciting new projects, positioning ITT and its brands as the technology leaders."

Erik Torseke

Torseke joined ITT Goulds last year after many years of experience with ABB as a project manager, sales & marketing manager, general manager and senior marketing and business development manager. He brings with him a wealth of experience and knowledge. A graduate of Uppsala University in Sweden, Torseke holds a Bachelor's Degree in Industrial Marketing and also a technology degree in Mechanical Engineering.

Jose Gutierrez

Jose Gutierrez has been appointed Marketing & Engineering Manager for Goulds Vertical Pump Operation in City of Industry, California.

Jose graduated from the National University of Mexico with a Bachelor's Degree in Mechanical Engineering. He also holds a MS in Hydraulics and an MBA from the Tecnologico of Monterrey. He comes to us with more than 20 years of Engineering and Management experience. Jose has also worked many years in other capacities such as Quality, Engineering, Customer Service and Product Development. He spent 17 years working at Flowserve, Mexico, manufacturing vertical, cantilever, boiler feed, and multistage pumps for the petroleum, power, water and general Industry. In 2000, he was transferred to Flowserve Vernon, CA where he held the position of Engineering and Technical Services Manager for commercial and nuclear products. In addition, he was nominated as Lead of Between Bearing Products for the Americas.

Jose's years of experience will make him a valuable asset in helping to service the needs of our Vertical Pump customers.