YASKAWA

Application Report
Oil Field Centrifugal Dewatering System

Incorporation of Yaskawa ac drives has enabled a major oil field service company to design and introduce an effective new dewatering and sludge removal system for use with offshore and coastal drilling rigs.

Drilling operations routinely bring tons of wet sludge to the surface. This sludge -- specifically the "solids" contained therein -- must, by law, be transferred to an approved landfill. Significant savings are achieved by removing as much water as possible from the sludge before moving the solids and storing them in the landfill area.

New Approach Increases Production Ten Fold
The process, known as "dewatering," is not new to the industry. The new approach, however -- generating ten times the production as outdated hydraulic systems -- is a breakthrough.

Previous centrifugal dewatering systems using hydraulic motors incorporated their usual drawbacks -- costly, high-maintenance components, complex plumbing and control systems, continuing oil and seal leakage.

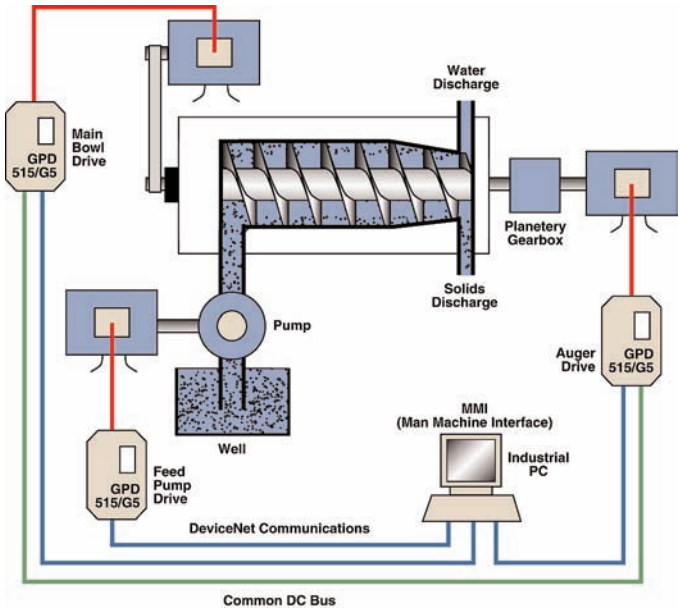
AC Drives Control Pump, Bowl, Auger
With the new system a "decanter" centrifuge operates in a continuous-feed mode using three Yaskawa drive/motor combinations in open loop vector mode to power the system's bowl, pump and auger.

A PC-based control system automatically adjusts all speed rates to keep motors running within programmed load and speed limits. Each drive is tied to the control system using DeviceNet serial communications.

Open Loop Eliminates Costly Feedback Encoders
Drives in closed loop configuration are commonplace on decanter-style centrifuges and have a long, successful history.

The use of an open loop PC-based control scheme with serial communication to the drives, however, does away with the expensive and troublesome encoders required for closed loop operation, providing substantial cost savings.

A 40 hp drive controls the rotational speed of the Main Bowl. In addition, this drive provides the torque levels necessary to overcome the high inertia of the Main Bowl. Potentially excessive current draw during starting is eliminated as the drive provides smooth acceleration to bring the Main Bowl up to operating speed at low current levels.



Inside the Main Bowl, a full-diameter auger turns at a speed slightly slower than the bowl to force the heavier-than-water sludge to the outside of the bowl and out through a "solids discharge." Simultaneously, water separated by centrifugal force is disposed of through a "water discharge."

Auger Operates on Differential Speed Setting

Historically, decanter centrifuges have used a planetary gear box with a fixed differential speed to control auger speed. Since the gear box pinion had to be changed with each adjustment in differential speed, sustaining optimum differential speeds through changing conditions -- including weight and texture of sludge -- could require frequent pinion changes.

Because change of a pinion was a complicated, time-consuming operation, machine operators usually left the speed unchanged even though the centrifuge wasn't operating at optimum performance levels.
This problem is solved by adjusting the pinion speed through the drive controlling the motor, allowing for infinite variations in auger speed.

The auger is controlled by a 20 hp drive programmed to accelerate the motor up to speed, then set a differential auger speed for effective removal of solids from the inside of the bowl and their transport to the discharge. The optimal differential speed varies with bowl and feed pump speed.

Regenerative Mode

The centrifugal force generated by the bowl is so strong that the auger would follow at the same speed if no retarding torque was available to maintain a differential speed. This condition would not be acceptable since no solids would be discharged. The auger must operate at a slightly slower speed than the bowl to act as a plow and push the solids out though a discharge hole.

To accomplish the differential speed the Auger Drive Motor actually is in regenerative mode for most applications -- running as a generator. This regenerated power is fed back into the Main Bowl Drive by tying the Auger Drive and Main Bowl Drive together via a Common Bus.

Operator Adjusts Drum, Pump & Differential Speeds

The drives allow the operator to vary the speed at will, matching drum, pump and auger speeds exactly to prevailing needs.

A 15hp drive controls the speed of the pump feeding sludge into the bowl. The machine operator, using a human machine interface (HMI) PC display panel, can control and adjust drum, pump and differential speeds. The PC-based system automatically adjusts all speed rates to keep motors running within programmed load and speed limits. Current and speed are constantly monitored using DeviceNet and adjustments are made as needed.

Explosion-Proof Motors, "Conformal Coated" Boards
All motors used in the new centrifugal sludge removal system are explosion-proof Class I Group D rated to meet industry safety standards and are capable of operating in a Constant Torque, 1,000:1 speed range. All control components are located in a positive pressure purged air conditioned cabinet

The drives also incorporate "conformal-coated" circuit boards to seal against damage from salt air and water and to withstand heavy in-process vibration levels. Heavy-duty mounting support brackets were also added to the 40hp main bowl drive to improve rigidity.

Drives Eliminate Maintenance Headaches
The new system's AC drive-based design allows the builder to eliminate many significant potential maintenance problems, and in some cases to do away with complex components altogether.

Elimination of potential leaks from hydraulic components also assists in meeting anti-pollution requirements through replacement of hydraulics with modern electronics.

DeviceNet Monitors Conditions At All Drives
Yaskawa's interfaces for the drives are designed and built to comply with all pertinent aspects of the DeviceNet specification. These options mount integral to the drive and provide an easy open-tap DeviceNet connection.

DeviceNet features on the Dewatering System include access to all drive commands, parameters and drive diagnostics. Communication rates are 500, 250 or 125 Kbaud through a 5-wire network connection.

Network benefits include simplified control systems, reduced installation costs, minimized commissioning and downtime, with increased system flexibility and diagnostics.

Production Increase Is Tenfold
Operating in long, continuous runs, the system solves user problems by providing the versatility to handle a wide range of loads, while reducing maintenance costs to a fraction of those associated with previous dewatering solutions.

The new centrifugal sludge removal system has proven itself ten times as productive as the outdated hydraulic systems it replaces, according to the manufacturer.