design news

FLUID POWER/POWER TRANSMISSION

New Variable Speed Pump Design **Reduces Energy Use**

Moog's integration of an electric motor and drive in a fixed displacement pump system provides lower total cost of ownership.

BY AL PRESHER, CONTRIBUTING EDITOR, AUTOMATION AND CONTROL

In markets where energy use plays a vital role, key drivers behind the choice of fixed displacement or dual displacement pump systems are energy efficiency and the need for new hydraulic motion control concepts. These pump systems enable greater energy efficiency because of their tight integration with a drive and an electric motor to achieve intelligent operation and reduced energy consumption.

"The energy efficiency of the system is higher, especially when the system is working under partial load," says Dave Geiger, hydraulic systems engineering manager for the Moog Industrial Group. "Under full load conditions, the performance compared to the variable displacement system is nearly identical. With a medium load, the efficiency of the new system is 20 to 30 percent higher compared to the classic system. If you are running without load, or in a standby mode, energy consumption is up to 90 percent less."

The classic system for variable displacement pumps consists of a pump and an induction motor, which is directly connected to the power grid. In this typical system, the motor runs at a constant speed, normally at 1,500 to 1,800 rpm, and uses an internal mechanism to change the output flow of the pump.

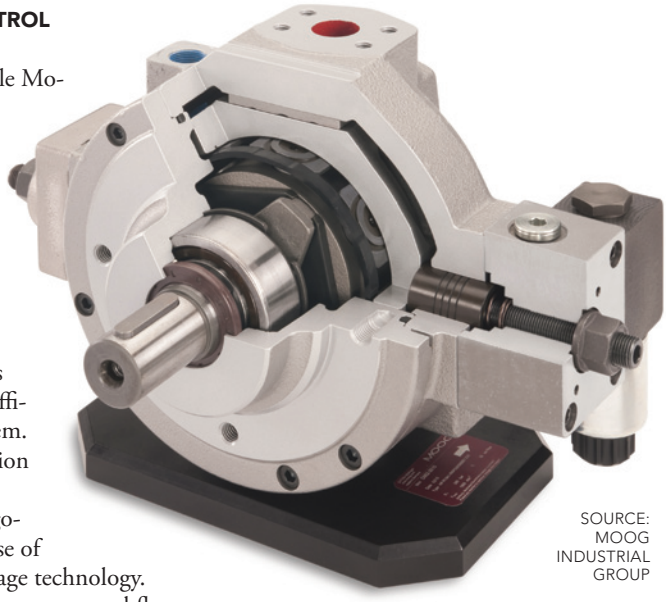
The new system design consists of integrated building block products from Moog, including a fixed displacement radial piston pump (RKP-II), the Maximum Dynamic Brushless Servo Motor and the Modular Multi-Axis Programmable Motion Control Servodrive (MSD). Users can change the speed of the motor and pump, which enables control of the fluid flow.

SOURCE OF THE SAVINGS

Two contributing factors lead to a higher overall efficiency of the whole system. The heart of the innovation is centered on the drive because of its control algorithms but also on the use of high-efficiency, low-leakage technology. The MSD drive provides pressure and flow functionality and, depending on pressure and flow demand values, the drive decides what torque and speed settings are required.

From the pump and motor side, pump and motor characteristics are measured at the factory and saved in the drive, so the system has critical information about the attached motor and pump. This creates a more intelligent system, which is integrated on the drive side and has the ability to communicate via fieldbus to external systems.

An additional improvement is a dual displacement pump design, which provides the ability to change between two displacements. In this case, the controller takes into account the actual displacement. This is similar to a gear shift on a bicycle, and is especially important if the application has a load holding phase. In that situation, the application normally needs low flow, but also high pressure. The dual displacement pump changes to the low displacement, reducing the required motor torque.



SOURCE: MOOG INDUSTRIAL GROUP

Variable speed pump systems are targeting applications using variable displacement pumps. Historically, these pumps have changed flow using an internal mechanism, but now new technology can replace that approach in applications such as die casting, injection molding and wrapping or bending machines when the focus is on energy savings, compact design or easier integration.

Depending on the operating conditions, the pump intelligently switches from one displacement to the other. This switchover is controlled by the drive and the algorithm.

DESIGN & OPERATIONAL ADVANTAGES

With a dual displacement pump design, it's possible to switch to the smaller displacement, which requires a reduced torque. As a result, the motor size required for the system can be reduced. This leads to energy savings during the application's holding phase due to more efficient operation of the motor.

Besides energy savings, the technology offers additional advantages including a more compact design and much easier system integration. The design achieves more compactness primarily because the synchronous motor is much smaller than the corresponding induction motor.

With older variable drive pumping systems, any fieldbus used in a system would be interfaced through the pump control because it is linked to the automation system. But now the fieldbus is connected through the drive electronics, which is identical to an electromechanical axis.

The new system is easier to integrate, because it looks like an electromechanical system. Since their interface is the drive electronics (MSD drive), the interface is absolutely identical to an electromechanical axis and the interface is more or less the same whether they use the electrohydraulic or an electromechanical system. Integration is much more straightforward and the system achieves a smaller footprint.

APPLICATION ASSESSMENT

This variable speed pump system is targeted for applications using variable displacement pumps today. These pumps change flow using an internal mechanism, but now the new technology can replace that approach for use in applications such as die casting, injection molding and wrapping or bending machines.

When comparing the cost of Moog's system with a system that uses a variable displacement pump and a constant-speed induction motor, the initial cost will be higher. But calculations and experience show that the total cost of ownership will be lower. And, typically after two years, energy savings has paid back the higher initial investment.

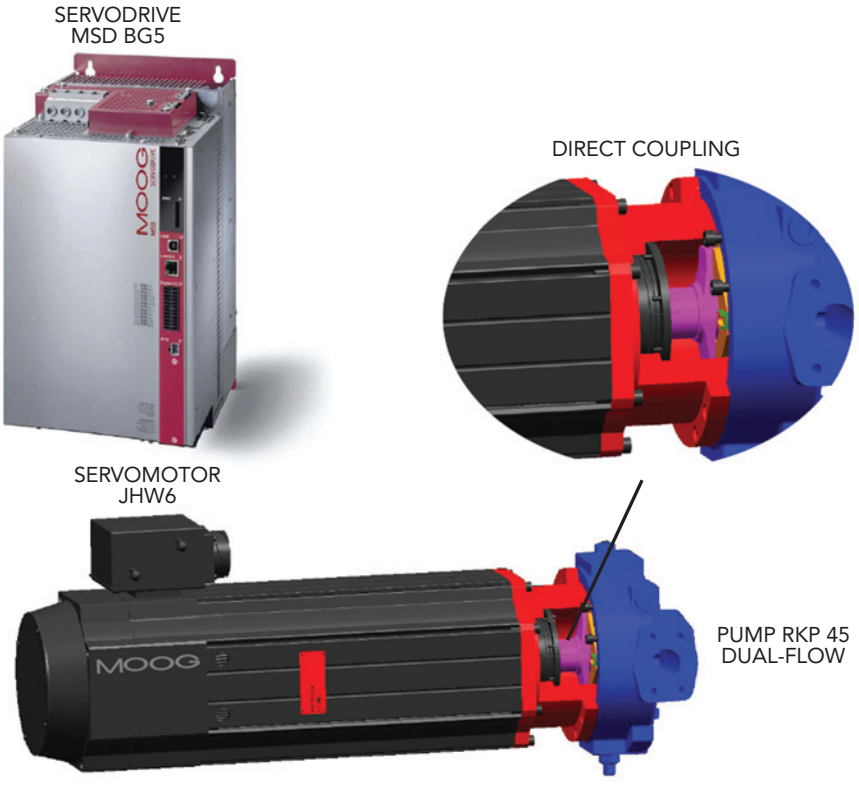
With mixed technology systems, whether you use electromechanical or electrohydraulic systems, what matters in the end is the impact and benefit of the technology on the application. With the Moog variable speed pump system, the human-machine interface is the same regardless of the technology and topics like energy savings and safety that are driving the use of the technology.

The technology was actually developed several years ago, but now adoption is dramatically increasing with Chinese and German builders of plastics and injection molding machines looking carefully at total cost of ownership as design criteria.

"The keys are upfront costs and what it costs to operate and maintain the machine," says Geiger. "The cost of ownership for electric systems was higher than expected because the initial purchase price is higher. But upkeep is also more expensive because, on an injection molding machine, the electromechanical devices are built into the framework of the machinery. It's not like an actuator that can be easily bolted in and later removed because it is integral to the machine."

The value of the variable speed pumps is the 20 to 30 percent energy savings versus variable displacement technology, plus the ability to changeover machines without moving to a completely electric solution. With a view of long-term cost of ownership, the cost of building the machine is very inexpensive and similar to a hydraulic machine. Plus, the process of rebuilding in the future is much lower because you can disassemble the actuators, put in new seal packages, replace some hose fittings and replace the pump cartridge.

Geiger says the key to higher adoption is the overall value of the variable speed pump. When there is a requirement for high performance and, in particular, high repeatability machines, OEMs move to an electric solution. And for high-speed machines, users typically move to servo valve hydraulics. Those are the areas where the variable speed pump technology is not a fit, but it does fit in 90 percent of applications.



SOURCE: MOOG INDUSTRIAL GROUP

These pump systems combine tight integration with a drive and electric motor to achieve intelligent operation and reduced energy consumption.

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