

Increase the **VALUE** of your machines **COMPETE** with low cost imports

New AC drive technology offers OEMs the advantages required to win



For OEM's the competitive environment is fierce. According to the U.S.

Census Bureau, the number of machinery manufacturers decreased by 7% between 1998 and 2001. At this rate the US could lose half of its machinery OEMs within the next 20 years.

To compete, machinery manufacturers **must** continually increase the value of their machines. In many cases, this is not an option, or a way to compete more effectively, rather it is a matter of survival.

A white paper from:

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AC Drives: The OEM's Key to New Capabilities

In a crowded marketplace where the purchase of even customized equipment is increasingly viewed as a commodity service, machine builders need to produce equipment that offers special benefit to the end user — and to the builder itself. The advanced functionality available with today's AC drives, coupled with their long-standing reliability, flexibility, lower cost, and rapid return on investment (through smart energy utilization and improved machine performance) are increasingly making them the device of choice among market leading machine builders.

This white paper explores the use of new AC drives on today's machines, illustrating how they offer machine builders key differentiating factors which help serve the customer better and position the OEM as a unique provider of custom requirements to suit the needs of the marketplace.

Just as inexpensive, powerful, reliable computers have profoundly altered the way people work, play, and interact, microprocessor-driven devices have dramatically changed the face of manufacturing. Motor drives are an excellent example of this fact. This niche was once dominated by DC motor drives which, while reliable, were limited in functionality. Today, original equipment manufacturer (OEMs) are rapidly making the transition to modern, microprocessor-driven AC drives, which ensure that every kilowatt of energy reaching motors is utilized wisely and without waste. Not only are these drives reliable, but they deliver a host of other advantages, such as programmability, flexibility, compact size, and low maintenance.

To illustrate how rapidly the AC drives market is impacting the marketplace,

consider the recent report from ARC Advisory Group, Dedham, MA, which forecasts that the global market for low-power AC drives will grow from \$4.1 billion in 2002 to more than \$5.1 billion by 2007, a compounded annual growth rate (CAGR) of 4.7%.

“OEMs are adopting this technology at a very fast pace,” says Himanshu Shah, an ARC senior analyst and co-author of the drives report. “They’re looking at many more applications of AC drives and greater use of AC drives in the many applications they have because of the drives’ energy savings capabilities, increased functionality, ease of use, and overall performance.”

While it is clear that OEMs should incorporate AC drives into their products because of their obvious advantages, those OEMs who select the most capable, flexible AC drives for their products will possess the ability to differentiate themselves from competitors. This level of differentiation is quickly becoming a key factor not just in the success of machine building businesses, but in their ability to survive in a marketplace demand customized product delivered at the cost and speed of a commodity.

AC Drive Evolution Puts Energy to Work as Smart Motor Control

The current, enormous market interest in AC drives serves to underscore the fact that these devices have been evolving for several decades, says Mark Kenyon, a drives marketing manager at ABB. The first industrial AC drives came to market in the late 1960s, but were relatively large, complex, and occasionally unreliable. Nevertheless, many automation providers and their customers quickly caught on to their potential advantages, not least of which was the fact that AC drives had fewer moving parts subject to wear and tear and thus required less frequent maintenance.

“At this point, we’ve been through about five generations of AC drive products,” Kenyon adds. “They’ve increased in complexity, but that’s hidden from users in the microprocessors and software. And, of course, they’ve come way down in size and cost.”

To better understand the advantages that AC drives offer machine builders, consider the benefits that AC drives bring to a typical function, such as maintaining proper tension in an unwinding application, where paper is unwound from a roll in a printing or gluing application.

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Traditionally, unwinding applications have relied on mechanical, air-actuated brakes, which include brake pads and calipers, much like the brakes on a car. These are subject to wear, which can result in unacceptable variations in performance. To avoid these variations, some manufacturers have used DC motors with gearbox drives to implement braking through motor torque. Until recently, however, the cost of motor braking solutions often put them out of reach for smaller scale operations; but the introduction of relatively inexpensive, variable frequency AC drives has resulted in a braking solution equal to that of DC motors and drives. The combination of a small AC motor and drive is competitive in terms of performance with mechanical brakes, but is lower in price when considering the lifetime costs of a mechanical brake and air supply system, not to mention variations in performance.

In one typical unwinding operation, which employed an ABB AC Drive for braking, the embedded advanced motor modeling eliminated the need for mechanical feedback of speed. Since the motor/drive torque response time was less than 5 ms, tension could be perfectly maintained from zero speed through rapid acceleration to steady state and down through rapid deceleration to a stop.

AC Drives Improve Rotary Screw Compressor Energy Use, Operations: 12-Month ROI

Compressors are standard fixtures in many manufacturing plants, providing the compressed air crucial to operating pneumatic tools and machines. While many industries still operate these compressors in standard fixed-speed mode, energy costs are prompting others to retrofit their compressors with adjustable-speed drives to provide controlled air-flow supplies in direct response and proportion to real-time load conditions.

In response to these needs, compressor manufacturer Curtis-Toledo Inc. sought an innovative way to make its rotary screw compressors more energy-efficient and

operator-friendly. To achieve those goals, it integrated ABB's low-voltage AC drives into its products. ABB's ACS 800 AC drive series combines variable-speed control and compressor control via an embedded software solution. ABB created custom firmware for Curtis-Toledo that optimizes the control system while minimizing the amount of hardware required to execute control. As a result, Curtis-Toledo was able to eliminate add-on PLCs from its compressor products.

Through the software, the drive regulates and changes speed to match a plant's precise air demands, thus eliminating energy-wasting loading and unloading

AC Drive Financial Benefits

State-of-the-art AC drives are capable of delivering huge financial benefits to machinery builders and users in many industries. For OEMs, the following benefits are among the most noteworthy for the direct advantage they provide to machine builders in terms of end product usability and ultimate value to the user:

Energy Savings: Centrifugal fan and pump loads operated with a variable frequency drive can significantly reduce energy consumption. If the speed of the fan or pump is cut in half, the power needed to run the fan at load is reduced by 12.5%. To achieve the same flow using a fixed speed motor, you would need some type of mechanical throttling device, such as a vane or damper; but the fact remains that the motor would still be running full load and full speed (full power). Energy savings (optional energy utilization) can be a quick way to stand out in the market with your machines.

Integrated controllers minimize the need for PLCs: To create customized, programmable drive systems for customers, OEMs have typically used separate PLCs, which would add complexity and increase the system's "footprint." By using state-of-the-art AC drives, however, OEMs are able to embed software

of the compressor. In addition, the drive software includes a formula that continuously calculates energy savings, enabling the end-user to see dollar savings on demand on the system's touchscreen.

A custom-designed touchscreen also features a walk-through menu that simplifies operational tasks. Operators can adjust operating pressure, external pressure, and oil temperature. The screen provides monitoring signals in digital read-outs or analog meters.

ABB application engineer Steve Boren says the touchscreen is so operator friendly that drives technology knowledge isn't necessary to use it. "An operator can set up machine parameters for operation, monitor all

running compressor system signals, access preventive maintenance timers and diagnostic screens, and even view a fault history log with a built-in troubleshooting manual, all with the touch of a finger," he says.

Curtis-Toledo says end-users can expect a return on investment on the drive within 12-18 months, with savings that could exceed 50%, depending on the air demands of the facility.

Other benefits include increased plant efficiency due to fewer manual adjustments by operators, easy evaluations of systems operation, and improved working conditions as the result of lower noise and heat levels.

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solutions directly in the drive. For example, ABB's standard ACS800 series drives include a set of application function blocks that can be programmed to perform any operation from a predefined set of functions. Users can freely define inputs to the blocks, wiring between the blocks, and connections to the drive I/O or the drive control.

In addition, embedded control eliminates the need for external mounting and wiring of external controllers and reduces the amount of space required for the system. In a typical application this could easily result in thousands of dollars in savings in PLC hardware, wiring, and panel space.

Common platform for multiple applications: In building their solutions, OEMs have a wide variety of AC drives and vendors to choose from. When deciding on a supplier, however, OEMs should consider the drive's ability to optimize productivity and enhance return on investment for their customers. ABB has written many customized applications that customers can use to optimize control of production lines while minimizing the hardware and engineering needed. For example, ABB designed a drive system for ITT's Goulds Pumps

Direct Torque Control Enables Creation of Single-Motor Centrifuge



MEP's CentraSep combines a bowl/blade clutch design with a single AC motor and drive.

ABB's direct torque control (DTC), embedded in its ACS 600 series of drives, is at the heart of Midwest Engineered Products Corp.'s (MEP) innovative single-motor centrifuge for the removal of fines from fluids. In fact, says MEP President Jeffery Beattey, his company could not have developed the centrifuge without ABB drive technology.

MEP, based in Indianapolis, IN, realized that traditional centrifuges were insufficient for removing fines from grinding swarf (a mixture of broken-off grit, metal filings, and lubricating liquid that results from the sharpening process), coolants, phosphate baths, wastewater, and other process fluids. The company responded by designing and producing CentraSep, the first centrifuge to combine a bowl/blade clutch design with a single AC motor and drive. The unit can remove particles from sub-micron to one-half inch in size, and is able to remove as much as

business that enabled Goulds to incorporate the drive platform into products for six of its divisions. The drive platform could be adapted for each division through a simple firmware upload. As a result, users have only one basic product to learn and fewer spare parts to stock. Since most customers of machinery builders are looking to lower their costs of ongoing support, this can be a significant selling point for an OEM to take to their clients.

Ease of use for operators: By integrating easy-to-use operator panels into its drives, ABB has simplified their programming and use. Through menu-driven displays, operators have easy access to information such as motor amps, power and kilowatt hours consumed, input voltage, and torque, as well as many others.

Steve Boren, an ABB application engineer who customized software for drives included in Curtis-Toledo Inc.'s rotary screw compressors (see application sidebar on page 4), says integrated operator panels, along with embedded application control, make the installation unique. "An operator can set up the machine parameters for operation, monitor all running

four times the fines as traditional centrifuges. Consequently, users are able to quadruple fluid life.

Design and operating benefits provided by ABB include:

- Seamless electrical/mechanical integration — A positive locking clutch couples the bowl's main spindle and blade so both rotate at the same speed when processing fluids. ABB's ACS 600, 10 HP drive accelerates the bowl and blade rapidly for the processing cycle, bringing them to a controlled stop and turning the bowl against scraper blades. The drive's DTC feature calculates the torque and flux of the single AC motor 40,000 times per second.

- Adaptation on the fly — DTC drives immediately handle changes in load, over-voltages, and short circuits. If the load in the bowl becomes too heavy, the drive/motor enter a stall mode rather than turning the bowl and breaking the shaft or blade assemblies.

- Long mean time between failures (MTBF), exact program replication — MTBF on drive applications is more than 150,000 hours. Identical startup software is programmed into every drive. The drive, in tandem with a call-out on a PLC, makes it easy to customize the centrifuge for any application.

- Compatibility - MEP easily migrated control to the ACS 800 series drive.

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compressor system signals, access preventive maintenance timers and diagnostic screens, and even view a fault history that features a built-in troubleshooting manual, all with the touch of a finger,” he says.

Built in EMC: The EU Council Directives set standards for various products. Many of these standards are derived from standards written by the International Electrotechnical Commission (IEC). The EMC Product Standard for Power Drive Systems, EN 61800-3 (or IEC 61800-3) is used as the main standard for adjustable speed drives. This standard contains test procedures that are specifically suitable for drives and the standard is quite comprehensive. It covers both the drive’s electromagnetic emissions and its immunity from received emissions.

For drives with the most comprehensive electromagnetic compatibility, specifiers should require drives to meet the IEC 61800-3 EMC standards and emission limits for Restricted Distribution, and installation in the First Environment. Manuals should be required to include instructions for installing the drive equipment so that it meets the specified emission limits as installed. For example, ABB has built a built-in EMI/RFI filter which guarantees trouble-free operation of surrounding equipment and instrumen-

PVC Production Increased Without Additional Extruder Line

Cantex Inc., a producer of polyvinyl chloride (PVC) pipes, increased production at its Reno, NV, plant by upgrading its lines with ABB AC drives featuring direct torque control (DTC) capabilities. As a result, Cantex significantly increased production at one-eighth the cost of adding an extrusion line.

The Reno plant operates 18 extrusion lines. The company opted to retrofit three of those lines with 75 kW, 90 kW, and 110 kW ABB AC drives, replacing non-ABB drives that had been used. The motors power mixing screws on the extrusion lines. The drives were supplied by Intec Solutions, an ABB

system integrator that provided dimensioning, engineering, and commissioning expertise on the project.

According to Ron Berry, Cantex plant manager, use of the ABB drives resulted in increases of hundreds of pounds of PVC per day on the upgraded lines.

“We have basically added the capacity of one more extruder without having to put a new line in,” he says.

DTC gives Cantex the ability to overspeed the ABB motor and maximize power and precise torque

tation. And the 208/240 and 380/480-volt class of the drives meets compliance to CE's First Environment standards. Specifying such drives is especially critical for global OEMs, shipping machines to all parts of the world.

Set Yourself Apart

The time is right to position your machine building business within the current manufacturing business expansion. This expansion is truly global — we're all aware of the booming business occurring in Asia, Eastern Europe, and parts of the Middle East, but even the U.S. manufacturing market has been expanding for more than 20 straight months, according to end of first quarter 2005 results from the Institute of Supply Management.

To differentiate your business from competitors in such a marketplace, forward-thinking OEMs must integrate the best, most capable components available into their products. In the continuous drive to market existing products, OEMs too often overlook this success factor.

By teaming with ABB, OEMs can avail themselves of a broad selection of industrial drives that can be configured and programmed to provide outstanding value not only to the OEM, but to the end customers as well.

control. Consistent speed control has eliminated speed variations that Cantex had to deal with while using the DC equipment. As a result, the company has been able to minimize downtime and scrap.



Retrofit on mixing screw on one of the extrusion lines at Cantex.