

The Green Revolution

A GLOBAL WIN-WIN

Matthew Jaster, Associate Editor

Green technology is more than changing a couple of light bulbs or reducing waste. In 2009, the concept is relevant in every facet of manufacturing as companies make a greater push towards energy efficiency and sustainability. In the power transmission and motion control fields, this technology has been integrated into the daily routine, both as an environmentally friendly business venture and a way to offer green products to customers. It's apparent that the revitalization of manufacturing,

both here and abroad, will center on energy technology. Many companies have already taken note of the benefits of going green.

Green Technology with SKF

With expertise in material, tribology, rheology and friction management, SKF is currently supporting several green technology initiatives. By reducing the friction of rotating

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SKF's E2 bearings are applicable to all types of gearboxes, transmissions, motors, fans and compressors. (Courtesy of SKF.)



SKF actuators control positioning of window sun blinds.

components, SKF's combination of bearings, seals and optimum lubrication reduces energy consumption and CO₂ emission.

"The impact is important considering that we have billions of bearings running in the world in many applications," says George Dettloff, CEO and president of SKF USA Inc. "This adds up to an enormous saving for the planet."

Furthermore, the company has expertise in reliability systems, asset management and the newly developed "SKF's Client Needs Analysis—Energy and Sustainability" tool, a facilitated assessment by SKF energy experts.

"These tools enable customers to estimate and achieve energy savings for an entire manufacturing process or a specific application and product," Dettloff says. "When used together with SKF's 'Documented Savings Program' tool, customers appreciate the real value we provide because the savings per machine can be identified and used as benchmarks for other savings elsewhere in the plant."

At the core of this green movement are SKF's E2 bearings, energy efficient as a result of optimized geometries, lubrication, special cages and manufacturing techniques. These bearings exhibit significantly less friction torque and friction loss than conventional bearings—at least a 30 percent reduction. With applications in electric motors, pumps, gearboxes and wind turbines, the E2 bearings run cooler, reduce lubricant use and extend machine life.

In addition, SKF has been involved in many energy efficient projects that extend beyond bearings including:

- Saving weight for commercial and business jet airplanes with fly-by-wire actuation and auto throttle systems.
- Window blinds with electric actuation that save energy at an average of 40 percent per year.

- Condition monitoring units for wind energy that prevent downtime and make renewable energy sources more efficient.
- Replacing pneumatic actuation with mechatronic actuation provides a 70 percent savings for energy in robotic applications.
- Centralized lubricating system and minimal quantity lubrication systems that provide less lubricant than traditional systems, yet lubricate just as well.

SKF's Maintenance Strategies and Practices are delivering more efficiency to large manufacturing plants, saving high amounts of energy and preventing breakdowns, so that the machinery lasts longer. And SKF's remanufacturing service can repair a worn bearing at significantly lower cost than the original new product cost, giving energy and materials savings for the manufacture of new products.

"We have many solutions and services that really contribute to reduce energy consumption, lubricant consumption and CO₂ emission," Dettloff says. "Many new projects are under way to promote green technology practices."

In addition, the sustainability section at www.skf.com takes green technology a step further, utilizing knowledge engineering, sustainability reporting and energy efficient solutions in its SKF Care concept. Sustainability is a major key to SKF, according to Dettloff, with the SKF Care approach to business, the environment, employees and the community.

"Our customers see our offers to save energy and to promote green solutions and they are facing the same challenges and opportunities that we do for developing greener products and for running their own factories in the most efficient way," Dettloff says.

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Miniature Motion Solutions at Portescap

The advantages of going green with motion solutions are multifaceted, ranging from energy efficiency to reduction of disposable, non-biodegradable waste. Green motor technology at Portescap, a Danaher Motion company, evolves in the design stage where the engineers model extensively electromagnet circuits of the motors to optimize power output as a function of input power.

Once optimization has taken place, the engineering team works with operations and sourcing experts to choose environmentally friendly materials in motor manufacturing. The efforts here range from choosing epoxies, solders and metals that are used in the design and manufacturing of coils, magnets, commutators and housings that are assembled into miniature motors.

"The efficiency of Portescap BLDC motors can reach up to 90 percent when the electro-mechanical circuit is optimized for a given application," says Simon Pata, business unit manager, BLDC technologies. "This implies a high conversion rate of electrical to mechanical power, thus minimizing energy waste and loss."

Portescap has a wide variety of high-efficiency motors that help lower the total cost of ownership of machines, reducing the amount of total power required to move the designated load. Efficiency is also increased, extending the required time for routine maintenance.

“Athlonix brush DC motors feature lower self heating and high efficiency that are attained using coil optimization. This allows the motor to have a higher product performance while increasing the energy savings. Also, the lower motor regulation factor allows the motor to last longer with sustained performance,” says Udayan Senapati, product line manager, Brush DC technologies.

As a motor provider for pumps, analyzers and surgical hand tools, Portescap can offer the medical industry a variety of green solutions. Energy efficient motors can be beneficial in applications ranging from portable ambulatory pumps to floor-mounted automated laboratory analyzers.

“A medical analyzer that is designed for 24/7 assay analysis and uses five 100 W brush DC iron core motors with a total energy usage of 500 W can gain 100 W of energy savings by using ironless brush DC technology,” Senapati says.

The other benefit is motion solutions that reduce non-biodegradable waste.

In certain segments of the medical industry, for example, there is a migration from non-motorized single-use disposable hand tools to environmentally-friendly motorized solutions. Autoclavable motor solutions are a positive impact to the industry as they facilitate multiple uses of power surgical tools, thus reducing waste output by a factor of 100 to 1,000 based upon the application.

Autoclave is a process of sanitizing and sterilizing surgical devices for multiple use and, hence, such devices with autoclavable motors reduce environmental waste while increasing reusable life. Portescap designs and manufactures autoclavable BLDC motors that can be sterilized in excess of 1,000 cycles without any performance compromises. These brushless DC motors have inherent design and manufacturing elements that make the motors withstand pressure- and temperature-treated steam environments used to clean and disinfect surgical devices. Portescap continues its innovation in motor technologies that can be autoclaved through multiple cycles by the appropriate choice of materials and sealants in motor design.

“Portescap’s other focus is motor electromechanical design optimization. Our BLDC motors are efficient, thus consuming less energy and running at cooler temperatures, which is exactly what the handheld powered surgical hand tool manufacturers are looking for,” Pata says.

“Portable medical devices that run on battery power benefit from ‘going green’ both in terms of improved efficiency and less disposables,” says Dave Beckstoffer, product specialist, Stepper Technologies. “Hence, there are a multitude of advantages and benefits that companies can bring to the customers by designing and producing green products, and such efforts would be a competitive edge for those in the medical arena.”

The majority of Portescap motors are RoHS-compliant, and the company restricts the motor content of lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE) in all phases of design and manufacturing. By using materials that have less impact on the environment, Portescap intends to be a participant and innovator in the green revolution of designing and manufacturing environmentally friendly motors.

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Romax Enters Hybrid Technology Market

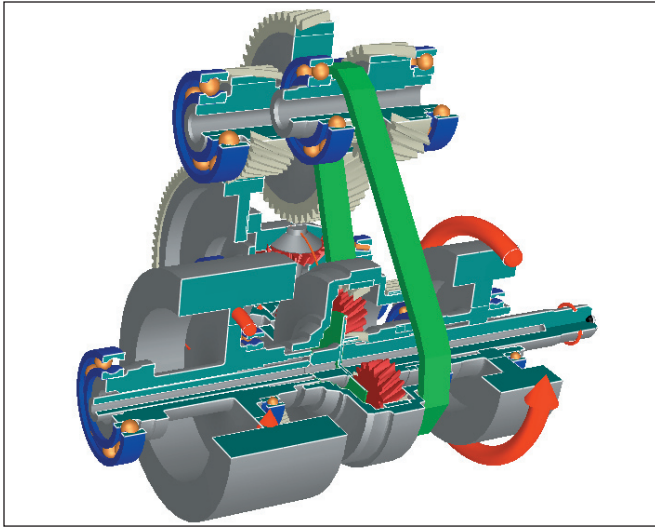
Although hybrid equipment represents a logical progression for automotive transportation, few manufacturers have fully committed to the technology. This is due to the increased complexity of the operating systems and modes of operation, the variety of hybrid configurations available and the range of driving scenarios that must be considered. As a result, real-world gains in efficiency are difficult to realize.

Romax Technology has recently entered the hybrid market with a range of capabilities that enable manufacturers to achieve the potential gains of hybrid technology. The service provides

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Portescap offers a variety of green solutions for motors utilized in pumps, analyzers and surgical hand tools. (Courtesy of Portescap.)



An example of a split hybrid transmission system. (Courtesy of Romax Technology.)

methods for visualization, analysis and comparison of different driveline configurations. While hybrids remain a complex optimization process, the capabilities offered by Romax will enable engineers to steer a more efficient path towards a solution.

“In order to optimize any system, a thorough understanding of the underlying modes of operation and processes is essential,” says Dr. Philipp Guttenberg, hybrid group leader at Romax. “Energy flow paths through a hybrid driveline are complex, with multiple energy routes from the fuel tank to the wheels. To be able to visualize and subdivide the key energy flows throughout the driveline is a vital step in knowing which direction to modify the driveline.”

Guttenberg adds that seeing the quantities of energies flowing through the various components provides an understanding of where and how energy losses occur.

“Furthermore, the tools can be applied in the validation of existing simulation models of vehicle drivelines. Romax can provide these capabilities, using patented energy analysis methods and visualization tools to provide a new breed of hybrid vehicle engineers with advanced analytical solutions,” Guttenberg says.

With the range of hybrid configurations possible—for example, parallel, split, combined or series hybrid—direct and qualitative comparison of these different options is not readily achievable. How, for instance, should the gearbox operating efficiency of a parallel hybrid, as in a Honda Insight, be compared with the more complex transmission systems of a split hybrid, as employed in the Toyota Prius?

“Romax can answer this question, and we’ve developed techniques that take detailed knowledge of energy flows within the driveline and condense them to more generic driveline overviews, enabling direct but still detailed comparisons to be made between different driveline structures,” Guttenberg says.

The energy analysis methods that Romax has developed offer huge potential for the optimization of hybrid drivelines. The techniques developed are generic in their nature, and as such could find use in a variety of applications, including combined heating and power (CHP) systems and national grid issues. These tools can be applied in any application where a multiple energy distribution path exists within an energy system.

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FANUC Offers Technology Solutions to Green Manufacturers

Due to the response from its green technology robotics at both Solar Power International 2008 and PackExpo 2008, FANUC Robotics is actively pursuing solutions for green manufacturers in several alternative energy fields.

“The ability to showcase our technology has led us to further explore how our solutions can be incorporated into customers’ applications,” says Rush LaSelle, general manager at FANUC Robotics West. “We have continued to be impressed by the strong market response to, and in many cases, the adoption of the technology being offered by FANUC Robotics.”

FANUC offers a wide range of products and services to alternative energy manufacturers and suppliers. The company has successfully installed solutions throughout the solar supply chain from wafer cutting and handling to final assembly.

“The ability to provide solutions, from the most cost-driven applications to those representing the highest technical risk on one platform, is a critical consideration for many of our customers,” LaSelle says. “Our proven track record in the solar industry has been an important factor for companies interested in manufacturing on multiple continents.”

Operations within the solar industry that are currently implementing robotic automation include tray and dunnage loading/unloading, process load/unload, sorting into boxes, wafer handling, wafer machine toll tending and complete mode build (framing, edge delete, assembly, j-box installation).

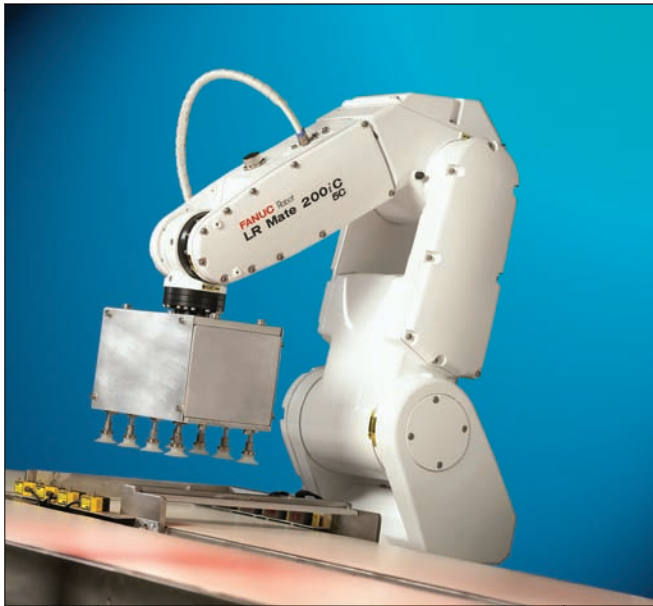
FANUC has more than 200 model variations with payload capabilities ranging from 2 kg to 1,200 kg. The company also offers simulation packages, application software, controls and integrated vision products.

“We are able to provide alternative energy manufacturers and suppliers a competitive advantage compared to manual processes, hard automation and offshore manufacturing,” LaSelle says.

Some of the advantages that FANUC provides green



FANUC offers more than 200 robotic models. (Courtesy of FANUC.)



More than 200,000 FANUC robots have been installed worldwide. (Courtesy of FANUC.)

technology manufacturers include reduced costs by eliminating fixed automation, quick production startup with robotic technologies, the ability to design small batch sizes by using robots to process and transfer components, eliminate errors and scrap with an integrated process validation system and increased uptime with reliability and support.

“From brick, wafer and module lines for the solar industry, to carbon fiber lay-up and trimming for wind energy, FANUC and our manufacturing partners look at every step to optimize our customer’s operations,” LaSelle says.

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University Research Increases Efficiency of Hydraulic Pumps

The MAHA Fluid Power Research Center at Purdue University is working on advanced methods of surface design that improve the efficiency of hydraulic pumps and motors. Dr. Monika Ivantysynova, director of the center, says the research team is using an in-house simulation code that models the physics of the various phenomena taking place in the rotating group of piston pumps and motors.

“The code has helped us in creating new ideas for advanced surface design such as microstructured surfaces and new macrostructured surface geometry,” Ivantysynova says. “The goal is to reduce energy dissipation in lubricating gaps of pumps and motors. Currently, 60 to 90 percent of pump and motor losses are due to losses generated in these lubricating gaps.”

The microstructured surface generates hydrodynamic effects that can help reduce losses due to viscous friction through a small increase of gap heights. This effect, according to Ivantysynova, helps to reduce losses especially at lower pressure or lower displacement in variable displacement pumps.

“Consequently, the efficiency increases in these ranges of

operation where normally the efficiency of pumps and motors is very low,” Ivantysynova says.

These narrow gaps are located at several locations between the cylinder walls and the piston and between the cylinder block and the valve plate. The research team at MAHA is testing various piston machines and has equipped test rigs with special sensors to support their theoretical work and benchmark the code.

The test rigs focus on steady-state measurements of pumps and motors, low-speed testing and start-ability management of motors, dynamic performance, measurements of tribological systems, measurement of instantaneous cylinder pressure during real-time pump operation, thermal measurement of valve plate/cylinder block interface and sound intensity and measurement.

Using a software tool known as *CASPAR*, developed by Ivantysynova’s research team, engineers can determine the calculation of real flow ripples at both ports, further the calculation of the instantaneous cylinder pressure, the internal and external volumetric losses, viscous friction forces, gap heights, oscillating forces and moments exerted on the swash plate.

CASPAR is a design tool developed using the C++ programming language. Models implemented and solved in *CASPAR* consider the time-dependent change of gap heights due to oscillating forces, the interaction between machine parts, the dependency on design and operating parameters and the energy dissipation within the gaps.

“Pumps and motors need to be designed using computer-aided methods that ensure the complex physical nature of phenomena is considered in the design process,” Ivantysynova says. “A general goal in pump design should be to ensure full lubrication in the entire range of operating and to minimize the number of parts. The simplest design is the best solution.”

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