Magnetic clutch controls bottle-capping torque

Hysteresis method eliminates loose or crooked caps

VARIOUS METHODS CAN BE USED to screw caps on bottles containing everything from juice to medications. Some prove unreliable in putting the caps on tight enough or straight enough. Others tend to be too costly—including those using electric transducers and servo motor feedback. The most repeatable and reliable method involves using a hysteresis permanent-magnetic clutch, such as those manufactured by Ogura Industrial Corp. (Somerset, NJ).

If you look in a dictionary, you'll find this definition for hysteresis: *(physics) the time lag exhibited by a body in reacting to changes in the forces, especially magnetic forces, affecting it*. In practice, says Dave Kane of Ogura, "the bottle-capping clutch works by placing a hysteresis disk between two circular magnets. The disk is made of a special material that doesn't retain more than a trace of residual magnetism after being subjected to magnetic force applied by the magnets on either side of it. The alignment of the magnets can be changed in relationship to each other to vary the effect on the hysteresis disk for the particular bottle-capping application."

It's a little more complicated than it sounds. Hysteresis units have a very wide torque range, with minimal drag torque. Ogura hysteresis permanent-magnet clutches offer fast response because, says Kane, "torque is independent of slip speed." Under identical operating conditions, this means that the unit will be able to duplicate its performance as many times as an application needs.

A permanent-magnet field transmits torque in the unit, so no wearing parts are involved in the normal operation of the unit except for bearings and seals. "This results in extremely long life," says Kane.

On the capping machines at U.S. Bottlers Machinery Co., the chuck, on a shaft attached to a clutch, picks up the cap. A bottle remains stationary under the chuck as it turns in the correct direction to screw on the cap. It's the job of the clutch to make sure the machine tightens the cap just the right amount.

This is how it works: The magnets create a magnetic flux, which passes through the hysteresis disk. The hysteresis disk physically rotates between the magnets without touching them. The disk becomes temporarily magnetized depending on the strength of the flux—a magnetization that dissipates

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VENDOR ADVERTORIAL

3D models speed packaging machine design

If necessity is the mother of invention, then the time to adopt 3D mechanical design software is sooner rather than later for cutting-edge packaging machinery manufacturers like Hartness International.

Based in Greenville, SC, the company designs packaging machinery for a variety of industries. Its custom-built case-packing equipment ranges from high-speed packaging solutions to starter systems for companies that are just beginning to automate.

Faced with last-minute changes in specifications for a custom machine, the company's rapid adoption of 3D mechanical design software came about from necessity rather than a deliberate plan. "The machine we had intended to install in a customer's plant was no longer suitable," recalls Hartness President Bern McPheely, "but the company still expected us to meet the delivery date."

Hartness engineers determined that SolidWorks® software offered the easy-to-use, intuitive solid-modeling capabilities they needed to explore part and assembly alternatives in real time to optimize performance of the customer's machine, a dynamic accumulating conveyor system (DYNAC).

Using SolidWorks to design the new product, Hartness engineers were able to shorten the design and manufacturing cycle from five to two months.

"SolidWorks was easier than we thought it would be," says Product Manager Olivier Duterte. "We had formal training for two days and started making parts on the third. Two months later the machine was delivered on time!"

During the rapid design of the DYNAC, managers would often discuss ways to optimize the design with engineers, while viewing 3D Solid Works parts and assemblies from different perspectives to gain a better idea of how the product would look and function.

"Our previous 2D method would never have allowed us to work in assemblies as we do in SolidWorks," asserts Duterte. "We can now test how moving parts will fit and interact. In fact, we can assemble the whole machine and with no surprises." Circle 803

upon removal from the flux field. Thus, as the rotor rotates, magnetic drag takes place between the rotor and the disk, creating a "pull" on the hysteresis disk.

"The point of using this design," says Kane, "is to obtain repeatability of torque for capping bottles with a preset torque. No friction occurs with these devices. In fact, spring loaded friction devices used for the same purpose suffer because the amount of torque needed to begin to slip—that is, release the cap and bottle after capping—is higher than the actual slip torque. As a result, you get a large torque spike and then a sharp drop-off. Because of this, friction devices can leave caps loose or crooked. In contrast, the hysteresis device has a breakaway torque that is virtually equivalent to the preset slip torque, resulting in a very tiny torque spike and complete repeatability of action."

For bottle-capping applications, Kane says, "the clutch has to be in a stainless-steel housing. Many capping operations deal with caustic and corrosive materials. Hot Gatorade can be very corrosive because of the minerals it contains, and there's cola syrup, or chlorine bleach. We used different materials in the past, but learned from experience that only stainless steel will stand up to the conditions."

'What's nice about these clutches is their lack of a need for maintenance.' Tom Risser, president of U.S. Bottlers

U.S. Bottlers Machinery Co. (Charlotte, NC) uses Ogura hysteresis clutches in its machines. Tom Risser, president of U.S. Bottlers, says that the company has manufactured capping machines and other bottling supplies since 1912. "My great-grandfather founded the company," he says, "and I'm the fourth generation to run it. My grandfather would say that we've made cappers since early in the 20th century, but in terms of modern technology, we've been making them since the early 1980s."

Risser first saw a "permanent-magnet clutch" in an advertisement in an engineering magazine. He says, "We use the clutches in rotary packaging equipment. The machine sends bottles down a conveyor until they enter a star-shaped formation that aligns them under the machine's chuck assembly."

The chuck is the part of the apparatus that picks up the cap. The chuck, on a shaft attached to the clutch, "spins above the bottles at between 100 and 200 rpm, depending on the particular bottle and cap," Risser says. "The bottle remains stationary under the chuck as it turns in the correct direction to screw on the cap. You can have many machine stations in a bottling plant. The trick in every case is not to over- or under-tighten the cap."

It's the job of the clutch to make sure the machine tightens the cap just the right amount. "If you have the machine set for 15 in/lb, the magnetic clutch stops the screwing action and lets the bottle transfer out of the machine."

Kane of Ogura elaborates on that theme: "As the bottle enters the chuck station, the chuck, clutch, and cap are in an up position. The assembly comes down and begins to twist on the cap until the clutch hits its pre-set torque, slips, and lets the bottle exit."

"What's nice about these clutches is their lack of a need for maintenance, and lack of complexity, along with their accuracy and repeatability," Risser says, pointing out, however, that they aren't entirely foolproof. "The clutch does hold some weight, and you do have to deal with inertia, though this can be controlled by a motor. While most of the elements in the clutch are no-wear, corrosion can be a problem with bearings, so we insist that the bearings be made of stainless steel."

The machines made by U.S. Bottlers cap 700 to 800 bottles per minute. "Some capping machines in the carbonated beverage market can run 2,000 bottles per minute through capping machines," Risser says. "We've never gotten into that market. But in the juice and Gatorade market that we're in, you can have 30 permanent-magnet clutches on a machine. They can cost between $500 and $1,200 each—so you want them to be pretty foolproof at that quantity and price."

For more information

Clutches from
Ogura Industrial Corp. Circle 750