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Cleaning Gears with Ice Chips—and Nothing Else

Residue from cleaning solution.

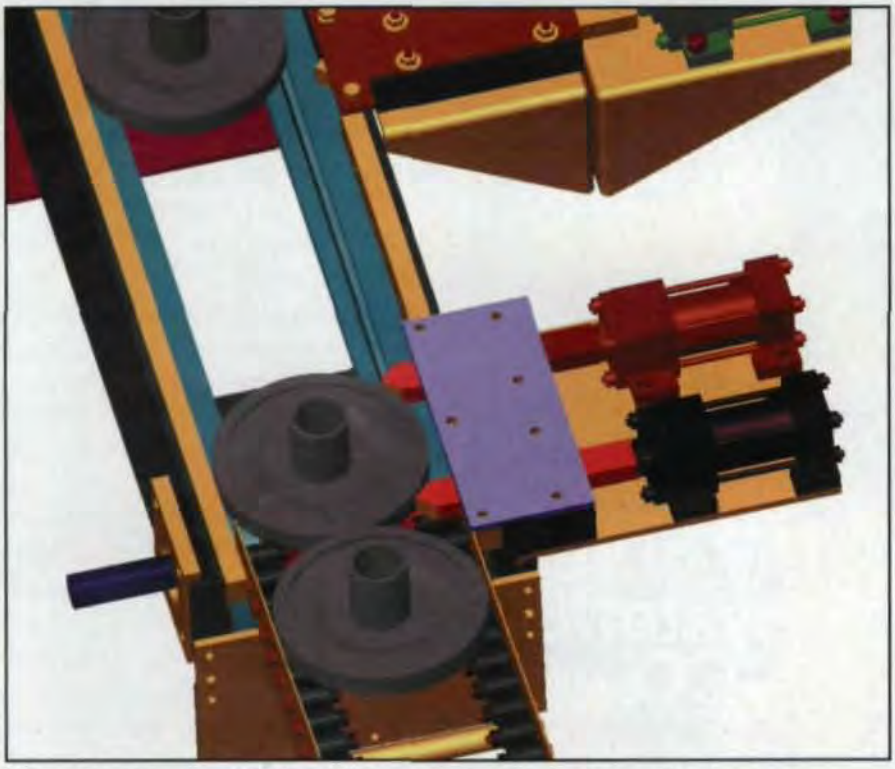
You wash your gears as best as you can, but it's there. Then, it gets on the master gears of your gear checker. After a while, enough residue collects on the master gears that it throws off your checker, which starts rejecting good gears.

Your solution? Stop the checker, pull out the master gears, clean them, put them back in the checker, and recheck your rejected gears.

Not much of a "solution"—especially when you have to do it every couple of hours. That's been the problem at several Ford Motor Co. plants for many years.

Ford has a possible solution, though—clean gears with ice chips.

The solution is a new system that cleans gears by spraying them with ice chips instead of using solvents or water-based cleaning solutions. The system was developed by Universal Ice Blast Inc. of Kirkland, WA. UIB manufactures ice-blast machines for commercial and industrial use.



Universal Ice Blast Inc. of Kirkland, WA, conceived and designed a machine that cleans gears by spraying them with ice chips. The machine doesn't use solvents or water-based cleaning solutions.

The system was installed for production cleaning at Ford's transmission gear plant in Sharonville, OH.

With this system, ice chips are sprayed through a nozzle at a pressure ranging from 65–75 pounds per square inch. Hitting a gear, the chips deform and create a scrubbing action, displacing the gear's contaminants. After impact, the chips melt into water and wipe away the gear's debris and contaminants.

The chips are created in a refrigerated drum. The drum uses ordinary tap water to form an ice layer. The layer then cracks into small chips, which are moved into a stream of compressed air and sprayed through the system's nozzle.

"You have an environmentally friendly process," says Tony Tonello, UIB's vice president of marketing and engineering sales. "You save the cost of supplying these soaps or solvents, as well as the cost of treating these solvents in the waste stream."

As for its effectiveness, the cleaning system was placed online at the Sharonville plant in March. The new system has been operating 16 hours a day, five days a week, cleaning the input

transfer gear used in the transmission of the Ford Focus.

The input transfer gear is a helical gear with an internal spline that has undercut. The gear arrives at the cleaning system straight from grinding, so gear and spline have swarf on them. The system has a fixture that lifts and rotates each gear so ice chips can reach all the gear's surfaces.

The old system cleaned gears with water and a soaplike cleaner, and included a rust inhibitor. The gears' residue of cleaner and inhibitor would build up on the master gears in the end-of-line gear checker. The build-up would result in 30–35% false rejects.

Reinspecting rejected gears uncovered the good ones and raised the pass rate to 95%.

With the new system, the first-time pass rate is about 98%. "That's what we were really hoping for; that's a biggie," says Mike Gourlay, a Ford manufacturing engineer.

Universal Ice Blast built the machine, its first ice-blast gear-cleaning system, for Ford Motor Co. The Ford plant in Sharonville, OH, is using the machine to clean the input transfer gear used in the transmission of the Ford Focus.

Gourlay is responsible for the final drive and transfer gears used in the Ford Focus transmission.

With the new system though, Ford must add the rust inhibitor to the gears after they're checked, using a machine built by UIB.

Other companies also make systems that clean gears. Located in Cincinnati, OH, Ransohoff Inc. makes water-based gear-cleaning systems. But, Tonello says UIB's system at the Ford plant is the first application of ice blasting for cleaning gears.

A 17-year Ford employee, Gourlay has worked with gears for 10 years. Before the UIB system, he knew of no viable alternative to the plant's old gear-cleaning system.

The plant also checks the UIB system's effectiveness at achieving a set level of cleanliness. The plant takes samples of its cleaned gears and checks their cleanliness with a second washing. The samples, groups of five gears, are washed with an inert liquid. The liquid's resulting contaminant level is then measured. The level must be 2.5 milligrams or less for each group.

Early tests showed the system met that requirement.

Using a six-sigma approach, the plant's data has indicated the UIB system would successfully clean more than 99% of the gears.

Ford hasn't accepted the system yet, but plans to use it for three months, through the end of May. It will then compare performance data from the system's first three months and the old system's last three months to make a final evaluation and decide whether to accept the system.

"I think it represents a very big potential to solve a long-standing problem," Gourlay says. "But, I guess—being an engineer—I'm reluctant to say we're successful until I see the data.

"But, we're expecting to be successful."

The system consists of a gear-cleaning unit and an ice-making unit. The Ford system's gear-cleaning unit is 8 feet X 12 feet and is 12 feet tall. The ice making unit is 4 feet X 6 feet and is 5 feet tall.

The two units are connected by an industrial hose, so the ice-making unit can be as much as 100 feet from the gear-cleaning unit. Tonello says the hose lets a company place the ice-making unit in a dead space in its plant.

The Ford system uses about 20 gallons of water an hour. But, 50% of that water evaporates. The compressed air that accelerates the ice chips creates a wind that causes forced evaporation of the resulting droplets.

Tonello compares that forced evaporation to a man rubbing his wet hands together in front of a warm fan.

So, gear manufacturers have to deal with about 10 gallons of water an hour.

A fully automated ice-blast system—able to process a gear every 20 seconds—costs between $250,000 and $300,000. An air delivery system increases the system's cost by $15,000–$40,000, depending on the air pressure required.

Manual systems that handle fewer gears start at $50,000 apiece.

The costs assume air and water will be supplied by the purchasing companies.

Gourlay hopes the system will reduce the checking of master gears to just once a shift, at the start of a shift, just to make sure they're OK—that the system gets rid of the problem of good gears being falsely rejected.

"That's what I thought was the big carrot," Gourlay says. "This really does have the potential to deal with a problem that we've had for a long time."

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