➤ BY JIM ROMEO

Attractive Cleaning

Using magnets for coolant filtration, either to collect the chips or move the filter, pays dividends.

Eriez Magnetics

The Xtractor rare-earth coolant cleaner can collect ferrous materials down to 5µm.

Shrinking budgets. Increased production. Reduced labor forces. These are familiar phrases to companies that make parts for a living. Every nickel that can be squeezed out of operating costs can be tacked onto the bottom line.

One way of gaining incremental efficiency where it might be least expected is coolant filtration. Experts say proper filtration can lengthen coolant life two times or greater, while significantly improving the performance of machine tools and cutting tools.

A variety of coolant-filtration systems are available, including sumps, coalescers and skimmers. Presented here are two systems that rely on magnets to help users meet their cost-cutting goals.

A Rare Find

Eriez Magnetics' rare-earth magnetic coolant cleaner utilizes a permanent-magnet circuit, which uses magnetic materials that will never lose their attractive force.

According to Dan Zimmeran, metalworking market manager for Eriez Magnetics, Erie, Pa.: "The increase in the strength of permanent magnets has been extraordinary, and the advent of rare-earth permanent magnets has allowed the design of high-intensity magnet circuits operating without electrical energy. Magnetic circuits designed with rare-earth magnets generate a magnetic force greater than conventional ferrite magnets' force."

These technological advances are quite significant in that they focus specifically on the magnetic collection of micron-sized ferromagnetic and paramagnetic particles. The coolant cleaner can collect ferrous materials down to 5µm.

"The magnetic drum collects not only metal chips," Zimmeran said, "but also harmful contaminants such as rust and iron fines that continually erode machine components, pipelines, chutes, bins and process equipment."

Around the Clock Cleaning

A manufacturer in New York that machines ball bearings from steel bar stock for the aerospace and automotive industries recently installed a rare-earth coolant cleaner.

The company manufactures bearings from ¼" to 4" for a wide range of applications. Its plant is equipped with several different types of screw machines for processing bar stock, including single- and multiple-spindle screw machines that use oil-based coolant and CNC screw machines that utilize water-soluble coolant. Cutting steel

bars on a screw machine produces a substantial amount of chips—as much as 75 percent of the bar can end up as chips.

During machining, chips fall, along with some coolant, to the bottom of a machine and collect in a holding tank. The chips are transferred into containers, which are then taken to the plant's chip-processing system. The system removes chunks of metal and shreds the chips into smaller pieces. Then the chips enter the centrifuge, which spins them and separates them from the coolant. However, the coolant from the centrifuge still contains minuscule chips.

Previously, the manufacturer had used only a centrifuge to separate the chips from the coolant, but not all the coolant could be recovered with that method. The company would transport the chips to a recycling facility, but, along with the chips, unrecovered coolant was being discarded at a cost of $2.50 per gallon. To recover this coolant, the plant installed Eriez's rare-earth coolant cleaner.

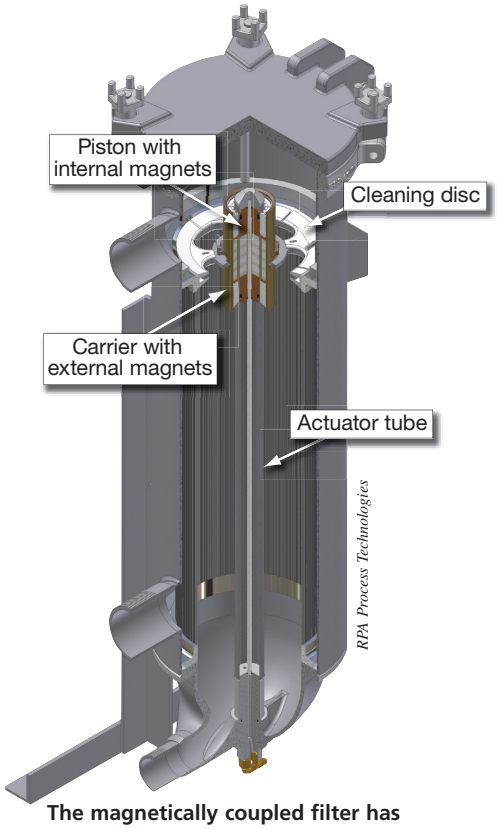
Now, the coolant is pumped from the chip-processing system directly to the coolant cleaner. The coolant and chips enter the sump area and flow past the counter-rotating magnetic drum. From there, a mechanical discharge mechanism moves them to a discharge chute. The coolant, now virtually free of ferrous particles, is discharged from the bottom of the cleaner.

After the coolant is run through the coolant cleaner, it is pumped through a 200µm bag filter to remove any nonferrous particles before the coolant enters a holding tank. From there, the cycle starts again and the clean coolant is reused.

Because the chip-processing system runs only once per shift for 1 hour at this plant, management decided to keep the coolant cleaner working and to process the coolant stored in the holding tanks continuously.

Whether the coolant originates from the chip-processing system or a holding tank, the coolant cleaner handles 6 to 10 gpm, 24 hours a day. Before installing the coolant cleaner, the 200µm bag filter had to be changed twice a day because of clogging. Now, the plant changes the 200µm filter only twice a week—a real time and money saver.

For this plant, the coolant cleaner has reduced costs by removing the chips without the need for constant monitoring. It also has eliminated the manual labor often involved in cleaning coolant.



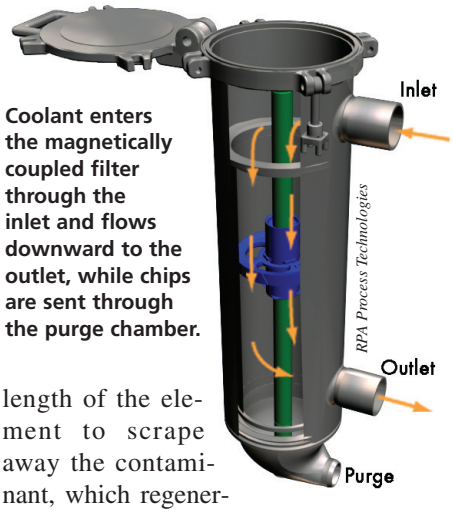
The magnetically coupled filter has magnets inside the actuator tube coupled to magnets in the carrier that move the cleaning disc.

Magnetic Movement

RPA Process Technologies, manufacturer of Ronningen-Petter filters, incorporates rare-earth magnets into its magnetically coupled filter system.

The mechanically self-cleaned filters are "ideal solutions for coolant use," said Dave Hanfland, product manager for RPA, Portage, Mich., because they "help reduce the cost of consumable media."

He explained that in the magnetically coupled filter, coolant is introduced at the inlet near the top of the filter and flows downward to the outlet. Both the inlet and outlet are mounted on one side of the filter with the purge chamber located at the bottom. Contaminant builds up on the inside of the stainless steel, slotted filter element, or screen. A spring-loaded cleaning disc travels the length of the element to scrape away the contaminant, which regenerates the open area of the element. The scraping action pulls contaminant away from the element and directs it down to the purge chamber. The purge chamber collects a given amount of contaminant and is purged on a timed basis, expelling the contaminant.



Coolant enters the magnetically coupled filter through the inlet and flows downward to the outlet, while chips are sent through the purge chamber.

The system's magnetically coupled actuator incorporates one set of magnets inside the actuator tube. The magnets are configured in an arrangement with seals to form a piston assembly inside the actuator tube. Air ports deliver air to the top or bottom of the piston, which pushes it up and down the length of the actuator tube. The magnets inside the actuator tube are coupled to a matching set of magnets outside the tube located within the carrier, which carries the cleaning disc. The magnetic coupling holds the two sets of magnets together as the air drives the piston up and down. The carrier rides on bearings, with the cleaning disc attached to it, to clean the element.

The Bottom Line

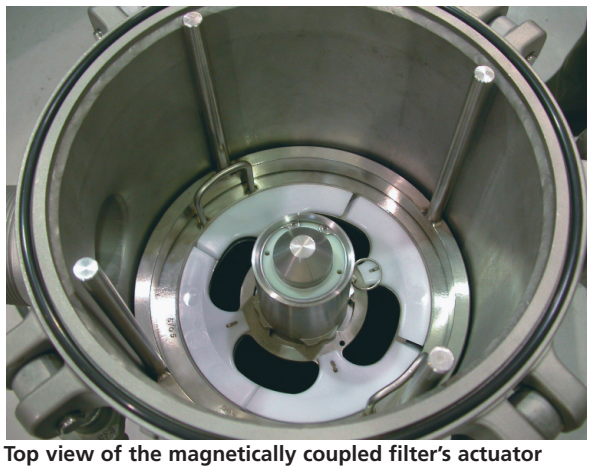
The payoff for coolant filtration can be handsome when one considers the total cost of operation. As in all discussions of manufacturing economics, the payback isn't just in the savings for direct operations, but in the many factors that have an indirect impact on the operation.

According to Hanfland, most of the published literature barely scratches the surface about all the ways a self-cleaning filter can reduce costs. "The bottom line numbers are the eliminated cost of consumables (bag or cartridge filters), reduced cost of disposal,

reduced man-hours and increased uptime," he said.

Metal chips created during machining can be detrimental if not purged properly. "Mechanically cleaned filters can purge chips from a machining operation to be recycled, where a bag filter would have to be discarded with the chips," Hanfland said. "This is inefficient and, for a continuous high-volume machining operation, the cost for filters can certainly add up."

In addition, the ability to purge metal chips from coolant provides additional cost savings and benefits. "How many pounds of chips leave the plant stuck to bags and cartridges, not to mention the amount of coolant?" asked Hanfland. "Indirect cost savings of eliminating inventory, reducing human interaction and reducing direct contact with the coolant are realized with self-cleaning filters."



RPA Process Technologies

Top view of the magnetically coupled filter's actuator tube and cleaning disc.

RPA Process Technologies

Removal of the filter core from a magnetically coupled filter is the same as with most cartridge filters, but it needs to be removed less frequently because it incorporates self-cleaning technology.

Filtration at Work

When a manufacturer with a group of three machining centers for making aluminum transmission parts used RPA's magnetically coupled filter, the results and cost savings were significant.

Previously, "the coolant was collected under the machines, where it was routed through a set of weirs, or grates, to separate out large particulates," Hanfland explained. "A pump then sent the coolant to a housing that contained three large 75µm cartridge filters."

According to Hanfland, the cartridge filters needed to be replaced three times per week. The indirect costs were discovered by audit and included the recurring costs of the cartridge filters, disposal, labor for the filter changeouts and machine downtime. In addition, the manufacturer wasn't able to remove all the chips from the coolant, which led to recutting of chips and shortened tool life.

The manufacturer selected the magnetically coupled filter to increase efficiency. The result was $60,000 in annual savings, and that was with one magnetically coupled filter to replace three cartridge filters. The return on investment was less than 3 months.

When they specified the filters, the engineers responsible for the machining centers requested 50µm filtration. This was a bit more stringent than the previous requirement and, therefore, provided a potential opportunity to increase tool life.

Both Zimmeran and Hanfland concurred: Proper cleaning and filtering of coolant leads to longer lasting machines, increased productivity and lower coolant disposal costs. "The right method of magnetic particle filtration will make a positive impact on any metalworking facility," Zimmeran said. △

About the Author

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