Rexroth
Bosch Group

Drive & Control
profile

“Cyclone” concept represents new twist in hydraulic filter design

The filter head is designed to move hydraulic media, and particles, in a spiral motion that enhances flow particles and increases absorption of particles.

Hydraulic fluids flow through filter in a spiral pattern that improves flow, increases absorption capacity, keeps filter cleaner and protects hard-working industrial and mobile equipment from contamination

For as long as industrial and mobile hydraulic equipment has existed, keeping hydraulic fluids clean and free from contaminants has been an ongoing challenge. And that challenge has only increased as new types of fluids are introduced and more is demanded from high-tech

Challenge:

- Prevent debris, dirt and particles from reaching sensitive high-pressure hydraulics, while avoiding clogged filters, reducing the need for replacement or maintenance
- Provide hydraulic equipment operators with advance warning when a hydraulic filter begins to become saturated with particles

Rexroth Solution:

- 110 LE(N) hydraulic filter series with specially developed filter head that propels hydraulic media in a spiral, cyclone-like path
- New filter bowl design for filter mounting
- Cyclone pattern directs dirt particles toward filter bottom, where they can be removed
- Mechanical/electronic contamination indicator for filter monitoring and advance indication of saturation

Benefits:

- Increased reliability and uptime
- Better repeatability and accuracy in positioning for hydraulics
- Improved filter life and reduced maintenance
- Electronic indicator can be added during machine operation
- No need for bypass check valve

hydraulic systems. Greater demands for precision, positional accuracy, repeatability and durability have led to more sophisticated, specialty-engineered hydraulic components such as high-performance valves. Today's industrial applications demand tighter tolerances as well. These developments have had an unwanted side effect: the more sophisticated the hydraulic component, the more damage that dirt and other contaminants can do. Designers have responded over the years by steadily increasing the sensitivity of filters, so that micron-level filtration is not uncommon today.

The science of dealing with filtration issues in actual hydraulic applications, however, has tended to remain rather low-tech: wait until the filter gets clogged, then clean or replace it. All filters eventually become saturated with contaminants and need to be replaced or serviced before reduced fluid flow compromises hydraulic performance. The question becomes, when and how often should maintenance be done? Often, the first sign of a problem is a sudden drop in hydraulics efficiency, which often results in a shutdown until the filter is replaced or cleaned. In some hydraulics applications, a system of regularly scheduled maintenance is used, but this can be inefficient if the system is shut down or filters replaced when there's no need. Filter clogging rates do not generally conform to a user's schedule, either, so sudden drops in machine performance can't always be avoided.

Bypass check valves, another common approach, can keep hydraulics operating longer as dirt accumulates, but they have potential drawbacks. The bypass line can turn into a backflow channel if hydraulic fluid pressure drops below certain levels, allowing contaminated fluid to recirculate through the system and cause damage. The likelihood of this occurring is increased by the fact that once contaminants begin accumulating at a given spot on a filter, they attract even more contaminants at that spot, causing sudden clog forming and pressure drop.

But what if that phenomenon could be avoided through a system that spread the particles out more evenly, and even better, directed the larger, heavier ones away from the filter while the fluid flowed through? That type of system, inspired by the swirling motion of the natural force called a cyclone, has been introduced to the hydraulic world through Bosch Rexroth's new 110 LE(N) "cyclone" filter series.

The filter head for this series of products is designed to force the incoming fluid to veer off at an angle alongside the filter instead of flowing directly through the filter element. The hydraulic fluid deflects off a protective sleeve and flows in a spiral pattern around the filter materials (mesh, fleece, etc.) as it moves down toward the filter bowl. This ensures that heavy dirt particles are transported to the outside away from the filter pores. Contamination residue is more likely to accumulate in the indentations of the filter bowl, rather than in the filter itself. This residue is then simply removed from the bowl.

The new design results in a filter that is not only more efficient (thanks to the hydrodynamic effects of the cyclone pattern) but is more durable as well. A pressure spring in the filter orients the filter element to

The filter bowl design improves filter element mounting and stability and helps to ensure constant pressure distribution.

the grooves in the filter bowl bottom and protects the filter element from uncontrolled movements due to flow and vibration. The filter bowl bottom's design helps to distribute the pressure evenly and prevents overburdening of the filter in demanding applications. The useful life between maintenance can be greatly extended, compared with standard filters, because the "cyclone" filter takes longer to become saturated.

Of course, sooner or later, the 110 LE(N), like all filters, will eventually become saturated with contaminants and need servicing or replacement. That's where another key feature, an electrical "early-warning" indicator, comes in. A yellow traffic light comes on and sends a signal to the control. The indicator tells the maintenance personnel that the element is at 75 percent capacity and replacement should be scheduled. At 100 percent capacity the red light indicates it is time to replace the element.

The mechanical/electronic contamination indicator gives operators advance warning when filter maintenance will soon need to be performed, without opening the hydraulic line.

In addition, a spring-mounted red pin pops up automatically from the filter head when fluid pressure drop is above a certain set point, also indicating that the filter has reached critical operating condition. This reduces the time, effort and expense of maintenance. “Because operators get advance warning (75 percent capacity) when the system needs attention, filter elements won’t be changed unnecessarily just because of fixed maintenance schedules,” says Ken Traub, Director, Bosch Rexroth Filtration Systems. “The operator will know when to change it, before performance declines significantly.”

In some applications, a mechanical indicator may be less than optimal because the filter may be difficult to see. That’s why there’s a second option: an electronic indicator that can be fastened on top of the mechanical indicator and provides color signaling to indicate the filter’s condition. Just like a traffic light, a green light means the filter is less than 75 percent saturated or go; at 75 percent capacity, a yellow light appears, followed later by a red light means the filter is 100 percent saturated. “It’s important from an operational safety standpoint and uptime,” Traub says. “You no longer have to stop the machine or open up the hydraulics to check the filter’s condition or simply replace the element when checking.”

The filter element itself also adds to reliability and decreases maintenance concerns. It features six layers of asymmetrically arranged inorganic glass fiber media. The combination of filter layers achieves high efficiency and dirt-holding capacity, while keeping pressure loss to a minimum. The filter material is star pleated, positioned around an internal, cylindrical support tube and wrapped in a protective sleeve made from perforated plastic film. This protects the filter against mechanical damage and ensures that the hydraulic fluid flows evenly to the entire filter area.

The “cyclone” filter concept promises to bring significant benefits to hydraulic applications: greater reliability, better machine performance and more efficient maintenance. The filter can be cleaned without replacement via the filter bowl detents, which collect larger particles at the bottom of the filter bowl, and when replacement becomes necessary, it can be accomplished before the accumulation of particles impacts performance. The installation of an electronic monitoring system is relatively simple—as is the installation of the filter itself, which protects hydraulic performance without need for a bypass check valve.

The advantages of the “cyclone” design have already been recognized in a prestigious international competition that recognizes high functionality and innovative design: the 2011 iF (International Forum) Product Design competition. The award, recognized worldwide for identifying quality design, was presented in 16 categories involving 2,756 entries.

Time will tell if this type of recognition and innovation translates into acceptance for the 110 LE(N) hydraulic fluid filter. But the filter’s “cyclone” flow approach is a good example of a new concept in engineering that offers enough user benefits that it just might take the world of hydraulics by storm.

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