DUAL-STAGE MAGNETIC FILTRATION SHOWN AS EFFECTIVE IN REDUCING FLUID CONTAMINATION

By One Eye Industries

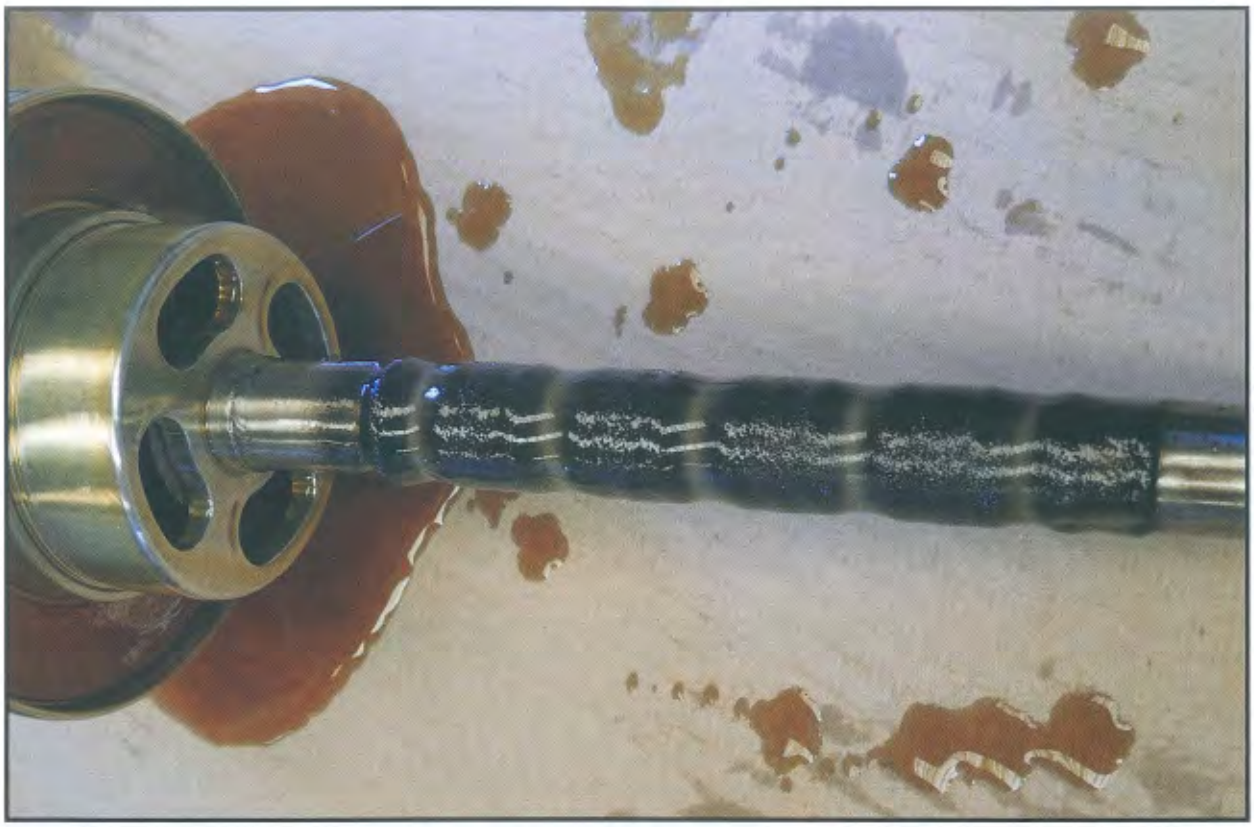

Figure 1.

In the fast-growing industry of wind power, new technologies for gearboxes, blades, rotors, and other major components are emerging every day but something that is often overlooked is the root cause of most turbine failures.

Gearbox and hydraulic system failures make up the highest number of failures in the wind power industry, resulting in fire, shutdown, and loss of production. In order to minimize the downtime and costs associated with replacing a failed gearbox, don't let it fail. In order to reduce failure of gearboxes, find the root cause of the failure. In the majority of cases the root cause is contamination (mostly ferrous metals and silica dust) wearing the gearbox components prematurely. This contamination is the result of the machining process, airborne ferrous metal, break-in wear and is even found suspended in new hydraulic fluids, gear oils and glycol.

Research indicates that contamination under 10 microns to sub-micron in size is the most damaging to components in gearboxes, fuel, coolant and hydraulic systems. Advancements in machining tolerances for transmissions and gearbox bearings, shafts and seals, and hydraulic valves, seals, and actuators, are now three microns in size and lower, so filtration able to remove contamination below this level is essential.

The first step in reducing this wear is to create a proactive hydrocarbon

Figure 2.

Figure 3.

management program. In one regard ensuring that the oils, hydraulic fluids, and glycol used in the operation of the turbine are of good quality and are stored properly in a warm, dry location, closed off from the elements. The second step involves eliminating these wear particles, which is essential in maintaining the longevity of the fluids and the wind turbine.

New magnetic filtration technology developed by One Eye Industries offers the ability to remove ferrous and non-ferrous contaminants and protect the system from particles down to sub-micron levels. Traditionally, ceramic magnets have been used to filter hydraulic fluid and gear oil, but these offer minimal ability as the strength is low resulting in its inability to remove contamination below 10 microns. Another problem ceramic magnets pose is that they need to be in direct contact with the fluid to ensure the strength is not limited. This poses a contamination issue as the magnet is susceptible to vibration and temperature and can crack resulting in magnetic particles travelling through the system and attaching to metal components such as bearings. These in turn cause wear to the bearings and shafts.

GEARBOX

There is a link between failures of lubricants and failures of equipment. Oil analysis data will detect particles of contamination and degradation and the proper use of this information can detect the chance of a failure.

In November 2013 a wind turbine company in Taranto, Italy was finding it difficult to remove contamination below 20 microns using traditional filtration. This contamination was prematurely wearing the bearings, gears, and shafts of the turbine gearbox. Alex Priori of Renox suggested installing a dual-stage magnetic filtration system to increase the filtration efficiency to sub-micron levels, protecting the system components.

After seven months in operation, the magnetic filter removed a large amount of contamination from the gear oil. Analysis of the trapped particles indicated 48.3 percent was ferrous and 51.7 percent non-ferrous, down to 1 micron in size. "The company was amazed by how much contamination was retained by the magnetic rod," Priori said. A bearing

Figure 4.

failure in a wind turbine gearbox can cost an excess of $500,000 plus the downtime of production. The magnetic filter has a holding capacity in excess of 12 ounces (0.34 kg) before cleaning is required.

HYDRAULICS

Hydraulic systems operate at under 1 micron tolerances, yet most traditional filtration is nominally rated to 3 microns. These ratings can be misleading, as nominal indicates that throughout a number of passes at one time a particle of 3 microns will be trapped by the filter. Patented rare earth magnetic filtration systems trap contamination to sub-micron levels at 97% efficiency.

In February 2014, a Diamond Mine North of Yellowknife in the North West Territories had a problem with dirty hydraulic fluid with an ISO of 25/24/16 on their 5500 Komatsu shovel operating with a 4500 PSI hydraulic system. Traditional filtration was not able to meet their minimum ISO standard of 18/16/13 with the limited 3-hour kidney loop filtration interval. Mark Robillard of Kingland Ford Mining Division suggested employing the OEI high flow magnetic filtration skid as it guaranteed this minimum ISO standard.

On its trial run, fluid samples were taken before and after the unit and sent to three independent labs. Common results showed that not only had the kidney loop met the anticipated standards, but exceeded them — retaining a cleanliness level of 17/14/10. The analyzed contamination on the magnetic filter rods identified ferrous (88 percent) and non-ferrous (12 percent; mainly consisting of carbon and calcium) contamination ranging from 100-plus microns to sub-micron in size.

The diamond mine maintenance manager is very pleased with the results and is incorporating other OEI filtration solutions.

In May 2008, Newcrest Mining's Cracow Gold Mine was finding large amounts of metal contamination were being missed by their traditional filters, degrading the fluid viscosity in the hydraulic cooling system of their Symons 4 1/4' Cone Crusher. After suggesting they replace one of the OEM filters with an OEI ADD-Vantage 9000 dual stage magnetic filter a 64-hour run was conducted. The amount of trapped contamination is shown in the adjacent photo. Newcrest anticipated that had this not been captured by the magnetic filter it would have found its way back to the valves, motor and hydraulic pump. As part of the continuous improvement program at this site other pieces of critical plant equipment have been identified as benefitting from magnetic filtration technology.

COOLANT

With the price of glycol constantly on the rise, wind operators are looking at ways to reduce the consumption of this substance. Most coolant

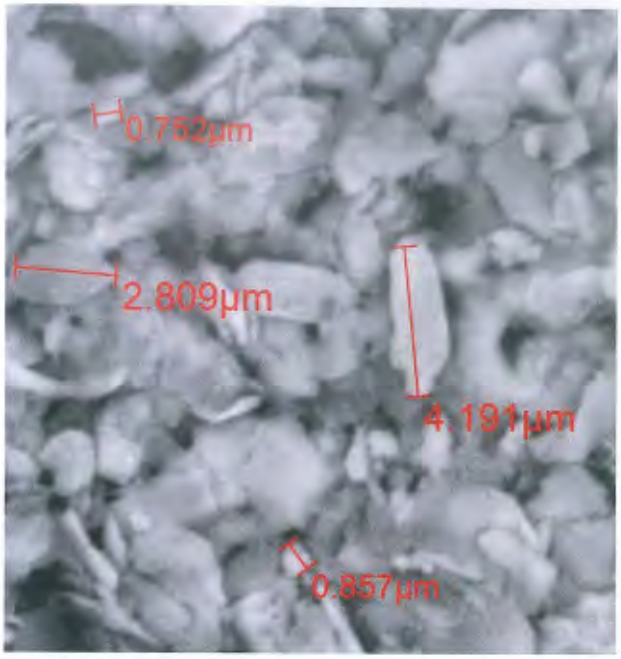

Figure 5.

lines have no filtration, but with the employment of rare earth magnetic filtration contamination is removed to sub-micron levels leaving the glycol — in most cases — cleaner than new. Fluid life can be extended by a factor of two to three times.

From 2007 to the present, Chris Hampson has been using magnetic filtration to remove harmful contamination found in the coolant system on his 2007 CAT C15 engine. Chris was experiencing seal wear and pump wear due to ferrous metal contamination in his coolant lines. One Eye Industries suggested the installation of a one-inch Y-Strainer in line of the engine coolant circulation system. After 12,000 km, a large amount of ferrous contamination was trapped. In June 2014 at the annual PM period, Chris is still finding a large amount of contamination trapped on the rod (see Figure 3). If left in the fluid, these metal particles will prematurely wear the water pump and radiator components and degrade the quality of the glycol.

SAFETY

Magnetic filtration offers a highly efficient, environmentally friendly solution to improve filtration capabilities. By employing this reusable, cleanable technology, the life of the components and fluids can be extended resulting in extended PM intervals, in turn reducing the risk of injury as the technician's contact and time to and from site is reduced. This should have a positive effect on insurance costs.