It pays to keep lube oils super clean

BALANCED CHARGE PURIFICATION REMOVES PARTICLES OF 1 MICRON SIZE

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Particulate contamination in turbomachinery lubricants is an ongoing problem that results in the less-than-optimal operation of equipment. The central issue here concerns small particulates that gradually cause mechanical wear. Coupled with water contamination, these small particulates can cause corrosion of metal surfaces and accelerate the oxidation of the lubricant, leading to increase in capital costs.

The clearances between sliding surfaces in turbomachinery components such as ball bearings, gears, vane pumps and servos can be quite small, making small contaminates a big problem in lubricating oil. Average clearances have been found to be between 0.1 and 500 microns.

Most of the conventional filtration equipment is effective in removing particulate down to the 10 micron range. Fine filtration systems are effective in catching particles that are between 3 and 5 microns in size. Particle size analysis of contaminants typically found in lubricants shows that over half of these contaminants range in size from 0.1 to 5.0 microns.

Small particles increase wear

It has long been thought that only large particulate contamination is the major cause of mechanical wear. Improved research and measuring standards in the field of tribology (the study of wear and lubrication) has revealed that particle size is very important in determining the cause of machinery breakdown.

The graphs on the right show a high concentration of contaminants in the 0.1 to 5.0 micron range. They also show that the 0.1 to 5.0 micron particles have high hardness. Over time the number of small particles increase, which coincides with the potential for equipment damage.

Much of the discussion about particles so far has centered on those metallic in origin. But small particles can also be generated from decomposition of the lubricant. Excessive heat, water contamination, aeration and metal particles can oxidize the lubricant leading to the formation of oxide-insoluble particles.

These chemically insoluble particles tend to be small (one micron in size) and highly polar in nature. They also tend to be attracted to the surface of machinery which also carries a charge. This sets the foundation for the formation of varnish as more particles adhere to the surface. Once water is introduced into the system, the varnish can easily turn into sludge.

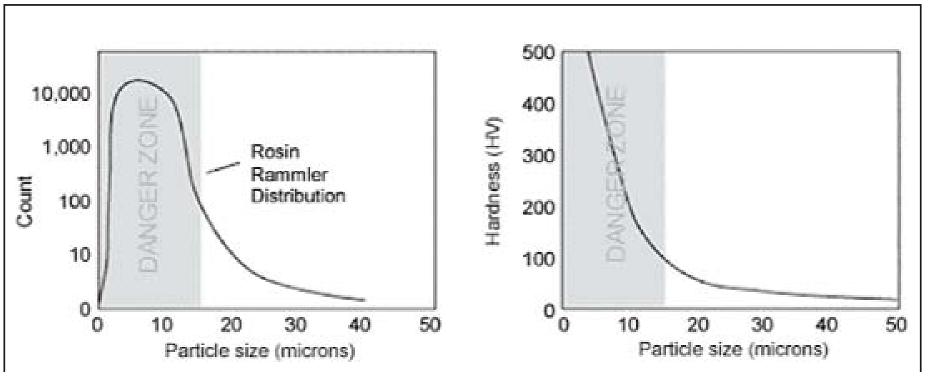
Oil filtration is an absolute necessity as the first step in protecting industrial machinery. Filters, while good at removing medium- and large-sized particles, are not the answer when small particulate removal is required. The cost of a filtration system might seem attractive at first glance but increased maintenance, machine downtime, part replacement, and oil quality become very costly when the small particles are not removed. Water removal, air release, and sludge removal all remain costly issues with the use of filtration alone.

Another method of particle removal is Electrostatic Precipitators (EP). These devices charge particles in a unipolar fashion (i.e., all the particles are charged in only one direction) to achieve cleaner oil. This process involves charging all of the particles either negatively or positively and then using a grounding plate with the opposite polarity to isolate them from the system. One drawback of this approach is the high voltages (between 75,000 V and 100,000 V) that are required.

EP units are highly sensitive to water, and have problems when the water content exceeds a meager 0.5 percent. Water in the system can cause shorts between the charging electrodes and collection plates. For a variety of technical reasons, EPs are flow-rate limited. Most EPs operate at or below 1.0 gallon per minute, with the highest flow versions coming in at 2.8 gallons per minute.

Still another method is a centrifuge. These devices are usually called upon when contamination levels are very high and full of large particles, and when there is a high water content. Centrifuges are a common solution for the maintenance of turbine and hydraulic oils. They are good at large particle removal. In fact, they are a preferred solution in certain machining applications, where the quantity of large-particle debris makes them the only viable solution.

However, medium-sized (10-30 micron) particles are difficult to remove, as these particles tend to stay with the oil during the separation process.



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Small particles have higher hardness values

Centrifuges are ineffective at fine filtration (less than 10 micron) and ultra-purification (less than 3 micron).

The particulate separated by a centrifuge does not exit the system easily. Instead, it tends to cake on drum surfaces. This caked sludge must be removed manually by plant maintenance workers, adding several man-hours per week per centrifuge. This results in higher man-hours and maintenance costs.

Centrifuges are metal drums spinning at high speeds and gravity force. Therefore, periodic breakdown and repair is common, causing strain to capital budgets.

New process cleans more

Balanced Charge Purification (BCP), a proprietary process developed by Isopur Fluid Technologies, Rocky Hill, Connecticut, removes sub-micron contaminants from lubricating oils. In this process, the fluid is split into two streams and given a positive and negative charge. Once a balanced charge is achieved, the opposite charges attract. The result is an agglomeration of the particles, making them larger in size and easily removed with standard filtration.

The key to the process is to separate the fluid into two streams and charge the particles with an equal amount of positive and negative charge to ensure that the overall system remains neutral. In effect, BCP neutralizes a charged system enabling the balanced distribution of negative and positive particles to attract and combine into larger particles. The input power in BCP ranges from 115 V to 480 V.

BCP is successful because the extremely high flow conditions (from 50 to over 1000 gal/hr) force particles to come in contact with the electrodes. Tests have concluded that sufficient numbers of oppositely charged particles are available to attract each other. Electrical charges can also be bumped from one particle to another. Larger particles will tend to bump into more particles and lose their charge more often than smaller particles. The result is that the charges will more likely end up on the smaller particles.

While particles are being charged, mineral oil remains neutral and is not affected. Other lubricant base stocks are being evaluated and testing is underway with lubricants based on polyol esters, diesters and polyalkylene glycols.

Isopur's BCP technology is effective with water concentration levels up to 20 percent. Higher levels might benefit from a coalescer to remove water from the lubricant. However, this technology is not designed to operate on oil and water emulsions used for machining or high pressure hydraulic emulsions.

Gerald Munson is a co-founder of ISOPur (1995), developer and patent holder of the Balanced Charge Purification technology. Prior to co-founding Isopur, he was vice president of ITP Corporation where he was instrumental in developing other solid-liquid separation technologies. (for more information on BCP, contact Keara Langston at klangston@isopur-fluid.com)