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VISWA LAB. FUEL ANALYSIS

BULTEN #10

"Viswa Lab.'in sahibi olan Dr. Vis'in "Marine Lube Buyer" dergisinde Mart ayinda yayinlanan makalesi uc sayfa olarak ilisiktedir. Calismalarinizda faydali olacagini umariz."

Sound maintenance of hydaulic oils can prolong a system life indefinitely

Dr. R. Vis President director of Viswa Lab Corporation of Houston, Texas, looks at the problem of particle contamination in hydraulic oil and how best it can be monitored

Contamination is the biggest single cause of excessive wear of machinery parts. The reliability and the useful life of a hydraulic system are directly linkedto contamination control..Manufacturers of bearings bluntly state that if particles larger than the lubricant film can be kept out of a system, bearings can have infinite life!

As this article will examine in more detail later, impurities can enter a number of ways, including air vent pipes, filler caps and shaft seals. The damage potential of these particles dependsupon their number, size, weight, hardness and shape.

Size compared to film thickness is critical, since this determines the ability of the particles to destructively enterthe contact zone. Also crucial is the time the particles stay in the oil before being removed by filtration and purification.

All destructive contact causes surface abrasion, fragmentation and sedimentation. How much it causes depends on the hardness and angularity of the particles. But with aech destructive contact, wear debris is produced which in turn generates more contaminating particle.

Relationship between particle size and wear

The presence of particles in lubricants is measured by ISO Code 4406. Under this system, a code value of 16/13 means that the sample contains between 320 and 640 numbers of particles Per millimetre of 5 micron size (representing 16) and between 40 and 80 numbers of particles of 15 micron size(representing 13).

In general, the smaller the size of the contaminating particles the more numerous they will be. It is also generally true that smaller the size of the particle, the greater their hardness.

This means that controlling small particle populations is key to wear control.

Setting targets

According to a research study at Imperial College in the United Kingdom, improving the cleanliness of the oil to eliminate particles of less than 10 microns produces a huge life extension in the components.

Contaminants and their effect on oil quality

Contaminant	*Chemical changes in oil*	*Physcal changesin oil*	*Chemical damages to machine parts*	*Physical damages to machine parts*
Solids	Oxidation Additive Depletion	Viscosity effect	Variations and sludge	Abrasion and surface fatigue
Water	Oxidation Additive	Viscosity effect Rust	Acidity destruction	Cavitation Scuffing
Air	Oxidation	Oxidation	Rust and Corrosion	Davitation
Heat	Thermal degration	Viscosity Increase	Varnish Acidity	Film strength loss

In the contrast improving cleanliness of particles more than 10 microns produces only marginal benefits. In the maintenance of a hydraulic system the contaminant level should be monitored frequently and cleanliness targets should be set. For hydraulic sytems a recommended value ISO is 14/11.this means particle numbers per millimetre of between 80 and 160 of micron size and between 10 and 20 for particles of 15 micron size.

A three-year controlled field study by the British Hydromechanics Research Assocation (BHRA) on hydraulic systems, including marine hydraulics, has concluded that if the average ISO Code cleanliness level is improved from 18/15 to 14/11, the relative life factor increases by 3.2 times and the average time between breakdowns increases from 1,050 hours to 3,800 hours.

Sources of particle contimination

There are three main sources of participle contamination in hydraulic oils. They are:

1. Built in: In this, service debris from repairs, new filter, new oil, dirty hoses and fittings mixes with manufacturing debris such as machining burrs, swarf, weld spatter, abrasives, drill turnings, filings, dust, etc.

2. Drawn in: These are particles ingested from the atmosphere through the breather pipe, end seals, tank openings. It can include particles originating from cargo hadled, deck water, rain/sea water, etc.

3. Generated: Debris generates more debris. Wear on components such abrasive wear, corrosive wear, and mechanical wear itself generates additional damaging particles.

Particle counting

Regular particle counting is essential not only to check particle contamination but also to check filter performance. Needless to say, filtration is a continuous means of capturing and eliminating particles from a hydraulic system.

There are many types of filters, but these will not be discussed in this article. However always check for the brating of filters.

Beta_x = No. of particles greater than x microns before filter / No. of particles greater than x microns after filter

When there are 10 particles of 10 micron size before going through the filter and only one particle of 10 micron after the filter the rating can be expressed thus :

Beta_{10} = 10/1 = 10

Filter efficency = (Beta-1/Beta) x 100 = 10-1 x 100 = 90%

Monitoring hydraulic oils

Monitoring frequency depends on the existing condition of the oil,, the contamination it experiences and the service conditions of the hydraulic system. It is important to set limits on permissible variations in the properties of the oil. The properties to monitor include viscosity, Total base number (TBN), and particles by size and number. There should also be wear metal analysis to identify what type of wear is taking place.

Particle count cleanliness and abrasive wear. Depending on the targeted cleanliness level, a 'caution' level and a 'critical' level of contamination have to be defined and built into the condition monitoring system. This will mean corrective ateps are well before failure occurs.

Viscosity controls the oil film thickness. Viscosity has to stay with in a certain range for the intended purpose. As with cleanliness levels, the level of variation in viscosity that can be tolerated has to be defined. Oil in service is aged to oxidation, polymerization, cracking, hydrolysis and evoporation. These tend to alter fluid properties such as densityt and viscosity.

Frequent monitoring, proactive maintenance and emphasis on cleanliness will ensurre a long and trouble free life for hydraulic.