Tips & Tabs is a free news letter for Private circulation to all our esteemed customers and friends in the industries. Forward it to all those who are involved in machine maintenance, design and interested in technical matters.

Hymat Services

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Filter Economy - Insider Tips on Managing the Costs of Lubrication Filtration

There is a price tag for removing dirt from oil. For large plants and fleets operating in dusty environments, the cost can be substantial – hundreds of thousands of dollars per year. Of course we all know that contamination control is optional, like dental hygiene – we don't have to brush all our teeth, only those we want to keep.

That said, where quality filtration is needed, we still have a few options to get the most cleanliness for the fewest filtration dollars. After all, throwing money at the problem doesn't take brilliance; however, achieving oil cleanliness at economy rates is the domain of the astute maintenance professional.

First Priority - Stop the Ingress

It goes without saying that filters last longer when they don't get plugged with particles. Therefore, the best strategy comes from working backward by tracing the particle ingression pathway (**Figure 1**).

Dirt (D) and Water (W) Ingression 100%

Contributing Source		Bath and Splash Gears and Bearings	Circulating Lube Oil Systems	Hydraulic Systems	I.C. Engines
Service Debris Parts and Repairs	D	5%	10%	15%	5%
	W	10%	10%	10%	5%
Oil Changes and Makeup Oil	D	10%	20%	15%	10%
	W	5%	5%	5%	5%
Oil Seals (Shaft, Cylinder Rods, Etc.)	D	15%	15%	30%	5%
	W	5%	5%	15%	5%
Headspace and Ventilation	D	30%	40%	30%	5%
	W	80%	60%	70%	15%
Generated Debris	D	40%	15%	10%	25%
	W	0%	0%	0%	0%
Combustion Gases (Blow-by), Coolant Leaks Process Steam	D	0%	0%	0%	50%
	W	0%	20%	0%	70%
Totals	D	100%	100%	100%	100%
	W	100%	100%	100%	100%

Example Ingression Sources Proportioned

Figure 1.

Follow the Contamination Trail Backward : After all, particles are not an ingredient in a lubricant's formulation or an item on a machine's bill-of-material. Perform a walk-around inspection from the standpoint of ingression. Imagine yourself as a 10-micron particle… how would you get into the machine's lubricating fluid? Then start the process of exclusion by systematically blocking these free-pass entry points. It is often said that the cost of excluding a gram of dirt is only about 10 percent of what it will cost you once the dirt is allowed to get into the oil (**Figure 2**).

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1. ***L&T (Defense & Aero Space Projects).***
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Over All more than 200 satisfied and repeat Customers.

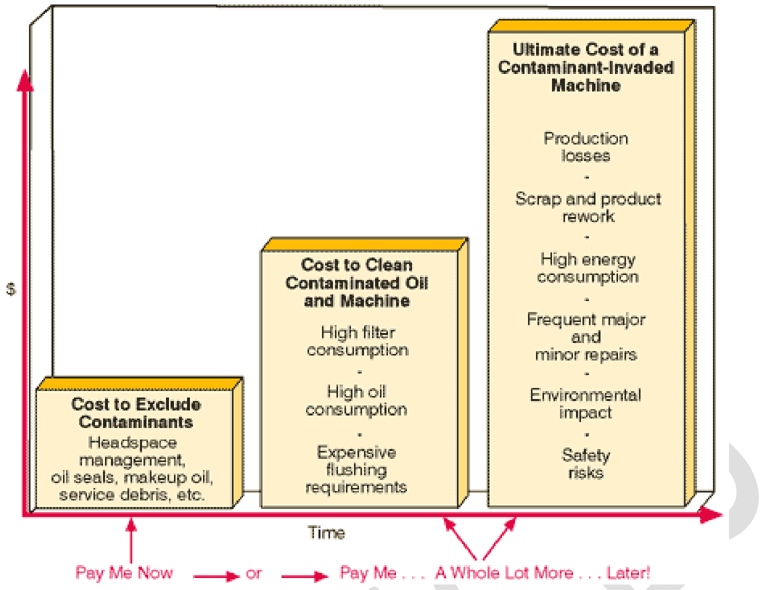

Figure 2. The Cost of Contaminant Invasion

Second Priority – Select Filterable Oil

Consider testing the filterability of your oil, especially if your plans are to filter at five microns or below. Even if your new lubricants are relatively clean, they may be simply nonfilterable (or poorly filterable). A related article on filterability testing[1] can be found at www.machinerylubrication.com.

There are several contributing factors that cause impaired fluid filterability. For instance, many new lubricants may have soft, organic impurities or metal soaps that contribute to premature filter plugging. Some of this filterable material may be undissolved additives or perhaps stringy polymeric additives (perhaps VI improvers or pour point depressants) that partially restrict flow through fine pore-size filter media.

Another possibility is old oils with an increasing population of very small particles (ghost riders) that remain largely undetected by standard particle counting or microscopic analysis. While these particulates may be smaller than the mean pore of your filter media (say less than two microns), through a mechanism known as secondary and tertiary flow restriction, the filter can become rapidly plugged by these particles which the filter was never intended to remove. In many such cases, an oil change may be a more economical solution than filtration.

Undissolved moisture (above the oil's saturation point) can also shorten a filter's life. Water has a tendency to absorb into the pores of cellulose media or adsorb onto filter media fibers. In either case, the presence of water can shorten filter life and may even impair the structural integrity of the filter media. Water also contributes to oxidation and hydrolysis of the oil which can produce gums and resins, leading to filter plugging.

The filtration of cold oil may exacerbate all of the problems mentioned above. What was dissolved often becomes undissolved (and filterable) when the oil is cold. So too, the higher viscosity that comes with cold oil in some systems may trip a filter change indicator prematurely.

Third Priority - Select Economy Filtration

This can be broken down into two categories: economic filters and economic filtration – different concepts but still intrinsically intertwined. Economic filters relate to such considerations as filter size, media type, dirt-holding capacity, etc. Economic filtration relates to the system and operating conditions such as flow density, pressure, filter location, use of multiple filters, use of centrifuges, etc.

Following is a list of factors and conditions that, with few exceptions, improve filter and/ or filtration economy.

Low Filter Pressure – Spin-on filters and even disposable cartridge filters that are designed for high-pressure systems generally cost more for the same dirt-holding capacity than most low-pressure filters.

Low-collapse Filters* – High-collapse hydraulic filters generally don't have bypass valves. The filter elements are robustly constructed to resist desorption, media migration and collapse. All of this is pricier compared to more common low-collapse filters.

Oversized Filters – The lower the oil's flow rate relative to the maximum allowable element flow rate (catalog flow rate), the better the filter economy (Figure 3). This is also referred to as flow density. For instance, doubling the size of a filter may triple the dirt-holding capacity (and triple the filter's service life) but may cost less than twice the price.

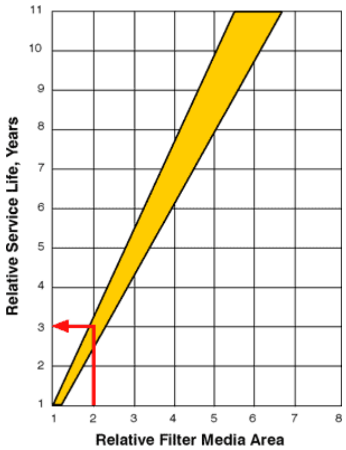

Figure 3. Filter Size Effect (Element Area) Double the size of the filter and you can triple the service life (dirt-holding capacity).

High Dirt-holding Capacity Elements* – The technologies used in filter media and filter element construction vary considerably. For instance, mean fiber diameter, pore density, pore depth, tapered pore structure, and cladded media are design factors that influence the dirt-holding capacity of a filter. There are also differences in pleat and element construction that influence media area per filter element unit volume, which in turn influences oil flow density. The element construction also influences the risk of pleat movement which can pinch off oil flow. As mentioned above, the lower the effective flow density, the higher the dirt-holding capacity and the longer the filter's service life. Most filters are tested to ISO 16889 or ISO 4548, which reports information on dirt-holding capacity (Figure 4).

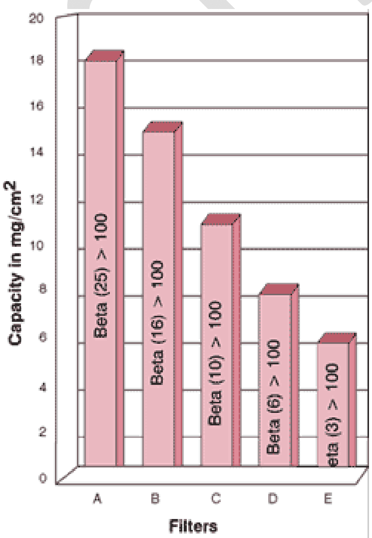

Figure 4. Mean Pore Size Effect Same basic media technology. Going from 10 microns to 3 microns, dirt-holding capacity is cut in half.

Series Filtration* - Two or three filters arranged in series have been found, in some cases, to improve filtration economy. The oil passes through coarse, lower-cost filters before reaching the final polishing filter. Most of the dirt is removed by these lower-cost filters first, allowing the more pricey polishing filter to have extended service life.

Warm Oil Filtration - Arranging filters to be located upstream of heat exchangers can extend service life as well. The lower viscosity of the warm oil enables the oil to flow more easily through the filter media delaying the time to reach the terminal pressure drop (filter change alarm). As mentioned, warm oil also improves fluid filterability. However, exceedingly high oil temperatures present many other challenges such as premature oil oxidation.

Cleanable Filters* - There are a couple of filter designs that allow filters to be cleaned and reused. In such case, one must consider the labor cost to perform the cleaning operation. *May compromise filter capture efficiency (Beta Ratio) in certain cases.

Fourth Priority - Change Filters on Time

Changing a filter too late puts the oil and machine in jeopardy. Changing a filter too soon wastes valuable resources. It has been reported that in many cases, the cost of a common oil change can exceed 10 times the apparent cost of the oil and associated labor to change the oil. This multiplier may hold equally true for the cost of a filter change. In addition to the cost of the filter, there are additional costs for labor, inventory, scheduling, used filter disposal, waste oil disposal, and oil top-off costs (you always lose a little oil when you change filters).

There are many available technologies to help improve the timing of a filter change. These include pressure-rise profile monitoring, delta-P indicators, bypass indicators, on-line particle counting, and time-out alerts. Multiple methods used together may be the wise choice in certain cases. Nonetheless, changing filters on condition should be the primary objective in the quest for filter economy.

We all know that filters are consumable machine components. They have two primary jobs to do: 1) remove particles at the same rate that they arrive into the oil and, 2) protect sensitive machine components from contaminant invasion. Conventional wisdom tells us to focus on the value proposition presented by better filtration, not on the cost of filtration. However, the astute maintenance professional may choose to have his cake and eat it too.

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Source & Related Reading : Mike Day. "Filterability Testing of Paper Machine Oils." *Machinery Lubrication* magazine, November-December 2001.