



That Mobile Cart might not be the best choice!

By: Steffen Dalsgaard Nyman & Jimmy Pfaffenberger

Mobile filter carts are great tools for transferring oil from one container to another or a machine. They can also be a good option to clean up a system after a contamination incident. Companies striving for best practices and optimum machine reliability will agree that a combination of keeping out (excluding) oil contaminants and off-line fine filtration are the most cost effective way of keeping the oil clean.

If you are like many other people, think that a mobile filter cart used here and there will do the trick, then this paper might be an eye opener for you!



Mobile filter cart > varnish on valve spools



Continuous off-line filtration > clean valves





Myths and facts about why a mobile filter solution isn't ideal:

Myth 1

Mobile filter units work well on hydraulics and will work on more viscous oils as well.

Fact 1

It's easy to push low viscosity fluids through the system and do ultra-fine filtration, but trying to use the same filter unit for viscous oil e.g. gear oil, can send the filter into bypass immediately thus allowing the oil to move through the unit unfiltered.

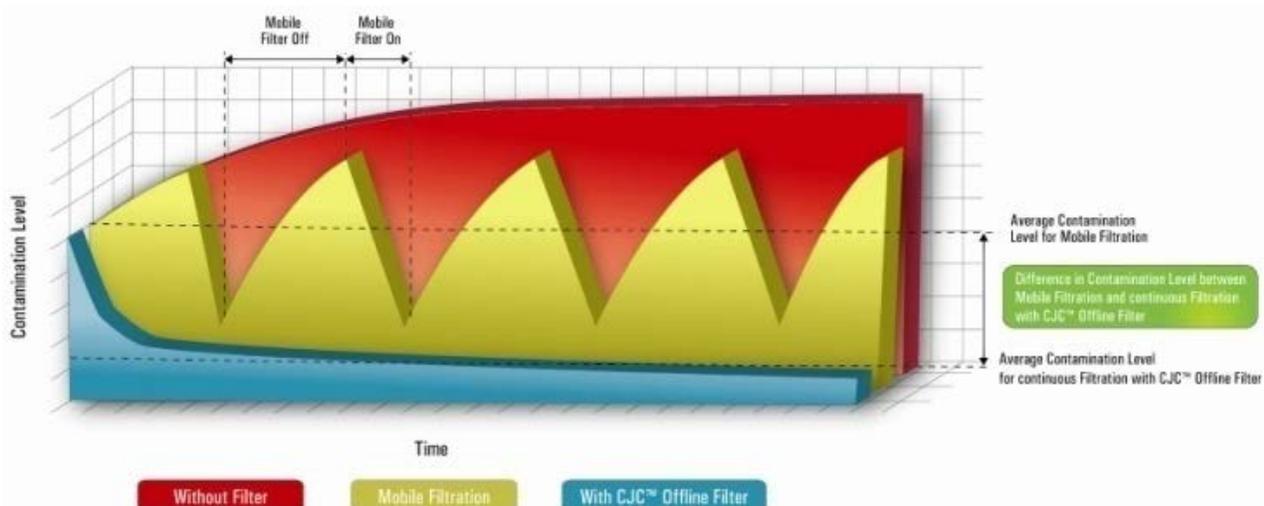
As the oil passes through the filter media, a pressure differential is created. Factors influencing pressure differential across the filter include filter pore size, total filter media volume (surface & depth), fluid viscosity, flow rate, temperature and the oil contaminant level. The filter should be selected to optimize performance.

Myth 2

Mobile filter units give a great ROI, because one unit can be used for several machines.

Fact 2

Every time the mobile filter unit is moved, the contaminant levels in the oil increase and the system gets dirty again (see drawing below). Thus, you are not actually realizing the full benefit of maximum oil life that can be achieved with continuous off-line filtration.





The red curve shows a system with poor filtration while the blue-green curve shows the optimum state which can be achieved with continuous off-line filtration. The yellow saw tooth curve illustrates how the oil cleanliness fluctuates when connecting and removing the mobile filter unit. The average oil cleanliness is much dirtier than the optimum.

The benefits related to clean oil improves vastly with better ISO cleanliness codes. A dirty oil at ISO 22/20/17 cleaned to 19/17/14 will extend the hydraulic component life by a factor of 2. Cleaning the same oil to ISO 16/14/11 will result in a life extension factor of 5 per the Life Extension Table from Noria Corporation shown below. This results in an extension of life of 1.5x compared to using a mobile unit in short intervals.

LET – Cleanliness Level ISO Codes, Complete										
	Expected Cleanliness level (ISO Code)									
Current Machine Cleanliness (ISO Code)	21/19/16	20/18/15	19/17/14	18/16/13	17/15/12	16/14/11	15/13/10	14/12/9	13/11/8	12/10/7
24/22/19	2 1.6 1.8 1.3	3 2 2.3 1.7	4 2.5 3 2	6 3 3.5 2.5	7 3.5 4.5 3	8 4 5.5 3.5	>10 5 7 4	>10 6 8 5	>10 7 10 5.5	>10 >10 10 8.5
23/21/18	1.5 1.5 1.5 1.3	2 1.7 1.8 1.4	3 2 2.2 1.6	4 2.5 3 2	5 3 3.5 2.5	7 3.5 4.5 3	9 4 5 3.5	>10 5 7 4	>10 7 9 5.5	>10 10 10 8
22/20/17	1.3 1.2 1.2 1.05	1.6 1.5 1.5 1.3	2 1.7 1.8 1.4	3 2 2.3 1.7	4 2.5 3 2	5 3 3.5 2.5	7 4 5 3	9 5 6 4	>10 7 8 5.5	>10 9 10 7
21/19/16		1.3 1.2 1.2 1.1	1.6 1.5 1.5 1.3	2 1.7 1.8 1.5	3 2 2.2 1.7	4 2.5 3 2	5 3 3.5 2.5	7 4 5 3.5	9 6 7 4.5	>10 8 9 6
20/18/15			1.3 1.2 1.2 1.1	1.6 1.5 1.5 1.3	2 1.7 1.8 1.5	3 2 2.3 1.7	4 2.5 3 2	5 3 3.5 2.5	7 4.6 5.5 3.7	>10 6 8 5
19/17/14				1.3 1.2 1.2 1.1	1.6 1.5 1.5 1.3	2 1.7 1.8 1.5	3 2 2.3 1.7	4 2.5 3 2	6 3 4 2.5	8 5 6 3.5
18/16/13					1.3 1.2 1.2 1.1	1.6 1.5 1.5 1.3	2 1.7 1.8 1.5	3 2 2.3 1.8	4 3.5 3.7 3	6 4 4.5 3.5
17/15/12						1.3 1.2 1.2 1.1	1.6 1.5 1.5 1.4	2 1.7 1.8 1.5	3 2 2.3 1.8	4 2.5 3 2.2
16/14/11							1.3 1.3 1.3 1.2	1.6 1.6 1.6 1.4	2 1.8 1.9 1.5	3 2 2.3 1.8
15/13/10								1.4 1.2 1.2 1.1	1.8 1.5 1.6 1.3	2.5 1.8 2 1.6

The same scenario goes for water too. If the system picks up moisture from condensation or ingress, using a mobile cart in short intervals will still allow the system to be exposed to moisture that can be as damaging as hard particles. (Not all mobile and continuous filter systems include water removal, it is important to include this in your selection requirements).

LEM - MOISTURE Level									
	Life Extension Factor								
Current Moisture Level, ppm	2	3	4	5	6	7	8	9	10
50,000	12,500	6,500	4,500	3,125	2,500	2,000	1,500	1,000	782
25,000	6,250	3,250	2,250	1,563	1,250	1,000	750	500	391
10,000	2,500	1,300	900	625	500	400	300	200	156
5,000	1,250	650	450	313	250	200	150	100	78
2,500	625	325	225	156	125	100	75	50	39
1,000	250	130	90	63	50	40	30	20	16
500	125	65	45	31	25	20	15	10	8
260	63	33	23	16	13	10	8	5	4
100	25	13	9	6	5	4	3	2	2

1% water = 10,000 ppm. • Estimated life extension for mechanical systems utilizing mineral-based fluids.



Myth 3

Mobile filter units will save filter inserts costs. I can use one cart for many applications.

Facts 3

In order to avoid cross contamination from one oil system to another, it is mandatory that the mobile filter housing and hoses are thoroughly drained and cleaned and the filter inserts are replaced before moving the cart to another oil system. Thus, every move will increase labor and filter insert costs. When operating a dedicated off-line filter continuously, the insert will hold more dirt as it loads-up much more evenly.

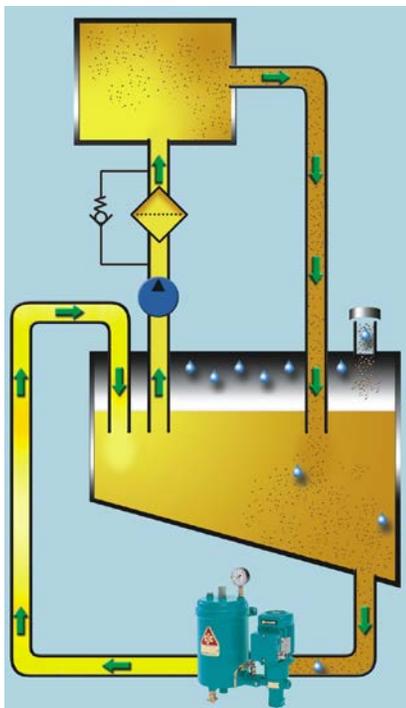
Myth 4

It does not matter where the pickup point is located in the tank when an off-line filtration system is used. The filter will pull in all of the contamination in the tank and clean it thoroughly.

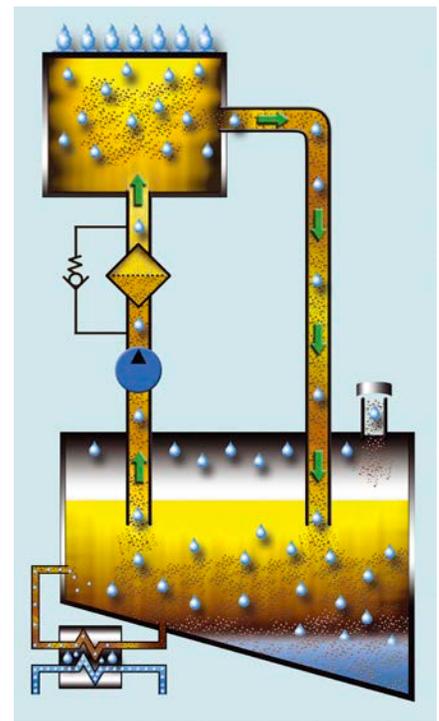
Facts 4

Most contamination (hard particles & water) will gravitate to the bottom of the tank. This is why the pickup point for the machine that

flows through the in-line filter is almost never located at the very bottom of a tank. That is great for the operating machinery, since the oil is cleaner higher up in the tank. Though the job of an off-line filter system is to totally clean all of the oil and the tank too. So It is essential that the pickup is located at the very bottom of the tank, typically using the drain port. We see that many times when a mobile cart is used, they don't spend the time to tap into the drain and use a port that is higher up in the tank or even run hoses in through the breather or fill valve. This could exposes the system to more contamination and will not pick up all of the dirt located in the tank.



System with continuous off-line filtration



Typical system with no off-line filtration



Myth 5

Maintenance staff will move the filter unit every week.

Fact 5

Have you calculated how much manpower it will take to do so and the associated costs?

When the problem is new and is high priority, the filter unit is moved as intended. As soon as the focus turns elsewhere or the electrical connection is needed for something else, then the mobile filter unit ends up forgotten in a corner of the workshop.

Typically, a good off-line continuous filtration system will achieve an ROI in 6 to 12 months depending on the application. If a mobile cart is only used a few times and then forgotten in a corner somewhere or only used during emergencies, the ROI could take years or may never even happen.



Myth 6

Varnish can be removed by an effective mobile filter unit, which can be move to another system when the varnish level is safe.

Fact 6

Do you know what contaminants do to your oil if not removed? See table below:

Sample no.	Catalyst	Water	Time (Hours)	AN Value
1	None	None	3,500	0.17
2	None	Exist	3,500	0.90
3	Fe	None	3,500	0.65
4	Fe	Exist	400	8.10
5	Cu	None	3,000	0.89
6	Cu	Exist	100	11.20



Clean Oil – Bright Ideas

This test was carried out by Noria Corporation. The oil is kept cold and dark for the time indicated in the table and the effects of metal catalysts and water on acid number (AN value - an indication of oil degradation and varnish formation) was evaluated.

You can slow down varnish development by about 50% if you keep your oil dry and clean with a good off-file filter that both removes water and very fine wear metals.

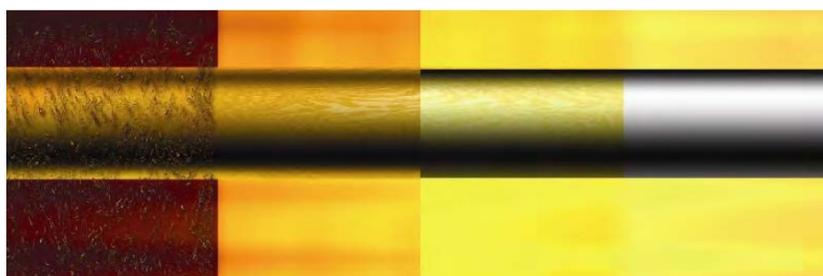
Even the most effective varnish removal technology will initially only remove the soft contaminants suspended and dissolved in the oil (sludge/resins). After the initial oil clean-up, the oil will start to work as a detergent on component surfaces to remove additional varnish and lacquer. This process takes time.

Some technologies also need a restarting period of e.g. 3 hours in order to obtain full operation efficiency.

A mobile filter solution may clean the oil to a certain level, but the chances are low that it will reach the point where you completely avoid varnish plating out in the future.

The drawing below shows the phases in which the oil cleans system components.

While getting from phase 1 to 2 only takes a few hours or days at the most, getting from phase 2 to phase 3 will take weeks or even months and phase 4 can only be achieved with a dedicated off-file filter running 24/7 – 360 days a year.



1

2

3

4



Why jeopardize plant reliability and the risk breaking down machinery worth of millions of dollars?

A continuous operating off-line filter will:

- Warrant optimum oil cleanliness at all times.
- Provide an ideal oil sampling point on each of your reservoirs.
- Add a topping-up point where filtered oil can be added to the machine while it is running.
- Monitor the machine's condition with the filter's differential pressure as an indicator: a rapid pressure increase could indicate a sudden water ingress such as a seal breakage or a cooler tube leak. A pressure sensor connected to an alarm will further enhance this.
- The best off-line filters will continuously remove particles, water and oil degradation/varnish.

More Information

For more information about Off-line Filter Systems for lubricated machinery, please contact C.C .JENSEN, Inc. at ccjensen@ccjensen.com, or call (800) 221 1430, or visit www.ccjensen.com