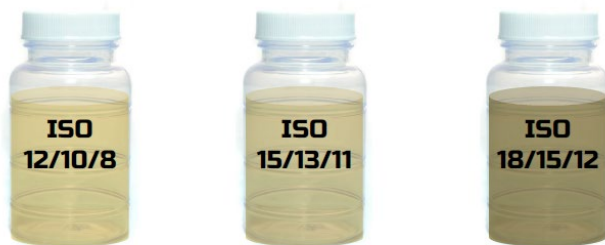


Particle counting - bottle sampling vs. online counters

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Particle counting using
sample bottles

vs.



Using online particle counters
(CJC™ OCM15 on HDU 27/27)

INTRODUCTION

Technicians who use online particle counters on oil systems, can sometimes wonder, whether the ISO codes are correct, being lower than the equivalent ISO code based on a bottle sample.

This is especially true when the oil system is small and fitted with a very efficient “over-dimensioned” offline filter e.g. running 50 percent circulation ratio per hour - meaning the complete oil volume goes through the filter every second hour.

When comparing to bottle sampling, there will always be a difference in ISO codes, but this becomes very significant when the oil system is really clean. This article will explain why this can be the case.



PARTICLE COUNTS

When drawing a sample of used oil, it is utmost important to take great care and follow best practice procedures. Especially when the particle count is part of the oil analysis report.

Some oil properties are not affected by poor sample procedures e.g. viscosity and additive level, but the analysis result for number of particles and amount of water, can be quite different comparing the bottle sample result and the oil operating in the machine. The person who draws the sample plays a huge role, and so does the lab technician.

The strength of an online particle counter is that little to no influence will come from outside i.e. no disturbances or background noise, and of course the ability to sample many times per hour from remote located oil systems.

SAMPLE BOTTLES

Are new sample bottles actually clean? No!

Even expensive Ultra-clean sampling bottles contain approximately 500 particles larger than 4 micron per 100 ml bottle.

This equals ISO code 8/5/0 or higher from the bottle alone.

Reference below from Midland Manufacturing Co. Inc.

MIDLAND MANUFACTURING CO., INC. RIBBED SAMPLE BOTTLE CLEANLINESS REPORT



Five random sample bottles were analyzed for cleanliness by HL-1185, HIAC Automatic Particle Counting using the SDS (Syringe Dispensing System). Reagent grade clean Heptane was the medium used to collect the contaminant in the bottle. Approximate 100 mLs of Heptane was placed in the bottle, up to the fill mark, agitated and counted. The average of two counts are reported.

	Sample report done on 4 oz Clear Ribbed Bottles						Average of 5 samples
	Heptane	#1	#2	#3	#4	#5	
4-6 microns	255	240	240	60	180	285	210
6-10 microns	75	30	30	30	45	75	48
10-14 microns	0	0	30	15	15	0	10
14-25 microns	0	0	30	30	15	0	13
25-50 microns	0	0	15	0	0	0	3
50-100 microns	0	0	0	0	0	0	0
>100 microns	0	0	0	0	0	0	0
ISO Code	9/7/0.7	9/6/0.7	9/7/6	8/7/5	9/7/5	9/7/0.7	8.8/6.8/3.5



When drawing a sample of “semi-clean” oil at ISO 16/14/11, containing up to 64,000 particles larger than 4 micron per 100 ml, these 500 particles from the bottle are insignificant, adding less than 1 percent contamination.

Even if the person who draws the sample is not that careful and let dust from the environment enter the sample bottle e.g. 2,000 particles > 4 μ m, these will still only contribute with 3 percent added contamination to the oil and may not change the ISO 16/14/11.

But when analyzing a super clean oil of e.g. ISO 10/8/5 containing max 1,000 particles > 4 micron, then the 500 particles from the sample bottle contribute to a minimum increase of 50 percent in particle counts !!!!

To ultra-clean oil of ISO 5/3/0 (max. 32 particles), the 500 particles from the bottle increase the count by 16 times!!



To ultra-clean oil of ISO 5/3/0 (max. 32 particles) the 500 particles from the bottle will increase the count by 16 times!!

500 particles per 100 ml in a sampling bottle into super clean oil at ISO 10/8/5

SAMPLE BOTTLES vs ONLINE PARTICLE COUNTERS

Since the “ultra-clean” sample bottles contribute with an ISO code 8/5/0 or higher, it is of course impossible to fill a sample bottle and get an ISO cleanliness lower than approx. ISO 9/6/3. Only the most experienced technicians, both onsite as well as in the lab, will make this low count possible, while most situation will result in 2-3 ISO codes higher. Add to this, that many technicians are using semi-clean sampling bottles, which are washed and reused many times. Experience shows that such bottles can easily add 10 ISO codes to the true particle counting result.



Online particle counters should be calibrated according to ISO 11171, and most types are extremely accurate (less than +/- 0.5 ISO code) with a high repeatability for particle counting.

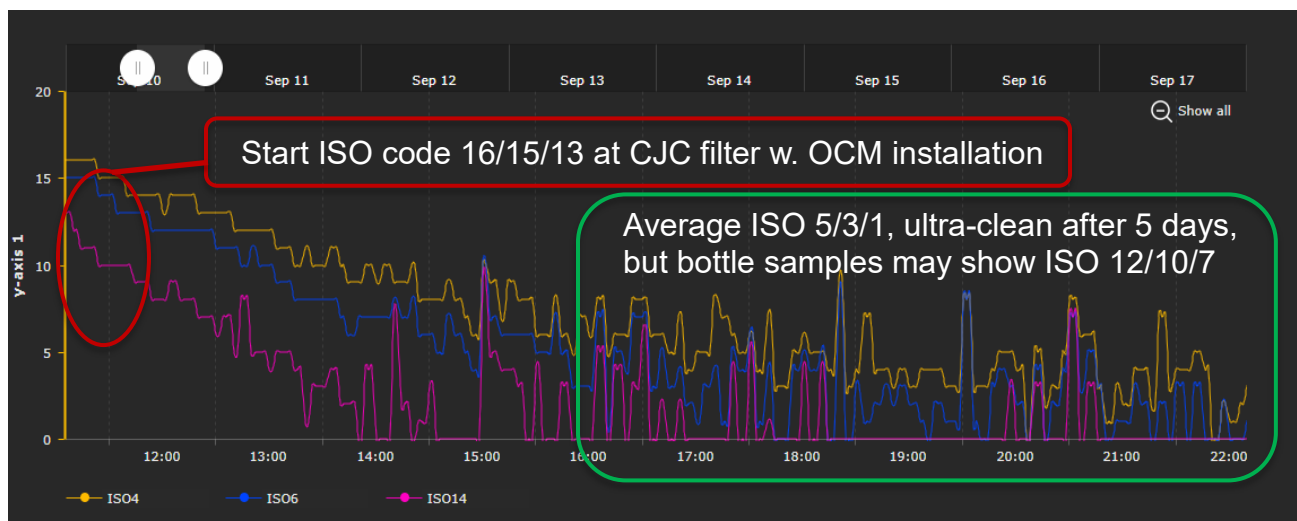
Same oil, but different sampling bottles:
ISO 11/10/7 using new ultra-clean bottle
ISO 22/12/9 using washed reused bottle

Some online particle counters are even insensitive to air and water in the oil (when below 60% of saturation point), therefore counting **only hard particles as part of the particle count**.

In some cases severe varnish contaminated systems can increase the online particle counts to some extent.

Since the online particle count is not disturbed by poor sampling procedures, dirty/un-calibrated lab equipment and badly trained technicians, it will count the true particles in the oil system - and this can be very close to ZERO particles in small systems with little ingress and an efficient offline depth filter with high circulation ratio.

Below example is from a hydraulic system (wind turbine pitch) containing 250 liter oil and a CJC filter running 120 l/h.



In the above situation, the offline installed CJC™ depth filter is turning over the complete oil volume in two hours, and when the wind turbine is not in operation, there is no pitch movement nor ingress, so the hydraulic oil will of course get extremely clean.



RECOMMENDATIONS

1. Follow best practice procedures when taking samples from oil systems
2. Don't change between laboratories, since they may use difference equipment e.g. optical laser counter, pore-blockage/flow decay or Millipore membrane patches
3. When using bottle sampling for particle counting on very clean oil systems, use membrane patch test (test ISO 4407), to avoid that air or water in the oil will influence the ISO code
4. Don't panic if one particle count, out of many, is high. It is often due to poor procedures or dirty sample bottle.
Take a new sample to verify the ISO code.
5. Most online particle counters will count lower ISO codes than bottle samples, and the CJC™ OCM especially - all the way down to ISO 0/0/0. Most other online counters will not count below approx. ISO 8/5/0

CONCLUSION

Taking great care during sampling makes sense, but even so, you will seldom see similar ISO codes for bottle samples and online particle counters. Most often 2-3 ISO classes in difference and possible more significant with very clean oil systems having ISO cleanliness below 10/8/5.

However, like other oil analysis results, your focus should be on the trend e.g. to verify if particle ingress is increasing or a machine bearing is starting to wear out.

Kind regards

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REFERENCES

Noria Corporation: Various papers from Machinery Lubrication Magazine

C.C.JENSEN: Various Online Contamination Monitoring reports

Midland Manufacturing Co. Inc.: Ribbed sample bottle cleanliness report

More Information

For more information about Off-line Filter Systems for gearboxes or any other lubricated machinery, please contact C.C. Jensen at ccjensen@ccjensen.com, or call (770) 692-6001, or visit www.ccjensen.com