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Life Sciences

Hydraulic Particle Counter Sample Preparation

Best practices for repeatable particle count results

Introduction

The number one contributor to an inaccurate Particle Counter sampling result is improper sample preparation. Although it may be well understood in many industrial arenas, like sample testing laboratories, it is quite often misunderstood by the general populace. Improper sample preparation can cause clean fluid to appear contaminated or a heavily contaminated sample to appear very clean.

Impediments to Proper Sampling

- Contaminated collection vessel – Collecting a sample in a contaminated vessel immediately compromises your accuracy. A typical and easy mistake is initially using a clean sample vessel and then continuing to reuse the same vessel on subsequent samples.
- Improper agitation to suspend the resident particles within the sample – Time and technique will differ depending on the fluid type, contamination type and mass, and length of time sample has been in a static state.
- Little or no degassing is performed to remove the entrained air after proper agitation – Degassing can be performed using an ultrasonic bath, or by vacuum degassing.
- Letting the properly agitated and degassed sample stand for an extended period before sampling – (contributes to particle settling) – The prevailing myth is by letting the sample set for an extended time after sample agitation it allows the sample to degas on its own. At first glance, this thinking is logical until you consider gravity is working steadily to drag those suspended particles (especially the larger or heavier particles) to the bottom of the vessel and thus, causing your sample to appear much cleaner that it is.
- Using a magnetic stirrer with the stir speed set too fast – If a little stirring is good, then a lot is better, right? Unfortunately not, too much speed can create a centrifuge affect and actually drive the particles out of suspension to the inside wall of the vessel, effectively taking them out of the sampling path. Also, if you see ferrous metals attaching themselves to the stir bar, you must not use it for that sample fluid or it will skew the reported results.

Basic Process to be used in Most Petroleum Fluid Preparation Situations:

A. Collect your sample in a suitable clean vessel with a clean cap. This is a critical first step. At the completion of your sampling you must perform a suitable and proven cleaning process on your collection bottle before using the same vessel again to collect another sample. 2nd option is to discard the original vessel after use and begin the next sample collection with a new vessel.

B. Ultrasonically agitate the sample to break up any agglomerated particles for 1 (one) minute. The ultrasonic bath fluid level should be halfway up the sample bottle. 1 (one) minute has proven to be adequate for most sampling scenarios, but if your fluid is viscous, you should extend this time accordingly to meet your fluid needs.

C. Handshake the collected sample for 2 minutes. Add additional time if the sample has been static for an extended period or is of a higher viscosity. Mechanical shakers can be used on a setting of 2 (two) minutes. ISO recommends a minimum of 1 (one) minute on a mechanical shaker (ISO 11171 Annex E, Section E4, 2010)

D. Immediately degas in an ultrasonic bath. Again, the ultrasonic bath fluid level should be halfway up the sample bottle. Degas for 25-35 seconds for typical hydraulic fluids with a viscosity range of 10-50 cSt. For fluids with viscosities >50 cSt, you will likely have to extend the degas time to ensure all entrained air is removed.

E. Let the sample stand for 5-10 seconds only to ensure no visible bubbles are present in the sample and then immediately introduce to the counter and begin sampling to prevent settling of larger particles. Additionally, Particle Counting systems like the HIAC PODS+ and HIAC 8011+ employ pressure to move the sample through the flow control and counting elements. While this pressurization is not a substitute for degassing a sample, it does provide a secondary method to further remove any residual air bubbles from the sample.

Figure 1. HIAC PODS System

Figure 2. HIAC 8011 System

Notes of Interest

Stir bars can be used (but are not required) to aid in keeping the 50 µm, or larger, particles suspended especially while measuring larger sample volumes, however, the stir bar must be essentially particle free and stirrer speed slow enough to prevent the centrifuge effect and yet fast enough to suspend the contaminants you are attempting to measure.

Like with all robust and sustainable processes, you will want to minimize variables. The message isn't only to exercise discipline and rigor in your process, but make certain you have all the necessary steps and that those steps are in the correct sequence.

References

ISO, (2010). ISO 11171:2010 Hydraulic fluid power Calibration of automatic particle counters for liquids. Geneva, Switzerland: ISO

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He has created and developed many of the liquid systems production processes and procedural tools for the Beckman Coulter Life Sciences Particle Counting Business Unit products. These products include: HIAC PODS+, HIAC 9703+, HIAC 8011+, ROC and HRLD Sensors. He received his Electronics Engineering degree from DeVry Institute of Technology.

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