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Life Sciences

Detecting Moisture in Hydraulic Fluid, Oil and Fuels

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Abstract

Monitoring the amount of moisture in petroleum based fluids before 100% saturation occurs will reduce degradation and will increase the life and performance of equipment components. Advancements in technology allowed Beckman Coulter to add a moisture sensor to our HIAC PODS+ Portable Liquid Particle Counters. One instrument, one sample, one button, relative humidity percentage, particle count analysis; all in under 60 seconds. Free water is the real issue and it is imperative that you know when free water exists in your fluid.

There's Really Nothing You Can Do

It's inevitable, moisture is going to make its way into your petroleum based fluids (hydraulic fluid, oil and fuel) and there is nothing you can do about it. Moisture can invade your system in three different forms; it can be found as a gas (water vapor), liquid (dissolved in fluid), and solid (free water). Moisture will condense from a vapor to a liquid state as it dissolves into your fluid. The fluid can only take so much "dissolved moisture" before it starts to precipitate free water, and we all know that free water is the #1 contributing factor to costly breakdowns. Free water will create surface corrosion, oxidation, pump cavitation, pump failure, loss of lubricity, bearing damage, hydrolysis, crystallization, foaming, sludge formation and will compromise fuel efficiency and create a loss of power. In a perfect world one would constantly measure moisture levels in fluid so they could predict or determine when moisture goes from being dissolved to "free water ".

One way to reduce, or prevent, the amount of moisture that invades your system is to replace the standard breather cap on your reservoir tank with a hygroscopic breather cap. These hygroscopic caps have a woven-polyester layer and a silica gel desiccant that removes most of the water vapor from incoming air, drastically reducing condensation in your reservoir tank.

Monitoring Moisture using Relative Humidity

Measuring moisture in petroleum based fluids has been around since the 1930's. Common methods are the Fourier Transform Infrared Spectroscopy (FTIR) method and the Karl Fischer (KF) titration method; which is by far the most popular due to the fact that it has been around for nearly 90 years. In short, the KF analysis determines the amount of water by adding reagents into the sample until a chemical reaction is complete. The KF method is complicated, time consuming, and has to be performed in a lab by an expert. Remember, the objective is to monitor moisture levels in your fluid as an early indicator of the eventual development of free water.

Advancements in technology have allowed us here at Beckman Coulter to integrate a moisture sensor (optional feature) into our HIAC PODS+ Portable Liquid Particle Counters. Operators can now run one sample and observe both a relative humidity percentage (RH%) and a particle count. Measuring RH% in petroleum base fluids is very easy with the HIAC PODS+. You prepare your sample, press one button to run the sample, wait 60-90 seconds (sometimes it takes longer when analyzing RH% because the instrument needs a consistent RH% before determining the results). Understanding and interpreting the results is just as easy.

The four bottles in Figure 1 visually illustrates how moisture in fluid transitions from being "not likely to cause to damage" to "catastrophic damage is happening". At 10% RH (bottle A) there is a lot of room for extra moisture to dissolve into the fluid before it reaches a point where damage may occur. You will find that most oil based fluids will have moisture dissolved within the fluid at the point of purchase. Do not be alarmed if your new fluid has 20% RH to 35% RH; in most situations that % of RH will put your fluid in the "Less Likely to Cause Damage". However, once your fluid reaches above 70% RH you may be venturing in the "More Likely to Cause Damage" zone. At 100% RH there is no room for moisture to go, and as moisture increases within the fluid it will not dissolve, moisture will become free water. Monitoring your fluids RH% will allow you to determine when to replace your fluid, or will provide insight to when you should remove moisture from your fluid. Monitoring your fluid's RH% will increase the life of your equipment, improve efficiency of the fluid, and will reduce unplanned downtime.

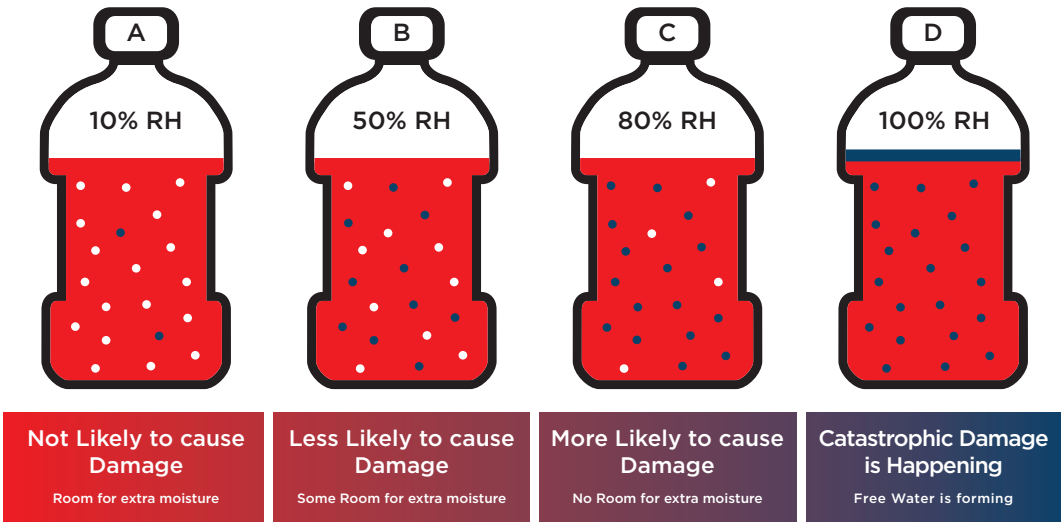

Figure 1

Frequently Asked Questions

Q. What does a moisture sensor do?

A. A moisture sensor detects the amount of dissolved water in petroleum based fluids in percentage of saturation or Relative Humidity. When the petroleum based fluid is dry, the reading will be close to 0%. When the petroleum based fluid becomes saturated, the reading will be close to 100%.

Q. Why is important to detect moisture in petroleum based fluids?

A. When the petroleum based fluid becomes saturated with a water based fluid, the water can no longer be absorbed and begins to precipitate as water droplets which can be falsely counted as particles. At this point, the particle counts begin to increase dramatically, which produces an inaccurate particle count result. More importantly, the moisture level indicates quality of the petroleum based fluid as it relates to moisture content. In other words, the primary fluid properties can be compromised when the fluid becomes saturated with water.

Q. Do all new PODS+ models include the moisture sensor?

A. No, this capability must be specified by the customer at the time of the order

Q. If my PODS+ includes a moisture sensor, can I use it for all fluid types including water and water based fluids like glycols?

A. No, the moisture sensor is for use in petroleum based fluids only and since it is in the fluid path it will become saturated and rendered inoperable if exposed to excess amounts of free water.

Q. What does it mean if there is moisture detected in my fluid?

A. There is always some dissolved moisture resident in industrial oils and fuels. When the Relative Humidity value approaches 90% then you are reaching a saturation point where the amount of free undissolved water will likely alter (increase) your particle counts and consequently negatively affect the performance of the oils or fuels.

Q. Why is "RH%" the unit of measure (UOM) for reporting moisture content in the PODS+?

A. This is due to the fact that the value of moisture content is relative to the surrounding fluid at a given temperature and it is the technically accurate description of the parameter.

Q. Why does the instrument sometimes pause before displaying the RH value?

A. The moisture sensor reacts to changes in moisture content within a few seconds.If the instrument senses a change is occurring in the RH% value, it will wait for the value to stabilize before displaying the final value. Consequently, if there is little or no change in moisture content from sample to sample, the reading will display right away.

Conclusion

The HIAC PODS+ requires no training or expertise to use and it measures both particle contamination and moisture contamination; two major issues, one smart instrument. Preventing free water in your petroleum based fluid will reduce costly repairs. Using RH% as a predictive measure will allow you prevent free water to form.

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Joe Dabbs is a Global Marketing Manager for Beckman Coulter Life Sciences Industrial Particle Counting. In this role he manages the HIAC portfolio of liquid particle counters and sensors and has recently driven the development of the new HIAC PODS+. He has a B.S. in Kinesiology from Western State College of Colorado and an MBA from Marylhurst University.

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