Forsythe Technology Inc.
9610 Long Point Road, Suite 206, Houston, TX 77055
Telephone: 713 468-1795 or 800 448-1795 Fax: 713 932-6874
e-mail: richard_slover@slovergroup.com

TECHNICAL NOTE
WATER REMOVAL FROM EHC CONTROL FLUIDS

1. Background

Excess water in phosphate ester control fluids if undesirable mainly because the fluid can break down by a process called hydrolysis. Consequently, one of the more important tests when comparing fluids can be the hydrolytic stability as measured using ASTM test methods.

Water can also be undesirable because it will load up the purification media, such as fuller's earth and activated alumina, so that they are now longer as effective in their main role of acid number and resistivity control. In addition, water can possibly leach water soluble metals out of the purification media, accelerate corrosion of mild steel pump and valve parts or copper cooler tubes, effect the viscosity of the fluid and effect the pump performance as a result of it's lower boiling point and higher vapour pressure. It can also cause high pressure drops across the cellulose media used in the less expensive filter elements.

Consequently, water is a fluid condition monitoring control parameter and typical in-service levels range from 600 to 800 ppm. It should be note that at these levels the water is dissolved in the fluid and is not present as either suspended droplets of free water (cloudy) or a layer of free water on the top. The fluids can reportedly hold up to 4000 ppm of water in solution but that actual amount will depend on the type of fluid and its condition.

2. Test Methods

The amount of water in these fluids is normally tested by ASTM D-1744. This is a titration method with a reagent and it is called the Karl Fischer test. Other methods such as distillation (ASTM D-95) and centrifuging (ASTM D-96) are not thought to be as useful. Splatter type tests in which fluid is dropped on a hot plate are also not as reliable because of the high amount of water that can be absorbed by these fluids. The amount of water that can be in dissolved also depends on the fluid temperature. The higher the temperature the more water that can be in solution. This is why a sample might be clear when you first take it from an operating unit but turns cloudy as it cools down.

3. Removing Water

With very high levels of water the solubility limit may be exceeded so that there can be a layer of free water on top of the fluid in the reservoir. This should be removed by siphoning using a floating suction pickup. Free water suspended in the fluid can also be reduced by using coalescing type filter elements.

Action is still required to reduce the amount of water suspended and dissolved in the fluid. This is important because the dissolved content can easily be 4,000 ppm or more. This can be achieved by a variety of means including some or combinations of the following; vacuum dehydration, absorption, adsorption and evaporation. A part drain is also an option.

Vacuum Dehydration: Because phosphate ester fluid have such a high solubility limit for water, centrifuges that are often the traditional method for separation of liquids and solids in fluids, are not effective. Vacuum dehydration makes use of the fact that the boiling temperature of water decreasing as the vacuum is raised so that water can in effect be boiled off. In some cases this is accomplished without heating the fluid. Such units can be permanently installed or portable. Because they are costly and should not be required on a routine basis, rental units should also be considered. Care has to be taken to ensure that all components, pumps, hoses, seals, paints and filters are compatible with phosphate ester fluids.

Absorption: Fuller's earth was the purification media being used in most cases. In addition to controlling the acid number and resistivity of the fluid, this media would also absorb water. This is undesirable if it happens while in stores but can be used to good affect to control water. For, example each 7"x18" cartridge can reportedly hold 1 gallon of water. Note, however, that when wet the media must be changed because it will not be effective at controlling acidity. Other purification media can also reported hold water but are not thought to be as cost effective. Special cartridges with water absorbing media such as cotton, cellulose or polymers are also available.

Adsorption: This is not as common but can include zeolites (molecular sieves). In such cases the water is held on the granules or beads that are then dried or changed.

Evaporation: In a closed system this was not thought to be effective however, in some cases raising the temperature of the fluid has been suggested. This is a trade-off because higher temperatures can also hasten fluid degradation.

In the relatively few systems having vapour extraction fans on the reservoirs, the water content will be reduced to that approaching a limit dependent on the relative humidity of the air. In humid months especially this process can be slow and might be too slow.

An option that is being used more and more is using a dry air purge. One source is instrument air which is both dry and oil free. A low flow of air at a pressure of 1-2 psi has been found to dramatically reduce the water content in a matter of days. Nitrogen has also been used.

Summary

There are many options for removing excess water but regardless of what is chosen, do it promptly to minimize consequential damage. GE recommend inspecting each valve after a high water event and if valves are then not testing properly.