

MONITORING WATER GLYCOL HYDRAULIC FLUIDS

Overview

Industrial fluid power applications have increased worldwide over the years. Hydraulic fluid performance demands have increased in operating pressures, safety and reliability. As operating pressures increase, the risk of fire from ruptured lines also increases. It is necessary to balance management's regulatory and insurance interests with equipment requirements for effective lubrication, wear and corrosion protection.

Water Glycol Fluids

On a pounds produced basis, water glycol fluids (HFC) are the number one fluid in the marketplace. They offer excellent fire-resistance and are relatively inexpensive when compared to other water-free fire-resistant hydraulic fluid technologies. While HFC fluids have a relatively low pressure ceiling (roughly 3,000 psi - 210 bar - depending on the type of equipment and the equipment OEM) they are widely used in steel continuous casting and die casting operations. Because HFC fluids have a significant market share and market presence it is important to understand both the formulation and maintenance parameters that will keep your water glycol fluid and your equipment operating efficiently.

Fluid Formulation

Water glycol fluids are complex solutions. The product classification clearly indicates that the fluid contains water and glycol. Other chemical building blocks are required in order to produce a finished fluid capable of operating in today's commonly used hydraulic hardware.

Water and glycol, when mixed together have the viscosity of water. In an HFC fluid, a water soluble polyalkylene glycol thickener is added to give the fluid viscosity. These three components When mixed together yield a fluid with an oil-like feel.

1. Water
2. Glycol
3. Thickener

Unfortunately, this fluid has no lubrication value and will not protect components against rust and corrosion. Additional chemical building blocks include - fatty acids and amines for lubrication, amines for ferrous corrosion protection, yellow metal passivators for brass and bronze and a dye for fluid identification. While ingredients like amines, lubrication additives, polymeric thickener and even water content can vary from one manufacturer to another, the final fluid formulations are roughly the same. Optimum fluid performance is obtained when all of the fluid components are kept in balance.

FLUID COMPONENT	% OF FORMULATION
Water	35-45
Glycol (EG, DEG etc.)	25-40
PAG Thickener	10-20
Additives	5-10
Corrosion Inhibitors	2-5
Lubrication Additive	2-5
Copper Passivator	0.1-0.5
Dye	0.1

Key Maintenance Parameters

Viscosity - A direct measure of a fluid's water content. The glycol and PAG thickener

The viscosity of a water glycol fluid is directly related to the water content. The glycol and PAG thickener contained in an HFC fluid are not volatile and will remain in the hydraulic reservoir regardless of fluid temperature. As such, one would expect to see the viscosity of the fluid increase over time as water evaporates. The rate of viscosity increase will depend on such factors as ambient temperature, reservoir temperature, and air flow across the reservoir breather, amount of make-up fluid added, etc. A knowledgeable hydraulic fluid supplier can supply their HFC users a graph that directly relates the viscosity

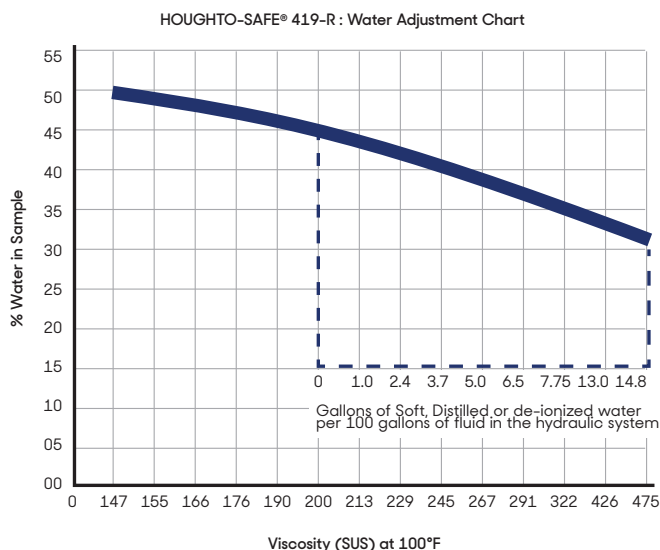
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to the water content. Having such a graph eliminates the need to run actual water contents and allows for easy maintenance. It should be pointed out that a falling viscosity is related to excess water in the water glycol fluid.

This excess water can only come from a leaking heat exchanger or over-addition of water in a water adjustment.

Suggested viscosity ranges:

VISCOSITY	ACTION
< 180 SUS	Check for source of excess water
180-250 SUS	Normal operating viscosity range, no action required
250-500 SUS	Adjust with soft, distilled, or deionized water according to charts
> 500 SUS or < 160 SUS	Discard fluid and refill system with fresh water glycol fluid



Should a water adjustment ever be necessary, adjustments will need to be made using soft, distilled or deionized water. Divalent metal ions such as calcium and magnesium, which are found in tap and spring water, will cause the lubrication additive in the fluid to become solid and ineffective.

pH – A measure of its total corrosion inhibiting properties

In a water based fluid, the pH of the fluid must be above 8.0 to inhibit rust. Additionally, alkanolamine

chemistry must be used to raise the pH; caustic materials like sodium hydroxide will not inhibit rust. The pH of fluid in use will drop due to loss of the vapor phase corrosion inhibitor. This is to be expected, as the vapor phase corrosion inhibitor is volatile; it must leave the body of the fluid in order to inhibit rust in the vapor space above the fluid in the reservoir. Quaker Houghton uses a dual amine additive system that ensures that the pH of fluid in use will remain above 8.0. A pH of less than 8.0 indicates that the system has been contaminated or diluted.

Alkaline Reserve (AR) – A measure of the combined corrosion inhibitor package – liquid phase and vapor phase

AR will drop with use because the vapor phase inhibitor is slowly being removed from the fluid. The rate of evaporation will depend on reservoir temperature, ambient temperature and air flow across the reservoir's breather. An AR of 90 or above is needed to inhibit vapor phase rust in a HFC fluid. Small additions of make-up fluid can have a significant positive impact on the alkaline reserve of a water glycol fluid. Depending on the amine used as the vapor phase corrosion inhibitor, there may never be a need to adjust the AR of a fluid in service.

Particle Count – A measure of dirt, silt and wear debris suspended in a fluid

To maximize component life, particle counts need to be managed. Pump and valve OEM's have recommended particle counts for fluid depending on pump type, operating pressure, whether or not servo or proportional valves are used, etc. Identifying the critical hardware in your hydraulic system will allow you to set particle count targets for a given piece of equipment. Typically, water glycol fluid will have particle counts in the area of 19/17/14 as determined using the ISO 4406:1999 standard. This applies to fluid supplied in drums and intermediate bulk containers. Obtaining accurate counts using ISO 4406 requires crystal clear fluid. Hazy fluid will introduce errors in the particle counts. Other methods such as Particle Re-suspension can provide better results but are not completely accurate. This method is good for trending analysis, however, review of OEM fluid cleanliness guidelines as well as dialogue with your fluid supplier will help in establishing cleanliness limits for fluid in service.

