DURATHERM
Heat Transfer Fluids

AVOIDING OXIDATION AND THERMAL DEGRADATION

Oxidative Degradation (Most Common)

Oxidation occurs when a fluid comes in contact with air at elevated temperatures. It is one of the most common forms of degradation a heat transfer fluid can suffer from and usually results in sludge formation within the system. While the various heat transfer fluid chemistries are affected at different temperatures, the most common petroleum based fluids will normally experience oxidation at temperatures above 93°C (200°F). In fact it's generally accepted that for every 15°C (27°F) increase in temperature above 93°C (200°F), the rate of oxidation doubles.

Thermal Degradation

Thermal degradation or thermal cracking is the breaking of carbon–carbon bonds in the fluid molecules by adding heat in excess of the fluid's recommended maximum bulk temperature. The reaction may either stop at that point – resulting in smaller molecules than previously existed being formed, or the fragments may react with each other to form polymeric molecules larger than those that previously existed in the fluid.

So What To Do About It?

Weak points, with respect to oxidation, can easily be identified by looking for any point in the system where the fluid comes into contact with air. Once these points are identified, measure the average fluid temperature in this area – usually the expansion tank or reservoir – during normal operation.

If the fluid temperature is below 93°C (200°F), the system should be sufficiently guarded against excessive oxidation. If however, the fluid temperature is above 93°C (200°F), there are a few quick steps that might help:

1. If the system does not have an external expansion tank or fluid reservoir, consider adding one at the high point of the system. Generally placing a reservoir of 'cold' fluid at the point of air contact will significantly reduce oxidation.
2. If the system has an external reservoir but it is running hot, examine the flow path. If the fluid is flowing through the reservoir, consider plumbing it so that the reservoir is "T'd" into the system and is not part of the circulation loop.
3. If the expansion tank is not part of the circulation loop but it is still running hot, you might try moving it further away from the main system or you may consider adding a nitrogen blanket to buffer the fluid from contact with air.

AVOIDING OXIDATION AND THERMAL DEGRADATION

One important note is that not all fluids are affected in the same way by oxidation. Recognizing that oxidation is a major downfall to heat transfer fluids, all Duratherm fluids contain an extensive additive system to help combat and limit the effects of oxidation. Check with your fluid supplier to ensure they have incorporated some protection into their fluid, particularly if your system is open to the atmosphere.

Thermal degradation happens when a fluid is heated past its recommend bulk or skin temperatures – sometimes resulting in a cracking or breaking of the fluid's molecules. Beyond ensuring your fluid is properly spec'd for your equipment and temperature requirements, there are a few things to be aware of that can contribute to thermal degradation:

1. Start-up and shut down. We commonly see systems either being heated too fast or shut down without allowing for adequate cooling of the thermal fluid first through continued circulation. During start-up, particularly with electrically heated systems, it's important for a few reasons to heat the system gradually. This not only helps reduce the risk of thermal degradation but also ensures any moisture or vapors are vented from the system gradually without cavitating the pumps – or even worse – having a geyser of hot vapor and fluid erupting from vent points throughout.

   Shut down is equally important – particularly with electrically heated systems. If a system is not allowed to cool before shutting down the pumps, fluid can become trapped in the heater/boiler and will likely quickly be exposed to temperatures much higher than what the fluid is rated for.

2. Another potential cause of thermal degradation are modifications to the original system design. A well-engineered system will utilize the heat transfer fluid as efficiently as possible without wasting valuable energy/fuel. This means that pumps, valves, heater watt densities, user loads, etc. are all engineered to work in harmony and within the original design parameters. However, as systems get older or needs change, it is likely that some aspect of the system will need to be changed, modified or in some cases even removed. If this is the case with your system, consult with system manufacturers, engineers and fluid suppliers to ensure you will remain within the parameters of the system's original design or that compensations are allowed for with respect to the fluid's capabilities.