Q&A WITH...

Edward J. Cass, Technology Manager, Paratherm Heat Transfer Fluids

Edward Cass is a chemicals and engineering professional with more than a decade of experience in specialty chemical processing and applications. Edward holds a B.Sc. in chemistry from Bloomsburg University of Pennsylvania, US, and is currently Technology Manager at Paratherm Heat Transfer Fluids. Edward's experience includes reactive and hazardous chemistries, pyrophoric gas processing, and formulation of synthetic lubricants. Edward has authored several articles and webinars on heat transfer fluid maintenance and performance and holds a patent for a specialised lubricant composition.

01 What are heat transfer fluids and how do they work?

Heat transfer fluids (HTFs) may also be referred to as hot oils, thermal fluids, thermic or thermal oils. Regardless of what they are called, the technology and working principles are the same. Heat transfer fluids are specialised fluid media designed to indirectly transfer thermal energy, by virtue of heating or cooling, to or from a manufacturing process.

The major advantages of thermal fluids is that they enable precision temperature control, and are capable of high operating temperatures at low system pressures.

02 When should heat transfer fluid be analysed?

As part of a preventative maintenance programme, it is standard practice to analyse the fluid at least once per year to ensure critical properties are within optimal ranges.

It is also recommended that the fluid be tested any time that an operating anomaly is experienced, or any time that fluid is replaced or topped off.

03 What are the main challenges for the industry when analysing fluid technology and performance across the workflow?

There are a lot of options to choose from when shopping for a heat transfer fluid. One challenge is selecting a fluid that is properly matched to the application requirements to meet or exceed performance expectations. Other challenges include knowing how to maintain and operate the system, and how to analyse and resolve performance issues when they arise.

04 How do heat transfer fluids degrade?

Heat transfer fluids can degrade in two ways.

First, if a hot fluid is exposed to air for a longer period of time, oxidation takes place. The resultant acids have poor thermal stability and get further degraded at comparatively lower operating temperatures, e.g. 400°F. Acute oxidation results in heater buildups, sludge, and exceptionally high viscosity, i.e. fluid becoming thicker, at atmospheric temperature.

Second, overheating takes place as a result of heating a fluid above the maximum film temperature specified by the fluid manufacturer. The maximum film temperature is the fluid temperature on the inner wall of the heater tube or on the surface of the electric element. Such extreme temperatures result in breaking apart or cracking of the fluid molecules, thereby decreasing the viscosity, i.e. thinner fluid. Cracking may also lead to pump cavitation. Solid carbon particles are formed as a result of extreme overheating.

There are three primary degradation modes for heat transfer fluids.

- Oxidation occurs when warm or hot fluid reacts with oxygen in atmospherically vented expansion tanks. Oxidation leads to sludges, tars and solids accumulation that can have significant impacts on system performance and reliability.
- Thermal degradation occurs when fluid is overheated beyond its maximum recommended temperatures. Excessive thermal stress can cleave or 'crack' molecules into smaller fragments called low boilers, which can also recombine into higher molecular weight species known as high boilers. Accumulated low and high boilers can lead to loss of performance and efficiency, pump cavitation, as well as operational safety concerns due to lowered flash point and autoignition temperature.
- Contamination may also lead to premature fluid degradation. Contaminants may be inadvertently introduced by user error, environmental ingress, or process leaks. The effects of contamination may be minor or significant, depending on the nature of the contaminant. T&T