Journal of Applied Mechanical Engineering
ISSN: 2168-9873

Wright, J Appl Mech Eng 2016, 5:1
DOI: 10.4172/2168-9873.1000193

Review Article Open Access

Myth Buster - Sampling and Chemical Analysis of Heat Transfer Fluids

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Abstract

A recent webinar entitled 'What to consider when making the buying decision about a heat transfer fluid (HTF) for your system', hosted by Process Heating, discussed the costs associated with the management of HTFs over and mentioned how HTFs could be protected through fluid and system preventative maintenance, which is more commonly referred to as routine sampling and chemical analysis. However, the presentation did not make it clear that sampling and chemical analysis needs to be conducted on a regular basis for each and every HTF. Indeed, there are common misconceptions / myths about the sampling of HTFs and such misunderstandings need to be avoided. The current article was written to address some commonly held misconceptions with the intention of busting the myths behind them. Herein, ten common myths are presented in an attempt to bust these myths.

Keywords: Heat transfer; Fluids

Introduction

The recent webinar hosted by Process Heating entitled 'What to consider when making the buying decision about a heat transfer fluid (HTF) for your system' discussed four key topics: topic 1, 'Overview of Heat Transfer Fluids' delivered by L.W. "Budd" Lee; topic 2, 'Glycol Heat Transfer Fluids' presented by G.L. "Bud" Warren and L.W. "Budd" Lee; topic 3, 'Organic Heat Transfer Fluids' presented by Ryan Ritz; and, topic 4, 'Synthetic Heat Transfer Fluids' presented by Pete Frentzos [1]. Pete Frentzos discussed the decision to buy a HTF based on 'value' rather than simply the cost of a HTF. This means that the performance needs to be considered when choosing a HTF.

One aspect was the 'long life' of the HTF and included: improved resistance to chemical changes over time; fewer HTF change-outs; a lower degree of system fouling by the HTF; and, a clean operating system. The specialist synthetic chemicals found in a HTF means that the lifecycle management costs of a HTF are reduced. Figure 1 is a schematic of the costs associated with the management of a HTF over its lifetime. Pete Frentzos stated that a HTF could be protected through fluid and system preventative maintenance (i.e., routine sampling and chemical analysis) [2]. The sampling and chemical analysis of a HTF has been reported previously and the reader should consult these articles to understand the methodologies used [3-6].

What was not clear in the presentation is that sampling and chemical analysis needs to be conducted on a regular basis for every fluid and not something that becomes less important when a synthetic fluid is used. This is the type of myth that needs to be dispelled and so the current article was written to address ten of the common myths about sampling and chemical analysis.

First Myth: Thermal Fluid Systems Typically Require Little Ongoing Maintenance for the First Few Years of Operation

In an article entitled 'Anatomy of a heat transfer fluid analysis' the opening paragraph stated that "Thermal fluid systems typically require little ongoing maintenance for the first few years of operation and then go on to extol the various advantages of indirect thermal-fluid process heating over competitive heating methods such as direct heating, steam, etc..." [7]. The context of this phrase related to the potential consequences of intermittent HTF maintenance and when things go wrong, which can occur within the first few years after a virgin HTF has been added to a system, the lack of information on the HTF's condition means that it is a guessing game as to what the issue is.

Myth busted: it is a myth to assume that a virgin HTF requires little ongoing maintenance as data gathered during this period serves as a baseline for subsequent changes in its condition that occur over its life time.

Second Myth: HTFs should be Sampled and Chemically Analysed at Least Once per Year

It is a fact that a HTF manufacturer will recommend that a HTF is sampled and chemically analysed at least once per year; however, the operating temperature does have a bearing on the sampling frequency per year. If a plant is operating close to its operating temperature then the HTF should be sampled once per year, but if a HTF is operating at a temperature below its operating temperature (i.e., ≥20 degrees below the bulk temperature of the HTF, then bi-annual sampling may be more appropriate [8].

Myth busted: it is a myth to assume that a HTF is sampled just once per year as the operating condition needs to be considered.

Third Myth: A Plant's Insurer does not Define the Frequency that a HTF is Sampled

This may be an unknown fact, but an insurer can also advise on the frequency of sampling. Indeed, annual sampling and chemical analysis is recommended by some insurers of plants using thermal fluids and inspection of the 'Property Loss Prevention Data Sheets' published by FM Global recommend a HTF is sampled once per year [2,9].

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Received December 22, 2015; **Accepted** January 21, 2016; **Published** January 23, 2016

Citation: Wright CI (2016) Myth Buster - Sampling and Chemical Analysis of Heat Transfer Fluids. J Appl Mech Eng 5: 193. doi:10.4172/2168-9873.1000193

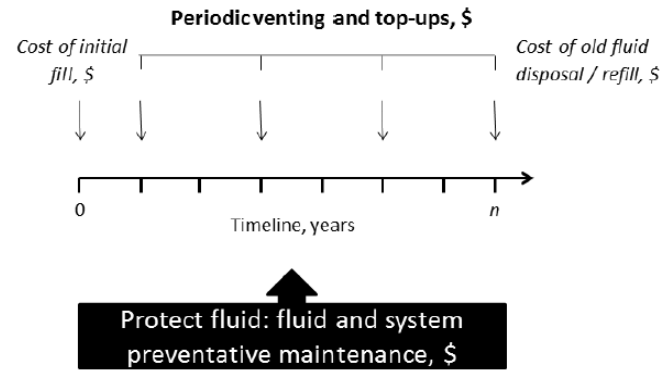

Figure 1: Lifecycle costs associated with a heat transfer fluid.

Myth busted: it is a myth to assume that the insurer of a thermal plant does not define the frequency that a HTF is sampled and chemically analysed. Hence it is important to ensure that the HTF is managed according to the stipulations defined by the insurer.

Fourth Myth: The Optimal Sampling Frequency is not Defined for a HTF

Until recently the optimal frequency for the sampling and chemical analysis of a HTF was not clearly defined. This is not surprising as the frequency may vary depending on the detection of an issue with more frequent sampling being conducted when a fluid is tested before than during and after any intervention to correct a change in a fluid's condition (e.g., raised carbon residue) [10]. Research published in Applied Thermal Engineering showed that an increase in sampling frequency (up to once every 3 months) was associated with improvements in the overall condition of a mineral-based HTF [2].

Myth busted: the optimal frequency for sampling seems to be 3 months, although research clearly shows that condition improves when a fluid is sampled more frequently. This suggests that more frequent sampling (i.e., more often than every 3 months) may be associated with better overall fluid condition.

Fifth Myth: The Frequency that a HTF is the Only Aspect that an Insurer Stipulates

As already mentioned, in real-life practice it is normal for insurers to stipulate how the HTF should be managed as well as how staff should be trained. For example, in the past FM Global [9] stipulated some of the following in addition to routine sampling:

1. Samples of the HTF should be tested for impurities and/or degradation at least yearly.
2. The HTF manufacturer should be consulted to help determine where in the system to take samples.
3. Ordinarily samples should be sent to the supplier of the HTF although analysis by independent and on site laboratories is also acceptable.
4. A full internal inspection should be made if tests of the HTF indicate a significant level of impurities or thermal degradation

Myth busted: Sampling is not the only aspect that an insurer may stipulate. Indeed, an insurer may stipulate what additional fluid parameters may be tested (e.g., thermal degradation).

Sixth Myth: An Insurer does not Stipulate the Training Required by Operators Coming into Contact with a HTF

In terms of training, FM Global has also stipulated the training of operators of a HTF system should be conducted annually and to include [9]:

1. All operators involved with heat transfer systems should be provided with a formal training programme detailing the proper operation of the HTF system along with emergency procedures to be taken in the event of all conceivable process control upsets and emergency conditions.
2. Operators should be aware of hazards relating to the HTF system, which may arise from HTF leakage, for example.
3. Training should include recognition of upset conditions that could lead to dangerous situations.
4. Refresher training should be given to all operators at least annually.

Myth busted: Sampling is not the only aspect that an insurer may stipulate and can include guidance on how frequently training of operators should be conducted.

Seventh Myth: Sampling and Subsequent Chemical Analysis only Focuses on the DegradationProperties of a HTF

Once sampled, a HTF is sent to the laboratory for chemical testing and this includes tests to assess different aspects of thermal degradation including thermal cracking, oxidation, contamination, HTF system wear and HTF system safety [10,11].

Myth busted: Chemical testing includes a wide array of tests that assess the physical properties of a HTF (e.g., kinematic viscosity) as well as its condition (e.g., thermal degradation) and contamination. Please read these references for further information on the standard 11-point test conducted by Global Heat Transfer [2,3,5].

Eighth Myth: Sampling and Chemical Analysis of a Synthetic HTF Differs from a Mineral-Based HTF

Synthetic HTFs, for example Globaltherm Omnitech, are sampled and chemically analysed using the same standard operating procedures and methodologies, respectively, as for other fluids [12]. However, synthetic HTFs generally operate at a higher temperature than mineral-based HTFs like Globaltherm M (please see www.globalheattransfer.co.uk) and have different chemistries so there is a need for the users to be trained how to safely sample, handle and store the HTFs they are managing [12].

Myth busted: HTFs are sampled according to defined standard operating procedures and then chemically analysed using the same methodologies for the same range of parameters.

Ninth Myth: There is no Guidance on How to Sample a HTF

HTFs operate at high temperatures and need to be carefully managed to ensure the safety of the engineering taking the sample. The best practice for sampling is to extract a sample from the HTF system whilst it is live / at operating temperature to ensure that a

representative sample is gained and chemical analysis is a fair reflection of the HTFs physical and chemistry properties [6]. This is especially important when assessing HTF system safety where it is important to get a reflective sample of 'light-chain hydrocarbons' in order to gauge the HTF system safety [13] but also to ensure that chemical analyses reflect the 'light-chain hydrocarbons' present in the system [13]. Sampling a HTF needs to be done by engineers that are trained to take hot, live samples and end users should consult specialist companies to do this.

Myth busted: The guidance for sampling a HTF is clearly defined. This this is a specialist area and end users of a HTF are advised to consult companies that provide this service.

Tenth Myth: The HTF System Needs to be Vented Periodically

In the presentation by Pete Frentzos it was indicated that top-ups and venting needed to be performed on a regular basis (Figure 1). This is true as thermal degradation leads to the formation of heavy and light-chain hydrocarbons and the consequence is that the fluid volume decreases slightly and will need topping-up. During this process, light-chain hydrocarbons (a fuel-like substance) need to be vented from the HTF system. This can be done intermittently, as suggested in Figure 1, or continuously [4]. Indeed, a light-ends removal kit can be installed in the system with very positive results being reported up to 5 years after installation [13] , which means there is no need for intermittent venting to remove light-chain hydrocarbons.

Myth busted: a HTF system does not need to be vented periodically if a light-ends removal kit is installed in a system. A light-ends removal kit continuously removes light-chain hydrocarbons from the system and this helps to maintain closed flash point temperature and therefore maintain a safe HTF system.

Acknowledgements

The author would like to acknowledge the writing support provided by Red Pharm communications, which is part of the Red Pharm company (please see @ RedPharmCo on Twitter).

More Information about Global Heat Transfer

Global Heat Transfer offers a number of services that includes the sampling and analysis of HTFs to monitor the rate of thermal degradation and extent of foreign contaminants such as water. Other services include HTF maintenance; heat transfer system design; and, heat transfer system installation.

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