QBE European Operations

Heat Transfer Fluid

Technical guide

Whilst sometimes a necessity, heated oil presents a potentially severe fire hazard to a business operation. This guide explores the hazard and how to mitigate the risk.

Background

Heat Transfer Fluids (HTF) in the form of organic and synthetic oils are used to transfer heat energy typically to a process. They are normally used when steam or water alone is insufficient due to the elevated temperatures required at standard pressures. Typical processes using this form of process heat include food production, laundries, paper and plastic machines and many more. HTF's are mostly used in the fluid phase but can be used in the vapour phase as well.

It is usual for the oils used to have high flashpoints typically in the region between 100 deg C– 200 deg C so the system is mistakenly classed as low risk. However, oil is often heated close to or above its flash point, and as its pressurised any leak can result in a flammable mist which introduces the hazard of fire and explosion. In addition to leakage, loss history demonstrates that most fires associated with HTF start within the pipe insulation, are caused by loss of flow or by cracked heater tubes.

This guide is designed to provide an overview of the typical hazards of HTF systems and their associated safeguards. For more information please consult QBE Risk Solutions.

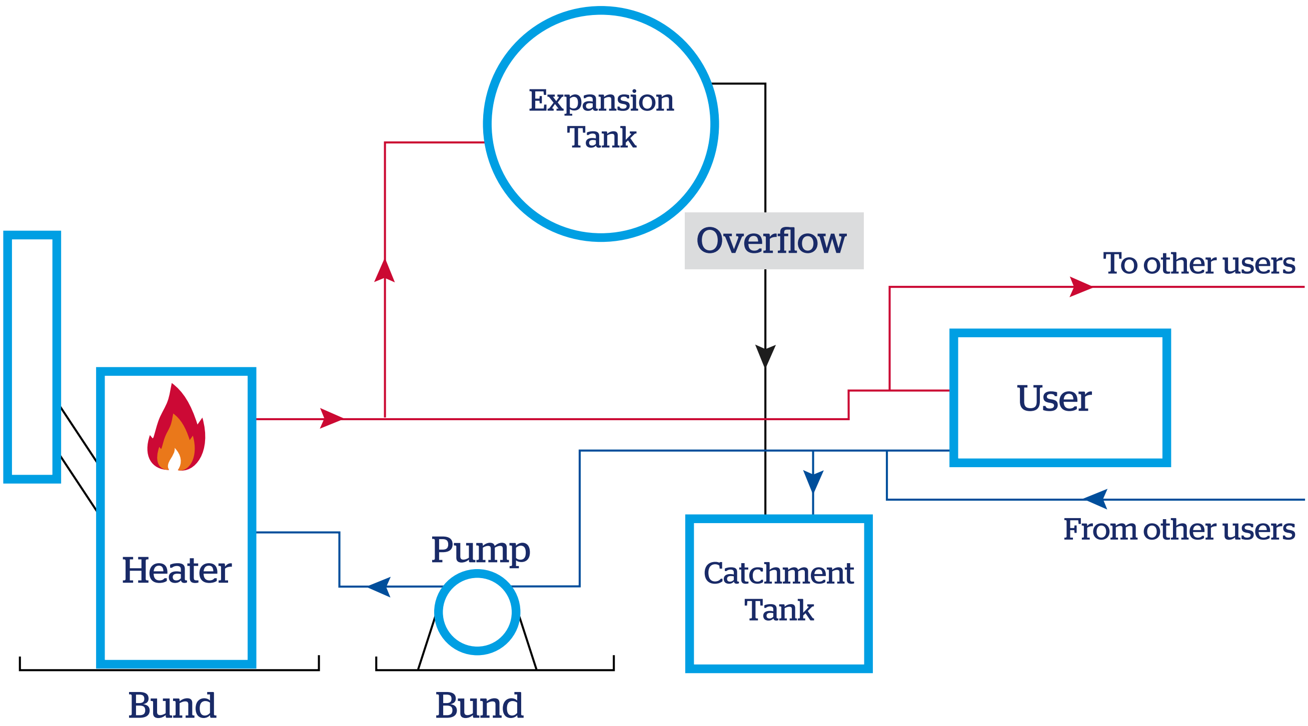

Fig. 1 - Simplified Schematic of Typical HTF System

HTF Overheating

Issues occur if the fluid is overheated leading to rapid HTF degradation and thermal cracking (fluid breakdown). A common cause is from flame impingement on a heater tube causing localised overheating. Overheating the HTF produces light ends and heavies. Light ends reduce the flash point of the fluid, may contain hydrogen gas and can form a flammable vapour. Heavies on the other hand, increase the viscosity of the liquid making it less efficient leading to further overheating, particularly if deposited on the heater tubes as a thick black coating. If the heater tubes were to fail, the result could be a very large fire. Regular maintenance and inspection by a suitably qualified contractor should prevent this.

Fluid Testing

All heat transfer fluids will degrade over time so periodic testing for fluid degradation is vital. It should be at least annual. It is also important the fluid sample is representative and simply opening a valve and filling a bucket is not. The proper method is to flow fluid through a sample vessel and back into the return for a few minutes. The valves are then closed and the sample is allowed to cool before dispensing. This way the volatiles condense rather than disperse allowing detection and a true state of the fluid. It is also inherently safer. In addition, the analysis of the fluid needs to be in conjunction with an understanding of the system, the operational requirements and the history.

The fluid must either be conditioned or changed when the fluid falls out of specification. Conditioning typically involves flowing the fluid through a vehicle mounted distillation kit, a service typically offered through specialist contractors.

Key safety elements of heater and flow controls

Key safety devices for the heater include those that are typical for burner controls including purging the burner chamber before ignition, fuel cut-off when flame failure or failure to ignite. In some instances the heater fire box may require fire protection such as carbon dioxide, nitrogen or steam.

Key flow controls should be interlocked to the fuel source of the heater and include differential pressure or flow switches, fluid over temperature and pressure, loss of pressure, and flue over temperature amongst others. Note that all control devices and safety interlocks should be inspected, calibrated and tested at least annually.

In addition and applicable to any system, a remote emergency shutoff switch should be provided to shut down the entire system.

Pumps

The pumps are the most common cause of thermal fluid leakage either via the mechanical seal or the flange connection to the pipework. In addition, if a centrifugal pump fails the mechanical seal can generate very high temperatures which can be above the auto ignition point of the fluid resulting in fire.

Single mechanical seals often don't provide sufficient protection against leakage so either use double mechanical seals or sealless pumps. All seals should also be regularly inspected as part of the maintenance programme.

Typical safety systems for the pumps include a fusible link over the pump and motor linked to a cut off switch, a leak detector behind the pump seals, a bund with level detector and differential pressure switches.

Pipe Insulation

Insulation is used for both personnel protection and to reduce heat loss on components and pipework. However fluid can be absorbed into the insulation and spontaneously combust which is a severe fire hazard.

Any type of insulation can be used where the pipe is welded and areas not prone to leakage, but closed cell cellular glass insulation must be used where it is.

If open cell fluid absorbing insulation has been used it should be removed in areas prone to leakage and covered with a spray shield (see next section) or recover with non-absorbing insulation.

Spray protection

Flange joints, seals, valve packings and other potential leak points are prone to leakage in the form of thermal oil spray which can auto-ignite given the right mixture of vapour and oxygen. Spray protection prevents spray or mist by ensuring a leak is released from a flange connection in liquid form.

Secondary Circuits

Large HTF systems generally contain one or more additional paths for HTF to follow known as secondary circuits. It is important that there is a means to isolate the secondary circuit in the event of a liquid release which gives a significant reduction in the actual size of the spill. Slam shut valves are typically used for this which are activated by an e-stop circuit, although system familiarity is required to ensure that the hierarchy of operation does not create a greater problem. In addition, 3 way control valves should be used to maintain the primary circuit flow characteristics.

Training

All operators involved with heat transfer systems should be provided with formal training in both normal and emergency operations. Refresher training should be given to all operators at least annually. In addition the Fire and Rescue Service should be made aware of the location of HTF equipment including shutoff valves with proper fire fighting methods pre-planned.

Checklist

- ☑ Statutory compliance (DSEAR, Pressure Equipment Directive, ATEX Directive etc) as required
- ☑ Heater and fluid flow safety interlocks calibrated, checked and maintained at least annually
- ☑ Fluid sampling and testing at least annually
- ☑ Spray guards in areas prone to leak
- ☑ Closed cell insulation where required
- ☑ Employee training of normal and emergency operations – refreshed annually.
- ☑ Portable fire extinguishers (type dry chemical) located wherever HTF piping or equipment is.

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