Paratherm™ HEAT TRANSFER FLUIDS
A Division of Lubrizol

Fluid Fouling Problems in Closed-Loop Temperature Control Systems

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Thermal-liquid temperature control systems provide major advantages over other methods of heating and cooling. Among them are efficiency, low maintenance, lack of hot or cool spots and the absolute control of temperature. One problem, system fouling, can reduce equipment per- formance and product output — and lead to increased downtime and unacceptable product quality.

Fouling can occur when the heat transfer fluid is degraded. And the "bruised" fluid can no longer transfer the same amount of heat or flow as quickly.

Fluid Damage

There are three ways the fluid can be bruised: oxidation, overheating, and contamination.

Oxidation occurs when hot fluid comes in contact with the oxygen found in air. The fluid will start to smoke (like overheated vegetable oil) and will become acidic and corrosive. And as the fluid oxidizes, it becomes less efficient—and less resistant to heat.

Overheating occurs as the fluid's film temperature rises above its recom- mended maximum. The fluid starts to distill, with the smaller molecules beginning to boil and vaporize. Viscosity (thickness) increases causing flow to decrease. This allows the fluid to linger in contact with the heated surface and pick up too much heat. As temperatures continue to rise, the fluid's molecules can break apart (called "cracking"). As the fluid's chemical bonds begin to break, the fluid releases sooty carbon. Allowed to continue unchecked, the process repeats itself until all the fluid has been reduced to carbon.

Contamination results from foreign matter in the system. In new systems, incomplete cleaning can leave weld slag, spatter and flux, dust and dirt, and quench oils and protective lacquers to mix with the fluid. In existing systems, dirty bruised fluid may remain, or a non-compatible fluid may have been added.

System Problems

Overheating is caused by loss of input heat control or a decrease in fluid flow.

Input Heat Control

Problems with the equipment include improper flame propagation in fossil- fired heaters, and controller glitches or human failure. Power failures and "bumps" can drop the pump motor out. The fluid, standing stagnant in the tubing of fossil-fired heaters, absorbs heat radiating and convecting from the refractory and starts to boil*.

Flow

Reduction in flow is the most common cause of overheating. As flows decrease, fluid velocity and turbulence also decrease, and the heat transfer fluid remains in prolonged contact with the heated surfaces. Even though the system's bulk fluid temperature may not change much, the film temperature can rise dramatically—and quickly. This extra heat is no longer transferred as rapidly to the bulk of the fluid, and the fluid decomposes at the heated surface.

As molecules at the film layer degrade, carbon can be formed. This carbon adheres to the heated surfaces and bakes on—thickening as the process repeats itself and successive layers are added. Difficult to remove, the carbon coating acts as an insulator both in heater tubing and on electrical heater elements, and can severely affectflows. Thecarbonthat escapes or breaks away from the heated surface is carried through- out the system, and can lodge in restrictions, clog small channels and hang up control valves—further contributing to the problem.

In addition, the fluid is now more viscous. Not flowing as well, it remains in contact with the heated surface longer, picking up even more heat and continuing to over- heat, degrade and foul.

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Flows may decrease for a variety of reasons—contaminants lodged in valves, lines or strainers, bypass valves hanging up, pump problems, out-of-spec components or the wrong valves mistakenly closed.

Solutions

Never exceed the maximum film or bulk temperature of any heat transfer fluid. This is possible, but in practice not very easy or inexpensive (power failures alone can victimize even the most fail-safe system—not to mention operator error or worn components).

Specify a heat transfer fluid that does not foul when severely overheated.

*In fossil-fired systems, the circulating pump should be allowed to run until the excess heat stored in the heater's refractory and structural members has safely exited the firebox.

Questions? We'd like to hear from you. Call toll-free, +1 800-222-3611, or fax or e-mail us, or visit our website, **www.paratherm.com**.