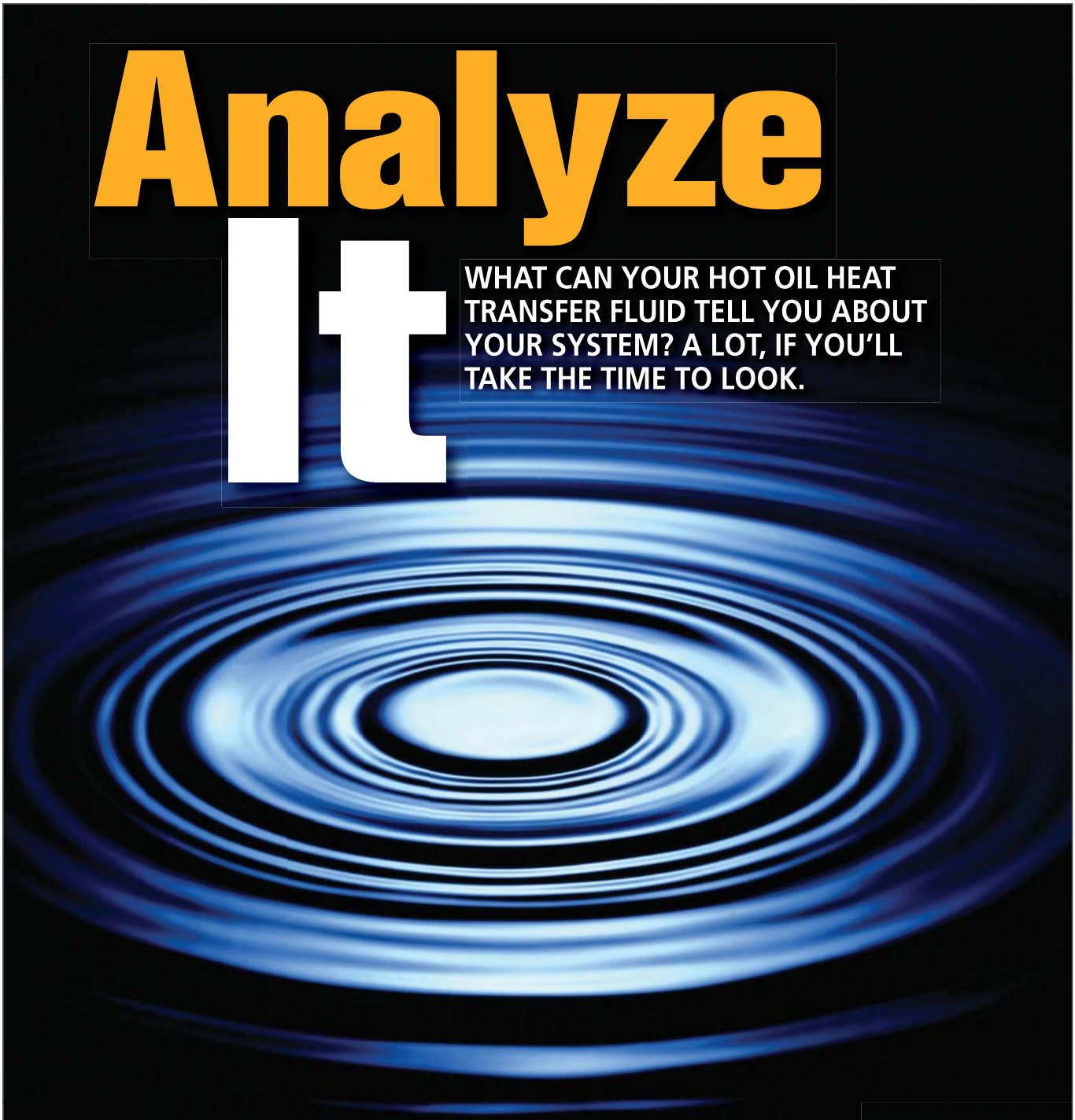
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Process Heating

FOR MANUFACTURING ENGINEERS WHO USE HEAT PROCESSING EQUIPMENT AND SUPPLIES.



Analyze It

WHAT CAN YOUR HOT OIL HEAT TRANSFER FLUID TELL YOU ABOUT YOUR SYSTEM? A LOT, IF YOU'LL TAKE THE TIME TO LOOK.

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Analyze It



What can your hot oil heat transfer fluid tell you about your system? A lot, if you'll take the time to look.

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When maintaining a hot oil heat transfer system, you must watch over many things: heater or exchanger, pumps, valves, expansion tank, piping, flanges, gaskets, studs, nuts, seals, insulation, etc. One component that requires particular attention is the heat transfer fluid, or hot oil. Like the blood in your body, the hot oil can help diagnose current or potential problems in your system.

Hot oils degrade over time, and the rate of degradation can be influenced by operating procedures, equipment layout and equipment malfunctions. Thermal cracking, oxidation and contamination from another material such as water are the three major reasons your hot oil degrades.

THERMAL CRACKING

Thermal cracking happens when the hot oil is heated past its boiling point by exceeding its maximum recommended film temperature. When hot oils boil, they go from the liquid stage to the vapor stage and then back after being cooled down. This process creates large oil molecules that decompose into solid coke (90 to 95 percent carbon) and light-end molecules that act like water in your system. The larger molecules polymerize or join with other larger molecules and develop a sludge-type material. This sludge-type material coats the internal components and changes the efficiency and performance of your system.

Thermal cracking can happen in all fired and electric immersion-type heaters. These heaters are capable of exceeding the maximum recommended film temperature of the hot oil under certain conditions. Exceeding the maximum film temperature for a period of time can cause excessive cracking and premature fluid failure. To minimize the chance that thermal cracking will occur, review your

- Designed fluid velocity through the heater.
- Startup procedure.
- Shutdown procedure.
- System instrumentation.

In addition, develop a preventive maintenance program to check the combustion chamber in your heater.

Maintain Design Fluid Velocity at all Times Through the Heater. Pressure drop across the entire system should be calculated when sizing pumps. System bypass valve response should be tuned to maintain design fluid flow rate under all process conditions. Filters and strainers should be properly located and monitored to prevent blinding or clogging.

Bring Cold Systems Up to Temperature Slowly. Cold fluid can overheat if the heater operates at full power from startup. Pump should be turned on to create circulation in the system prior to turning on the heater. Fluid temperature should be increased in 25°F (14°C) increments until fluid viscosity is less than 10 cP (check fluid property tables). Make sure this procedure does not heat up the system more rapidly than the fluid manufacturer's recommendations.

Avoid Sudden Shutdowns. Allow fluid to circulate until the heater outlet temperature is 250°F (121°C) max. If repeated power failures occur, consider connecting the pump to auxiliary power source.

KEY BENEFIT

Paying attention to the soundness of your heat transfer fluid will allow you to identify fluid degradation problems early. Maintaining a healthy heat transfer fluid charge in your system can extend your equipment's life.

EQUIPMENT COVERED

Hot oil/heat transfer fluids, thermal fluid heaters, immersion heaters

INDUSTRIES SERVED

Chemicals/petrochemicals, electronics, finishing, food, packaging/printing, pulp/paper/converting, pharmaceuticals, plastics, textiles

Maintain System Instrumentation. Failure of high temperature or low flow alarms not only cause overheating but also can create potential for equipment fires.

Check the Combustion Chamber in Your Heater. Improper flame propagation or burner alignment can cause hot spots on tubes, which will exceed the recommended maximum film temperature and overheat the fluid.

OXIDATION

Oxidation happens in all organic heat transfer fluids, which react with air to form organic acids. This oxidation rate is lower at ambient conditions but increases rapidly with temperature and doubles every 20°F (11°C) over 200°F (93°C). These acids can undergo free radical polymerization, which will increase the fluid viscosity and ultimately can result in deposits causing significant equipment problems. In many cases, expansion tank fouling or corrosion is the first sign that a problem exists if routine fluid analyses have not been performed. Minimizing oxidation is relatively simple by keeping the expansion tank below 120°F (48°C), minimizing the exposure of hot oil to air and maintaining positive net pump suction head (NPSH).

Keep the Expansion Tank Below 120°F. Smoke emitting from the expansion tank vent line usually is a sign that the expansion tank is too hot. Install either a cold-seal pot on the expansion tank vent or blanket the tank itself with low-pressure inert gas. Never continuously operate a system with the warm-up valve open. On a vented system, the tank itself and lines leading to it should be left uninsulated. The thermal loop seal, reduced diameter piping (one-third the main pipe diameter) between the expansion tank and main loop, or thermal buffer tank will reduce thermal currents.

Minimize Exposure of Hot Oil to Air. Install either a cold-seal pot on expansion tank vent or blanket the tank itself with low-pressure inert gas such as nitrogen.

Maintain Positive Net Pump Suction Head at All Times. High vacuum due to flow restrictions such as plugged strainers can allow air to be sucked into the hot oil and cause excessive pump seal wear.



Thermal cracking led to this badly burnt oil becoming like tar in the heat transfer system.

CONTAMINATION

Contamination can catalyze fluid degradation and also result in severe operating and equipment problems. Contaminants can enter the system when starting up a new system, performing system cleaning and during daily operations.

New Systems. Make sure that all protective coatings and fabrication debris such as mill scale, weld spotter and slag are removed before assembly. Never pressure test with water. Instead, pressure test the system with either heat transfer fluid or inert gas to ensure that all connections are sealed to prevent leaks.

System Cleaning. Complete draining from all system low points is required when using organic-based solvents or flushing fluids. At least one full charge of fresh heat transfer fluid should be used to flush the system if complete draining is not possible. Water-based cleaners must be rinsed completely from the system with fresh water. Residual water should be removed by draining and then purging with hot, dry nitrogen down to a -20°F (-28°C) dewpoint. Boiling off residual water through the expansion tank is not recommended because it will cause fluid degradation.

Daily Operation. Always use fresh fluid to top off system. Fluid "burped" out the vent or collected in the drip pans should be discarded. Do not mix fluids. If you have a problem, contact your fluid supplier, who can provide you with guidance.

To help prolong the life of the system and hot oil, a comprehensive fluid analysis program consisting of laboratory testing, evaluation of your system performance and discussion of the hot oil sample lab results is recommended. This analysis can identify signs of thermal cracking, oxidation and contamination and help ensure your system runs as productively and efficiently as possible. Remember that a fluid analysis will provide laboratory data that is a snapshot of fluid condition. The data must be put into a time perspective along with the operating history to obtain a complete system analysis. This allows corrective action to be implemented before the fluid life or equipment efficiency is compromised.

Hot oil samples should be taken from a "live" part of the system, preferably from the heat user or near the suction side of the circulating pump. The fluid should be circulating at a temperature of 200°F (93°C). Do not sample from the expansion or drain tank. It is important that the sample be put directly into the sample jar. Do not use another container to catch the sample if the fluid is too hot; instead, wait for the system to cool before taking the sample. A 1-qt sample bottle packed in a protective shipping container is available upon request. Most fluid suppliers suggest that a fluid analysis be done annually or sooner if you suspect a problem. PH

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