Filtration of heat transfer fluids increases efficiency

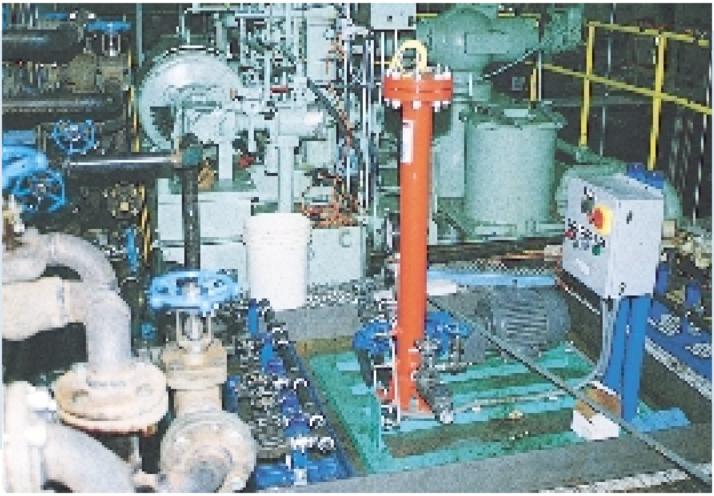
With properly functioning equipment being of utmost importance, hot oil filtration proves to be vital in increasing productivity and keeping contaminants out.

By Zak Shums, Liquid Process Systems Inc.

Hot oils or heat transfer fluids are used for the indirect heating of processes by circulating the heated fluid between hot oil boilers and reactor vessels, tanks, molds, calenders, extruders, or heat exchangers. The fluids are subjected to temperatures ranging from 300°F to 750°F for heating applications in the chemical, plastics, rubber, petrochemical, pharmaceutical, pulp and paper, fiber, and food industries.

The sources of problems

Proper maintenance of the system will control and retard degradation of heat transfer fluids. Some of the contributors to degradation are exposure to oxygen (air), low velocity of the fluid through the heating chamber and piping, improper heater selection, and operating the system at temperatures above manufacturer's recommended maximum temperature. The by-products of degradation are



This filter system filters heat transfer oils up to 650°F and 100 psig system pressure.

sludge and coke due to carbon formation. Contaminants that may be circulating in the system are pipe slag, mill scale, dirt, and dust accumulated in the system during installation or maintenance. As the amount of contamination increases in the system, the fluid undergoes drastic property changes that affect the heat transfer capability of the overall system.

Problems caused by contaminants are wear of rotating components (pump impellers, gears and shafts, mechanical seals, valve stems, etc.), reduced capability of heaters and heat exchangers, increased viscosity of the oil, and increased energy consumption.

Analysis

Heat transfer fluid should be analyzed at least once a year as part of proper maintenance. Depending on the usage, the analysis might be performed quarterly or even monthly to determine the condition of the fluid and compare it with specifications from the material safety data sheet for the oil.

The analysis should include measurement of specific gravity, total acid, viscosity, insolubles, and flash point of the fluid. (For more details, see the accompanying box, "Heat transfer liquid test analysis," p. **100**.)

Analysis of the fluid provides a snapshot of the sample's condition. It is critical to take a live sample of the fluid. That is, the sample should be collected while the system is operating at operating temperature. Care must be taken while drawing the sample. One should wear protective clothing including heat resistant

Hot oil filters use cartridges (shown) with excellent dirt holding capacity, and they offer easy disposal.

gloves, face shield, and eye protection. The valve should be opened slowly, and the fluid should be collected in a clean metal container. The sample should be drawn close to the discharge of the process pump where the turbulence is maximum. After collecting the sample, one should seal the container as soon as possible.

Depending on the level of degradation, the system may have to be drained, flushed, and replenished with filtered or new fluid. Preventative action, including filtration and isolation of the fluid from contacting the atmospheric air, should be incorporated to preserve the integrity of the fluid and the system.

Filtration methods

A traditional method for filtration of hot oils has been to incorporate a strainer before the system pump. Strainers are designed to protect a piece of equipment such as a pump, valve, or flow meter. They trap particles, preventing the particles from entering the pump and eventually the system. A strainer must be cleaned regularly to prevent cavitation, which causes mechanical seal failure or magnetic de-coupling.

Another filtration method is to install a filter in either a side stream or full flow arrangement. For both arrangements, the filter consists of a filter housing with a basket made of stainless steel, with perforations designed to trap fine particles. For side stream installation, the inlet of the filter is installed close to the discharge of the pump. The fluid is diverted through the filter, cleaned, and discharged to the suction side of the same pump or to a low-pressure return line.

The most effective filtration is a forced flow and side stream system arrangement that incorporates a pump and filter designed for high temperature use. This approach employs its own filter pump to divert 5 to 10% of the process flow continuously through the filter as the heating system is operating. All of the fluid passes through the filter at least 15 to 20 times per day.

The inlet of the filter pump should be plumbed into the discharge piping close to the process pump to take advantage of the turbulence in the piping which keeps the solids in suspension. The dirty fluid is forced through the filter and the clean fluid is discharged into the same process line at a pressure higher than the system pressure or to the return pipeline downstream from the process pump.

Heat transfer liquid test analysis

Specific gravity. Greater than the original liquid means other materials are present, indicating presence of low or high boilers and contamination.

Moisture. Water has low solubility in most heat transfer liquids except glycol.

TAN. Also known as Total Acid Number or Neutralization Number. The Acid/Base titration detects strong and weak acids in the fluid.

Insolubles. Indicates the amount of inorganic materials such as pipe slag, sand, construction debris, and coke carried by the fluid.

High/low boilers. When heated to high temperatures, certain molecular bonds begin to break or degrade. High and low boilers decrease heat transfer efficiency and thermal stability.

Viscosity. Fluid flow characteristics per unit time indicates thermal degradation.

GC scan. This test gives the signature of the degradation components of heat transfer liquid and often detects contaminants.

Flashpoint. The Cleveland Open Cup test provides a means of detecting fire/flash point of liquid.

Components

It is important to ensure that the material of construction of all the components on the filtration system are suitable for high temperature use. Many filter housings use “O” ring elastomer seals which are not safe for high temperature operation because they can lose strength or dissolve in the heat transfer fluid.

It is important to consider the replacement of the contaminated filter cartridge. The initial cartridge should be rated to filter 100- to 50-micron size particles and gradually reduced down to filter 25-micron size particles. Filtering the fluid to a micron size less than 25 may remove additives from the oil and affect the performance of the fluid and system.

Depth filters using glass-fiber-wound filter cartridge elements have proven to be most effective in this type of filtration system. They will withstand temperatures up to 700°F, have excellent dirt holding capacity, and are economical.

A typical filtration system should include a pump, filter, controls, isolation valves, and safety accessories. **ED**

Liquid Process Systems, Inc. provides side stream filtration systems designed to operate up to 650°F for hot oils. Contact Zak Shums at (704) 821-1115 for more information or circle ***346****.*

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