Hot Oil Filtration Improves Pump Life and Efficiency in Heat Transfer System

By Pumps and Systems Staff

Implementation of a hot oil filtration system from Liquid Process Systems, Inc. of Charlotte, NC has resulted in improving the efficiency of heat transfer systems. Bottom line benefits for a Minneapolis die casting company include reduced downtime and costs while tripling the life of its heat pumps.

Faced with the inherent problems of using heat transfer fluids for process heating, Twin City Die Casting decided to switch to a simple but effective solution when it implemented a filter to continuously clean the oil while their systems are operating.

"Our primary reason for choosing hot oil filtration was to increase pump life," says Don Jenkins, Corporate Equipment Manager for the casting facility. "We accomplished that and much more."

Need for Hot Oil Filtration

Twin City is one of many die casting companies that use hot oil heat transfer systems for heating dies during the manufacturing process. The plant relies on 13 heating systems for starting up and keeping dies hot. Each process has its own individual electric heating unit. This unit is portable and includes a heater, reservoir, pump and controls for continuously providing hot oil to the process.

Heat transfer fluid is circulated between the heater and the dies to provide consistent, uniform heating for manufacturing of parts. Over time, however, the oils and systems fall victim to the natural processes of oxidation and general wear, creating such contaminants as coke and sludge, and causing fouling of heater element surfaces and oil passageways.

The hydrocarbon oil used in these systems eventually breaks up and produces carbon, which turns the oil black. Eventually, concentrations of carbon turn to coke residue from the used oil and sludge. If not filtered, these fine particles quickly build up, coat the heat transfer surfaces and foul the dies, heater elements, pump internals and seal faces. Such was the case at Twin City Die.

These particles also cemented themselves onto the heater elements and low flow areas of the circulation loop. Coke and sludge made the operation of the relief valve sluggish and sometimes the poppet spool would stick.

"All of the impediments caused by coke and sludge particles from the unfiltered oil made the work of producing components more costly and inefficient," Jenkins states. "This is the reason we sought hot oil filtration."

The Pay-Off

"Since installation of the hot oil filtration system in late 1996, our pumps are lasting on average three

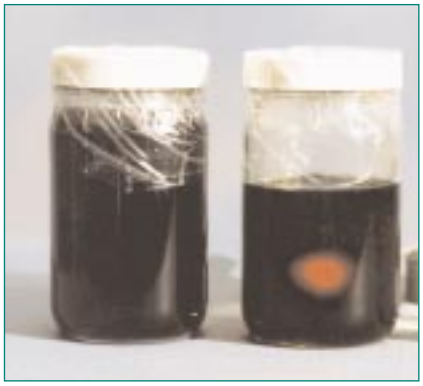

Photo 1. A laser light projected into two samples of heating oil. The unfiltered oil on the left lets no light through; the filtered oil on the right does. The filtration process has improved the oil's viscosity and reduced the particle count.

Photo 2. The HTF filter in a sidestream installation. The inlet of the filter is installed close to the pump's discharge. Fluid is diverted through the filter, cleaned and discharged to the suction side of the same pump, or to a low-pressure return line.

times longer," says Jenkins. "The end result of installing the filters has been less frequent repairing of pumps, which means an overall cost savings in labor and downtime."

Cost associated with pump repair and labor was about $700 per pump per breakdown, but now the filters have increased pump life threefold. "It's quite a savings, not only in cost but in aggravation as well," says Jenkins. Each of the company's 13 heating units has been equipped with its own filter.

Operating at temperatures up to 500°F (260°C), the filters continuously clean the heat transfer fluid and oil without disrupting system operation. The process reduces wear of such rotating parts as pump rotors, impellers, seals, valves and stems, and increases the life of the heating system. In addition, the expense from fluid degradation has been reduced, wear of dynamic seals optimized and burnout or cracking of the heater surfaces minimized.

Other Results

When implementing the filters at Twin City Die Casting, the differences between the filtered and unfiltered oil were noticeably different even to the naked eye. The unfiltered oil had more coke. The filter improved the oil's viscosity. This, along with reduced particle count, shows that oxidation has been controlled and the oil will last longer.

To put it in perspective, the replacement cost of a 55 gallon drum of heat transfer fluid ranges anywhere from $400 to $800. Add to this maintenance man-hours, repair time and the cost of replacement parts such as seals, valves, rotors, volutes, and mag-drive canisters and costs can quickly become considerable.

The pumps themselves still eventually need replacing, but not nearly as often, in large part, because of the filtering process, Jenkins maintains. Cost of a typical pump at the facility is about $1200.

The cost of each filter paid for itself within the first few weeks of installation and use. The supplier notes that these filters and systems normally pay for themselves within the first six months of installation, or in most cases sooner, by eliminating the regular maintenance costs previously required.

Jenkins also found that the amount of sludge accumulating in the systems' heating chambers was reduced, and the relief valves did not gum up or stick. Improved operation of these relief valves, especially in heat transfer systems, is an important safety benefit because of the potentially dangerous high temperatures and pressures involved.

The Filtration Process

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 flowmeter. The strainer must be cleaned regularly to prevent cavitation, which causes mechanical seal failure or magnetic de-coupling.

Twin City Die Casting wanted an alternative filtration method and selected the filtering technology from Liquid Process Systems. The filters consist of a filter housing with a fiberglass element installed on a stand pipe designed to trap fine particles. For side stream installation (recommended by the supplier), the inlet of the filter is installed close to the discharge of the pump.

Photo 3. Shown are the fiberglass elements used in the HTF filters from Liquid Process Systems. On the right is a new unit and on the left is a used filter that has collected coke and other contaminants from a heat transfer system. The filter's housing consists of a filter with one of the fiberglass elements installed on a stand pipe designed to trap fine particles as small as 10 microns.

Fluid is drawn into the filter unit by tapping off the existing piping and diverting a percentage of it (usually about 10%) through the filter unit. The fluid is then cleaned and re-introduced downstream or to the suction side of the existing recirculation pumping system while the heating system is in operation. All of the fluid passes through the filter at least 15 to 20 times per day. The results are a flowstream that is cleaned continuously and extended fluid life.

"Organic heat transfer fluids are generally stable if operated below their thermal stability limit and not contaminated by agents from outside the system," explains Liquid Process Systems' Zak Shums. "Fluids generally degrade when they are subjected to temperatures ranging from 150°F to 750°F (66°C to 399°C), which is common. As overheating and contamination occur, insolubles form. These contaminants deposit on the system and foul heat transfer surfaces. Sedimentation from the solids also causes plugging of pipes and heater element burnouts."

Maintenance of the filtration system is accomplished by simply removing the contaminated filter element and inserting a new one. Downtime is minimal. According to Liquid Process Systems, filter element change-out initially depends on the existing level of contamination. The life of a filter element can be from three to six months, depending on the cleanliness of the oil and on the operation.

"Once in a while a shaft seal will leak, but the operation is now much more predictable and efficient," Jenkins says. "Remember, filtration is only as good as the scheduled maintenance."

Liquid Process Systems, Inc., has been providing customized pumping, filtering and blending systems for more than 10 years to various industries in the United States, Canada, Mexico and Europe. ■

For more information on HTF (patent-pending) high temperature filter housings or other filtration systems, contact

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