PUMPS FOR SYNTHETIC HEAT-TRANSFER LIQUIDS:

REQUIREMENTS

Safe and continuous pumping of synthetic heat-transfer oil at high temperatures. Pumps with sealing systems and materials that are adapted to high temperatures.

SOLUTION

Use Allweiler heat-transfer pumps of the Allheat series.

RESULT

Low wear and therefore low maintenance expense, reliability, all pumps in a system from the same manufacturer.

SYNTHETHIC OILS FOR HIGH TEMPERATURES

As soon as the temperature in a heat-transfer system becomes too high for water, a plant operator must choose between petroleum-based or synthetic oils as the heat-transfer liquid. When modern petroleum oils are used, systems with feed temperatures up to about 300 °C can stay in service for their entire service life with one filling and with virtually no maintenance. Once feed temperatures rise above 300 °C, only high-quality synthetic oils will be appropriate. Under these conditions, even minor temperature increases will have a decisive effect on the service life of the oils. An additional 10 °C commonly doubles the product's specific rate of decomposition. When compared to petroleumbased heat-transfer oils, the amount of maintenance associated with synthetic oils is significantly lower.

INFLUENCE ON PUMP PERFORMANCE

The quality of the oil also directly influences pump performance. If a large number of low-boiling compounds form, pockets of gas and flow breakaways will be the result. This puts greater stress on the pumps and reduces their capacity. Low-boiling compounds reduce pump capacity, which elevates the film temperature in the heater, accelerating decomposition of the heat-transfer fluid, and ultimately forming more low boilers. Irrespective of this, synthetic heat-transfer oils place special demands on pumps. Compared to petroleum-based oils, their lubricity is lower.

That is why Colfax Fluid Handling's Allweiler brand has developed thermal-oil pumps that are specifically adapted to the properties of synthetic oils. Two factors are critical: lower lubricity and, in many cases, lower viscosity. Traditional pump designs are not suitable for handing these conditions. Just starting the pumps is difficult. Normal operation is accompanied by high wear and consequently higher maintenance costs as well.

Thermal oil heaters manufactured by INTEC Engineering GmbH of southern Germany provide a good example of how these pumps are used. This company's thermal oil heaters supply process heat to industrial plants around the world. INTEC focuses on the requirements of the wood, textile, palm oil, chemical, shipbuilding, and food industries. Standard heaters cover an output range of 100 to 20,000 kW; custom designs can deliver even higher output.

A VARIETY OF HEAT TRANSFER LIQUIDS

Operators of these systems must make a fundamental choice based on their own specific requirements: water or oil as the heat-transfer liquid? If oil is chosen, a second decision arises: petroleum-based or synthetic oil? When temperatures reach approximately 180 to 200 °C, the high pressures in the system almost always necessitate the use of heat-transfer oil, which can operate up to 320 °C with virtually no pressure. As a result, the entire system can be constructed with much thinner walls. Oil also does not have the corrosive properties of water. By contrast, when water is used as a heat-transfer liquid, it generates a system pressure of 80 bar at just 300 °C. For applications that require temperatures of between 350 and 400 °C, such

as ground preparation (decontamination), manufacturing of semiconductors and printed circuits, or solar thermal power stations, synthetic oil is the only choice. Overall, heat-transfer oils have proven to be the best choice in most industrial processes. Solar power stations and solar field engineering are major users of synthetic oils like Therminol VP1 and Dowtherm A with feed temperatures of approximately 400 °C.

ALLWEILER PUMPS PROVEN IN YEARS OF USE

Pumps are the core elements in every heat-transfer system, since they convey the heated liquid to the places it is needed. However, the high temperature of the liquid places special requirements on the pumps' sealing systems, especially during initial filling and the first time it is brought into service. Pumps from Colfax Fluid Handling's Allweiler brand are proven to handle these situations. According to Edwin Karrer, Managing Director of INTEC: “We have been using pumps all the Allheat series since 1995. In fact, for a long time Allweiler AG was the only place you could get pumps for synthetic oils. Their experience in this area has benefited us tremendously.”

This experience is reflected in numerous design details in the Allheat pumps. For example, the pump bearings have a special geometry that is adapted to the challenges of pumping low-lubricity synthetic oils. In this case, the bearings are not inserted with pressure, but instead allowed to tilt. This has two benefits for the operator: First, if an insert unit is not aligned and centered precisely after maintenance, for example, it will automatically find its proper position. Second, the bearing will move naturally if radial force is exerted on the shaft. This avoids point strains and lengthens service life. The special bearing geometry permits angular misalignment that is up to three times greater than with conventional bearings that are pressed into position. Finally, a larger bearing surface en-sures reliable formation and retention of the lubricating film at all times. This avoids point strains and lengthens service life.

Double-cardanic couplings are used for all hightemperature applications and especially for systems that exhibit strong hot/cold differences. These couplings absorb even very high mechanical loads, giving them the ability to counteract negative influences that large motors (drive power in excess of 37 kW), expansion processes, and axis displacement may have on the pump. What's more, the pumps are easy to disassemble.

If very high capacities are required (like in PET plants), the "Allheat 1000” is selected. This pump is capable of moving a volume flow up to 1,450 m^3/h with a delivery head of 100 mFls.

MOTOR-PUMP CONNECTION IS CRITICAL

Similar to choosing the right heat-transfer liquid, choosing between a mechanical seal or magnetic coupling in the pumps is another fundamentally important decision.

Due to their design characteristics, mechanical seals are always subject to wear and are sensitive to dirt in the liquid. Pumps equipped with a magnetic coupling do not have a shaft seal of any type, but are significantly more expensive to procure and have lower overall efficiency than mechanical-seal pumps. On large pumps, vortex stream losses can be as high as 20%. For these two reasons, pumps equipped with mechanical seals are the first choice approximately 80% of the time, according to Mr. Karrer.

THE BENEFITS OF A GOOD DESIGN

Gases contained in the system, such as low boilers or air, must be consciously collected in the pump. They result in lower pump capacity, although this can be compensated with special design solutions. A large seal chamber and the ability to collect gases within the pump (where they can be easily removed) are critical for extending the pump's service life and increasing its reliability. In addition, the bearing and the seal must be adapted precisely to each other, the low viscosity, and the overall application. Carbon bearings with non-balanced mechanical seals as well as silicon carbide bearings with balanced seals have proven to be effective combinations. These combinations also make the pumps more resistant to sludge and other types of contamination in the oil. Finally, quench fluid buffers contribute to a longer service life of the gaskets and provide greater security against leaks. A quench further reduces temperature at the mechanical seals and eliminates the possibility that fluid leaking out of the seal will oxidize and cause damage to the seal.

Furthermore, this approach makes it possible to use non-hermetic pumps with critical liquids, since the use of a non-critical quench liquid improves the lubrication of the sliding surfaces in a way that is comparable to the effects of a corresponding double-action mechanical seal. From the standpoint of operations and efficiency, hermetically-sealed pumps have the advantage that they consume less power by avoiding excessive losses from friction and the vortex stream during power transmission.

RELIABLE AND FAST

In addition to design-related benefits, INTEC has four additional reasons for choosing Allweiler pump/motor assemblies: the global service network; competent, rapid and on-site consultation by experienced Allweiler sales engineers; short delivery times in most cases; and strong support during warranty claims. “Like the pumps, our systems are very reliable. When problems do arise, it is very important to work with a cooperative partner who responds quickly,” according to Mr. Karrer. It is also important that each customer's system contains pumps from only one manufacturer, since this is the only way to keep expenses associated with spare parts and maintenance low. That is why INTEC uses not only Allheat pumps, but also three-screw pumps of the Allfuel series as burner and lubrication pumps. When serving customers in the chemical industry who require ATEX safety, INTEC uses magnetically-coupled pumps of the Allmag series.

Pumps of the CTWH series pump both low-viscosity, synthetic heat-transfer oils up to 400 °C as well as hot water up to 207 °C with the identical material configuration. These pump units employ a flexible modular system. Depending on the specific application, they are available in base-plate, block, and inline versions.

48-MW biomass-fired hot-gas generator with eight pumps for circulating heat-transfer oil and one for cooling water