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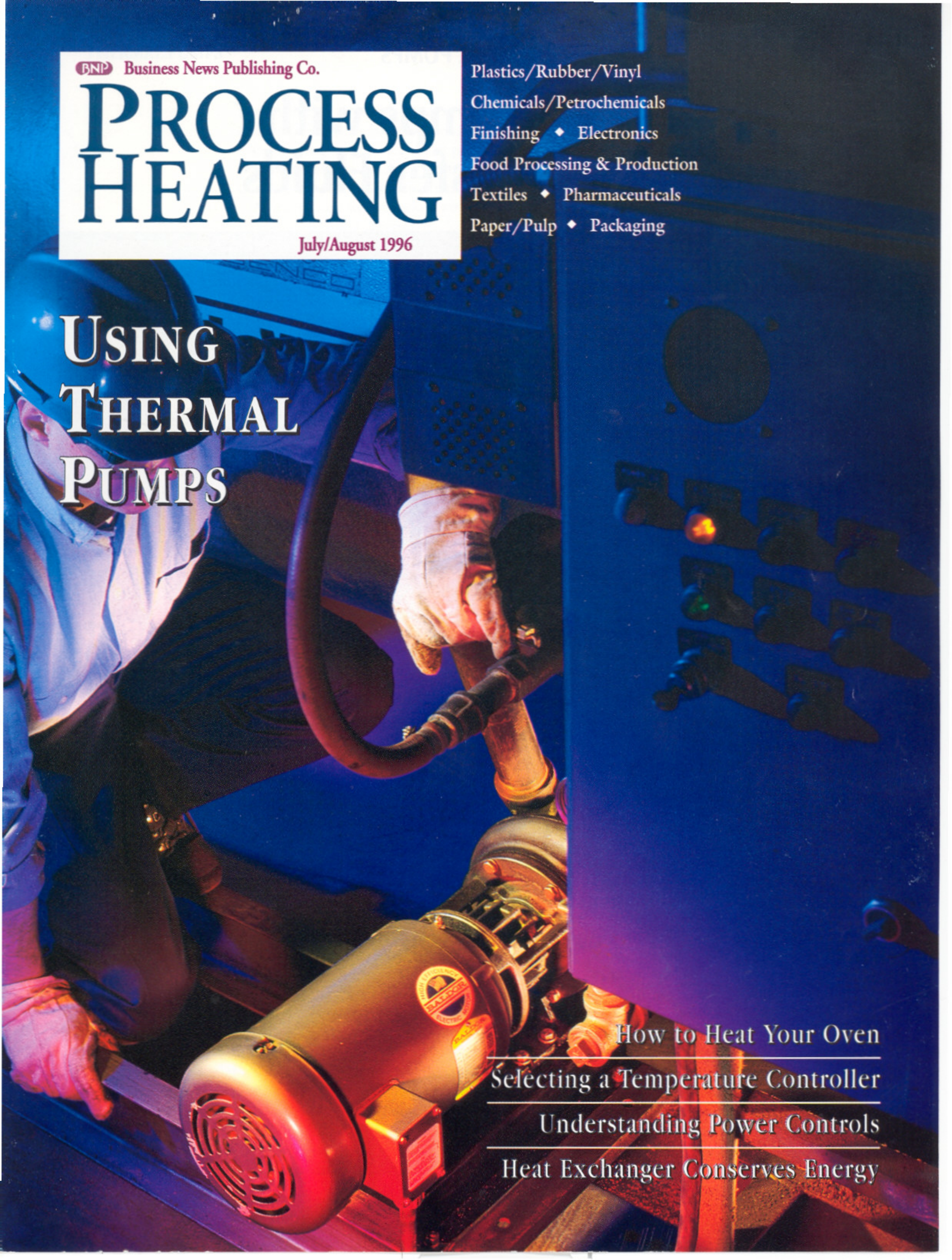

Using Thermal Pumps

How to Heat Your Oven

Selecting a Temperature Controller

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Heat Exchanger Conserves Energy

Using Pumps with Heat Transfer Fluids

Heat transfer oils used at temperatures as high as 900°F (482°C) demand higher process pressures. Thermal pumps provide the pressure needed in a range of applications.

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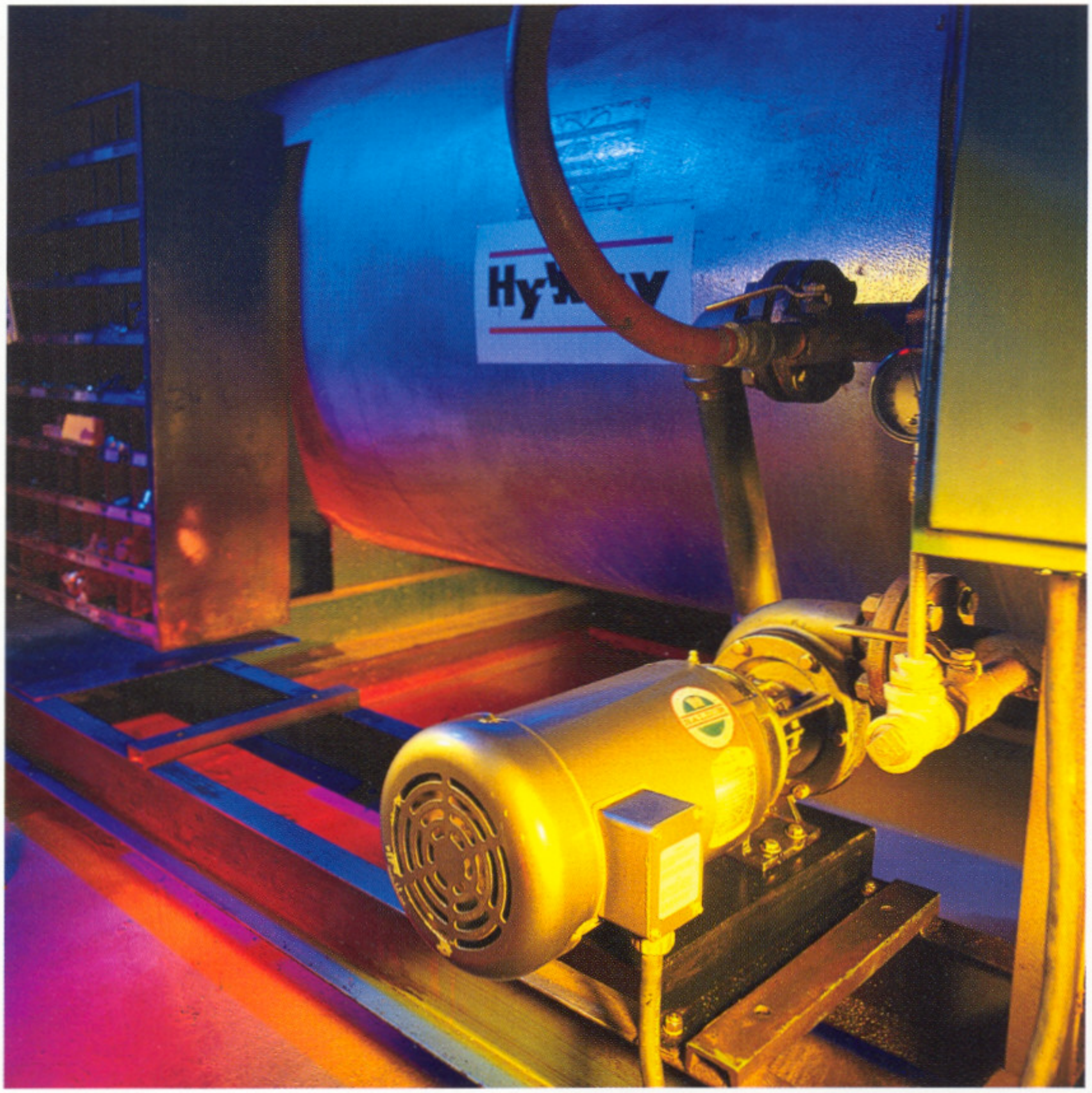

This centrifugal pump, used to pump low viscosity liquids, has a redesigned seal area that allows it to handle high temperature heat transfer fluids without degrading the seal.

Since the mid-'70s, the decline in steam and the ascent of oil have been roughly equivalent. If the task is manufacturing — whether pharmaceuticals or chemicals, food or plastics — heat is a must, and an oil circuit generally is the method of choice.

There are numerous heat transfer oils, and their bases are petroleum or hydrocarbons, mineral, paraffin or synthetic. The number of choices grows each year, as does the range of performance and cost — some synthetic grades cost $30 per gallon. Some are suited for applications up to 900°F (482°C) and may be used only from 600 to 900°F (316 to 482°C). Overall, the higher the thermal stability required, the higher the price tag.

With those higher temperatures comes a need for high pressure — not as high as steam, but high enough to demand a pump that meets the American Petroleum Institute's (API) 610 specification, which calls for a WCB-grade steel casting and other heavy service features. But, using a pump like that in lower temperature ranges means you may be applying too much pump to the task. So, when selecting a pump for an application, size the pump materials to the job based on actual pressures and temperatures. Is 500 psi necessary, or 300 psi? Can the rating be reduced to 150 psi? Overall, use the lowest pressure necessary to maintain good oil quality — that is the key consideration.

As any process expert knows, without appropriate pressure, oil will vaporize, oxidize and degrade. The "perfect world" heat transfer oil is one that can be used at very high temperatures but will operate at a very low pressure. In reality, as oil temperature rises, so does vapor pressure, compelling the engineer to apply a high pressure pump to the system. Fortunately, most process heating occurs below 600°F, and often it can be accomplished using a comparatively inexpensive, low temperature heat transfer oil and lower cost, cast-iron pump.

If the application involves high temperatures and a special oil, with its higher vapor pressure required, it is critical to ensure that the pump has that capability. But, if high pressure is not required, consider a general-purpose, hot oil centrifugal pump that is engineered specifically for the lower pressure, lower temperature end of the spectrum.

A real puzzle is industry's seeming infatuation with ductile iron. It often is the pump material of choice for low end applications — that is, pressures below 200 psi and temperatures less than 650°F (343°C). Many general-purpose hot oil centrifugal pumps are ductile iron, but small, positive-displacement pumps manufactured from cast iron can offer equivalent material performance in some applications.

One downside to positive-displacement pumps is that if there is a "no-flow" condition, the high pressure that develops within the system can burst piping and damage the heat exchanger and other piping components. Using a safety bypass valve can prevent a rupture.

With a centrifugal pump, this risk of rupture is avoided: A no-flow condition will not cause a dramatic pressure rise. The maximum pressure is limited by the hydraulic slip inside the centrifugal pump at a low-flow condition. This feature makes centrifugal pumps inherently safer than a positive-displacement pump, and safety is a big issue — that oil is used instead of steam provides strong incentive to keep pressures low. There is no avoiding the fact that high pressures create additional safety considerations — anything hot can be hazardous. The task is to minimize the risks with solid application engineering.

Reducing Seal Temperatures

Another important consideration to operate a pump safely is to reduce mechanical seal temperatures. With a shaft seal in a conventional pump, the pump side of the seal generally is the same temperature as the fluid running through the pump — if the conventional pump is pumping 500°F (260°C) oil, the seal will be subject to the 500°F fluid. However, most seal materials will not be up to the task, so Viton seals often are recommended for high temperature pumping, despite the fact that Viton is limited to 400°F (204°C) and will degrade significantly at 450°F (232°C).

Some hot oil pumps use Viton seals and address the overtemperature problem with a water-cooled jacket around the seal cavity. This can be inefficient, though, because of the high heat transfer: If water flows are not high enough, steam will result and seal failure follows close behind. In addition to the steam problem, fouling in the cavity can occur due to the mineral content of the water, and mineral deposits can collect in the heat exchanger, degrading its cooling capability quickly and substantially.

An alternative to water cooling is to limit the amount of heat transfer from the pump end to the seal cavity. For example, if there is a 78°F (26°C) ambient temperature and the system oil temperature is 600°F, the seal cavity temperature can be held below 270°F (132°C) by insulating the seal cavity and air-cooling the seal housing. With this arrangement, a conventional Viton elastomer seal can be used successfully and have a long service life. A carbon graphite isolation bushing will provide

Installing a Pump Properly

Selecting the right pump is only the first step to ensure proper operation in your application. Good installation practices are key to success.

When laying out and installing a pumping system for handling industrial and petroleum liquids, especially systems handling volatile liquids, the suction piping should be as short as possible. All horizontal runs should slope up to the pump to avoid air pockets in the suction line.

Many pumps are installed as replacements, where it is necessary to use existing suction lines. In these cases, the lift and friction of the piping should be carefully analyzed so the pump selected does not exceed pipe capacity.

On installations involving suction lifts, a good foot valve or line check located at the beginning of the suction lift or an angle-check valve at ground level will help ensure flow as soon as the pump is started. Careful consideration should be given to the friction loss through the valve. In addition, fittings should be provided to permit the installation of vacuum and pressure gauges on each side of the pump if the pump does not have them.

On the discharge side, quick-closing valves or nozzles should not be used on the discharge lines. Also, a check-valve should be installed in the discharge line as close as possible to the pump when the static discharge head exceeds 25'.

Source: ITT Marlow

thermal insulation between the pump and seal cavity. With this design, hot oil does interact and enter the seal cavity, but in small amounts. External cooling is provided by a fan that takes air from around the motor and moves it across the seal housing. This cools the seal housing, which in turn cools the oil. This design yields a product that performs well using standard Bellows-type seals.

Another consideration regarding hot oil pumps is the lubrication of mechanical seal faces by the pumpage. If a high temperature oil contacts the outside, it will oxidize between the seal faces and distill into a viscous, varnish-like material that abrades the seal. This is commonly called coking, and once these carbon solids form, they adhere to the seal and grind it to failure. Conventional hot oil pumps with water cooling have limited seal face life compared to designs that cool the oil before it reaches the seal. Cooling the oil also minimizes coking problems because a low temperature is maintained at the seal point.

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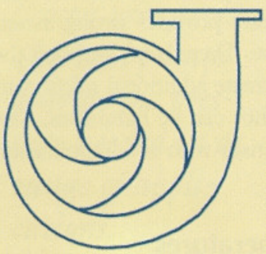
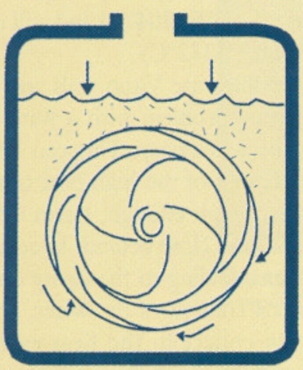
Understanding Pump Basics



A centrifugal pump is one that employs centrifugal force for pumping liquids. Liquid entering the eye, or center, of the impeller is accelerated by the impeller vanes to a high velocity, then thrown out from the rotating vanes by centrifugal force into an annular channel or volute to the discharge. It differs from a rotary positive-displacement pump in that there is no close internal fit of rubbing or sliding parts.



The self-priming centrifugal pump combines the smooth, quiet, efficient operation of a straight centrifugal pump with the self-priming characteristics of a rotary pump. It has an impeller rotating within a stationary diffuser. Air is mixed with liquid at the vane tips during priming action, and when primed, the diffuser acts as several volutes.

Source: ITT Marlow