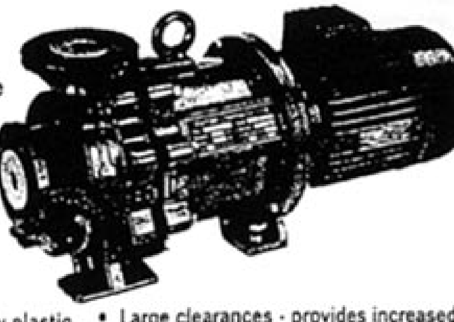
New Pump Technologies Offer Savings



Pumping is the heart of any processing operation. The material (whether gas, liquid, or slurry) has to be delivered to the ancillary processes before anything else happens, and that happens ever more effectively due to advances in process pump technology. Experts from ITT Industrial Pump Group (Cincinnati, OH) address the latest news in the industrial pumping field:

The pumping of highly corrosive liquids requires careful material selection and robust pump design to prevent leakage and contamination of the environment and to optimize mean time between planned maintenance. Conventional metal pumps manufactured of Hastelloy C and other more noble alloys can be an expensive proposition and require 14 weeks or longer for the delivery of special non-stock metallurgies. In addition, spare parts inventory, a virtual necessity for minimizing downtime, can represent a significant investment to the user and tie up vital resources which can be applied elsewhere.

Plastic lined magnetic drive pumps are becoming an increasingly popular choice for many severe service applications where leakage to the environment cannot be tolerated. The selection of liner materials depends on several important considerations in order to maintain reliability. Since the plastic liner is exposed to the process liquid, the key properties which must be considered in the application are: degree of corrosion resistance, temperature capability, resistance to permeation and abrasion resistance. Although, there are a variety of liner materials available to suit specific applications, PFA/PTFE offers the highest degree of confidence in a fluoroplastic liner material from the standpoint of corrosion resistance and temperature capability. High performance PFA/PTFE lining materials are virtually inert to chemical attack and have the flexibility of allowing the pump to be used in a wide variety of services while maintaining reliability. For applications requiring lower corrosion and temperature resistance the partially fluorinated PVDF and ETFE have been used successfully. UHMW-PE is a material which is particularly well suited for the pumping of abrasive solids in suspension provided temperature and corrosion resistance is satisfactory.

Plastic-Lined Magnetic Drive Pumps

Certain features of heavy duty plastic lined magnetic drive pumps are key to realizing economic benefits not only during the initial cost and installation of the unit, but also in lowering operating costs and reducing those costs associated with maintenance, cleanup and downtime.

High performance plastic lined magnetic drive pumps consist of a pressure containing metal outer shell covered internally by a typical 1/8 to 3/16 inch plastic coating of internal wetted parts. The metal outer shell, normally ductile iron, provides the structural rigidity to handle the pump internal pressure and external nozzle loads while the liner material provides the corrosion resistance. All wetted components are either covered by a plastic liner, manufactured of solid plastic, usually fiber reinforced, or made of engineered ceramics, such as silicon carbide, for the product lubricated bearings. Several key features of heavy duty plastic lined magnetic drive pumps are distinguishing from other lighter duty designs:

- Higher working pressure - full 150 pound flange rating to 275 psig.
- Superior corrosion resistance - PFA/PTFE plastic linings provide near universal corrosion resistance.
- Higher temperature capability - PFA/PTFE plastic linings have a maximum temperature limit of 360°F (180°C).
- Short term dry running silicon carbide bearings - silicon carbide is chemically inert, highly wear resistant and has excellent load carrying ability. Dry run capability is essential protection for surviving system upsets and occasional operator error.
- Heavy duty bearing carrier - supports all wet end bearing loads; no additional loads and vibration on the containment shell.
- Large clearances - provides increased reliability and allows for internal growth of rotating parts and solids passage.

Economic Benefits

Heavy Duty PFA/PTFE plastic lined magnetic drive pumps become economically important when comparing their costs to pumps with metallurgies such as Hastelloys and more exotic alloys such as titanium and tantalum. A favorable cost comparison can also be made for a PFA lined pump against conventional sealed pumps of Hastelloy C construction with double liquid lubricated mechanical seals or gas lubricated barrier seals.

- Since many unloading and transfer services require the pumping of a wide range of corrosive liquids, these services can be accommodated both easily and cost effectively by the use of a single pump with PFA/PTFE liner without risk of failure.
- Lined magnetic drive pumps can also be furnished in a close coupled arrangement whereby the outer magnet carrier is mounted directly onto the motor shaft and a separate pump bearing frame is eliminated from the design.

Inherent to the design of a plastic lined magnetic drive pump is a nonconductive containment shell. Typically the containment shell consists of a corrosion resistant liner material with a fiber reinforced backing. Dual containment shells are available which can be monitored for leakage between inner and outer shells, thereby providing secondary containment and an early warning in the unlikely event leakage occurs. Since the shell is nonmetallic, it is not electrically conductive and isn't subject to eddy current losses as in metal containment shells. Eddy currents are generated when rotating lines of magnetic flux cut through a stationary can conductor. These eddy currents are influenced by the geometry of the containment shell, shell material and pump operating speed. In metal shells a material of high electrical resistivity, such as Hastelloy C, is normally selected to keep eddy currents to a minimum. These eddy currents represent lost power which produces heat in the shell due to its electrical resistance. Magnetic drive pumps with nonconductive shells can operate as efficiently as conventional pumps with double mechanical seals and provide potential annual savings of thousands of kilowatt hrs in operating costs over metal containment shells. For example, a 50 hp pump with a nonconductive shell in continuous service will have an annual cost saving of $5200, based on a kwhr cost of $0.08.

Life cycle costs include not only first cost but the total cost of ownership. In addition to energy costs, these include parts and labor for overhauling the pump, lost productivity due to downtime and any costs associated with environmental cleanup and disposal of contaminants. These life cycle costs are influenced by material compatibility, robustness and simplicity of design and the ability of the unit to tolerate system upsets or occasional operator error. The design should be simple enough to allow the user to quickly repair the pump at the plant while offering little risk of improper assembly by unskilled workers.

For clean liquids, with little or no abrasive solids, there can be longer periods between planned maintenance since no corrosion occurs in PFA components.

Dry running has long been considered to be a major weakness of sealless pumps and a leading reason for users not purchasing these types of pumps. Product lubricated bearings of sintered silicon carbide (SSiC) offer important advantages in chemical inertness, wear resistance, temperature stability and load carrying ability. However, these bearings are particularly sensitive to dry running which occurs frequently in transfer and unloading services. Tests at 3600 rpm by one manufacturer confirm that silicon carbide will be destroyed in a matter of seconds if allowed to run bone dry.

Some manufacturers provide carbon bearings to attain short term dry running capability but these bearings have shortcomings in chemical compatibility, load carrying capability, increased wear rate and an intolerance for handling solids, particularly important since process liquids are seldom pure.

The elimination of a conductive containment shell from the design, as mentioned in the preceding section, eliminates the high temperature increase attributed to eddy currents which can cause shell temperatures to reach 1000°F in a matter of seconds during dry running.

Recently major advances have been made in dry run technology for silicon carbide bearings which will allow dry running for extended periods of time, even when bone dry. Safeglide coatings have been applied to silicon carbide bearings and tested successfully under laboratory conditions bone-dry for five (5) hrs without damage. Safeglide is a very hard, chemically inert friction reducing coating which has a dry coefficient of friction as low as 0.05. This is a reduction in friction of 85–90% over uncoated silicon carbide.

These dry run silicon carbide bearings provide valuable time to identify and rectify process interruptions before damage can occur. One added benefit for plastic lined pumps on transfer and unloading services is that the risk of mechanical shock due to slamming of the rotor, which can occur as prime is lost and re-established as the liquid level is drawn down, is greatly minimized by the cushioning effect of the plastic lining.

Prior experience of the Safeglide coating by a plastic lined magnetic drive pump manufacturer is reflected in the 1990 and 1992 repair trends at a large German chemical plant. A plastic lined pump manufacturer, began to introduce the Safeglide coating on SSiC bearings during late 1990. During 1992 this manufacturer experienced a 62% drop in repair frequency (29% to 11%) at this plant.

Plastic lined magnetic drive pumps can represent an economic alternative to metal magnetic drive pumps with metallurgies more noble than 316 ss; these pumps can become highly attractive when compared to pumps of Hastelloy C construction where savings of more than 50% can be realized. These plastic lined sealless pumps have also been found to have a cost advantage of 10 to 20% over conventional ANSI B73.1 mechanical seal pumps of Hastelloy C construction with liquid lubricated double seals and gas lubricated barrier seals. Additional savings can be realized due to lower cost spare parts inventory.

Typical delivery cycles of 3-6 weeks or less can routinely be accommodated with plastic lined pumps compared to 14 weeks or longer for special nonstock metallurgies. Close coupled pumps can provide further savings in both lower cost and reduced space requirements since the pump bearing frame, coupling and coupling guard are eliminated. Heavy duty PFA lined pumps provide near universal corrosion resistance and high temperature capability (to 360°F) which permits application flexibility for pumping a wide range of corrosive liquids while maintaining process integrity.

Nonconductive containment shells result in lower operating cost when compared to metallic shells, where power losses of up to 20% can be experienced due to eddy currents. This results in plastic lined pumps operating as efficiently as conventional pumps with double mechanical seals. The consequence of undesirable heat input to the process liquid, attributed to eddy currents, is also eliminated when nonconductive shells are used. This is of paramount importance when pumping liquids with steep vapor pressure curves.

It becomes obvious that as the technology of sealless pump design advances, the trend toward their use will increase. Demands by process pump users for more cost effective pumping alternatives as well as environmental safety will fuel this trend.

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