The Secret Is Out:

The Advancement of Submersible Pumps

Most of us have viewed with fascination the rapid development and evolution of computer technology in recent years, while perhaps overlooking some important technological advancements in the less glamorous, but nonetheless vital, process machinery sectors. Solid advances in basic machinery such as submersible pumps have demonstrated a measurable potential to enhance basic process tasks, increase equipment dependability and provide a long-term reduction in everyday operating costs.

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In this regard, many could say, "What's wrong with submersible pumps as they have been?" This would not be a surprising response in that many of the standard pump products still on the market today have remained unchanged for decades. However, advances in the engineering of pumps and pump-based equipment has been steadily evolving in a dramatic and significant way. Without fanfare, many dedicated engineers have worked to push the parameters of submersible pump design to an entirely new level of efficiency and reliability. These much-overlooked advances have enhanced the performance, reliability and energy consumption of submersible pumps. In comparison, previous approaches seem awkward, mechanically weak and generally outmoded.

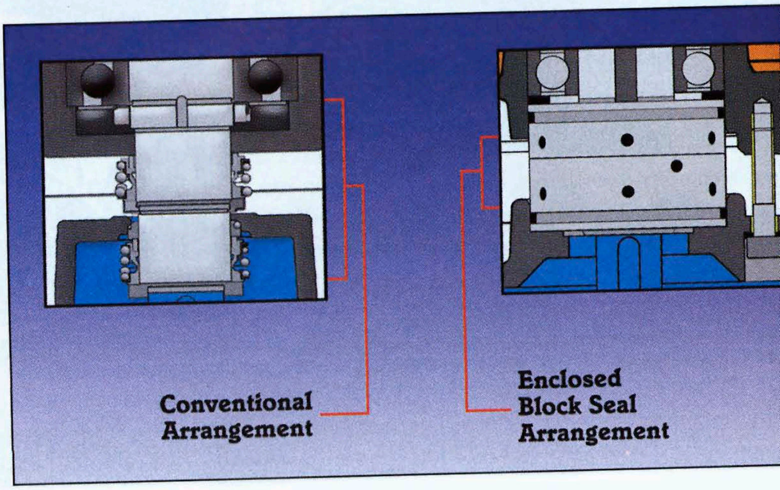
Submersible pumps using these advanced technologies are showing up in the water and wastewater marketplace, and in many of the industrial process sectors such as pulp and paper and the food industries. Submersible pumps are readily available that virtually eliminate shaft deflection as a life-cycle concern; that use sintered (a specialized heat and pressure process) silicon carbide in the creation of exceptional long-life seals; and will remain significantly cooler, even in the harshest of conditions.

The following is a brief summary of some of the key advances that have put today's submersible pumps several generations ahead of the old outmoded desig that required near-continuous maintenan

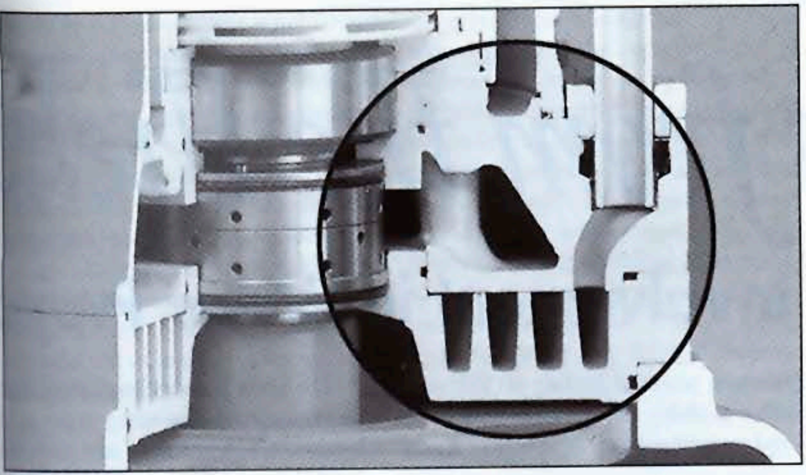
Shaft Deflection

A major enemy to the life of su mersible pumps has always been sh deflection. Deflection is a totally destru tive force inside a submersible pump. causes vibration that adversely affects mechanical seals that ride on the shaft a eventually produces a distortion of the s faces. Deflection also causes the beari to absorb angular forces on their roll resulting in internal misalignments t act to increase bearing load.

Deflection has been virtually elimi ed in advanced submersible pumps by diameter-to-shaft length ratios. The o mum equation is simple to visualize: thicker the shaft and the shorter the s length between the lower bearing and impeller, the better suited the entire pu system is to resist deflections. The rati shaft length to shaft diameter is known to be one of the critical factor the strength and stability of any pu This is because an overly large ratio m



Conventional Arrangement Versus the Enclosed Block Arrangement. This diagram compares the conventional mechanical with the more advanced enclosed block seal arrangement. Note the length of shafting taken up by the seal faces and external springs is much longer than the space necessary to accommodate the enclosed block design of equal shaft size. This factor directly affects the critical shaft thickness to length ratio.



This is a close-up view of the heat exchanger used in a submersible pump. Every customer should consider checking the exchanger when purchasing submersible pump technology.

the shaft prone to substantial deflection when forces are placed on it.

In some submersible pumps, even in some of the pumps being sold today, shaft-length to shaft-diameter ratios are as high as 7 to 1 or even, in extreme cases, 10 to 1. Operational experience has shown that a shaft with a length 7 or more times its diameter will deflect dramatically when subjected to operational loading, causing seal faces to open. This, in turn, allows grit and other contaminants between the faces, reducing the overall life of the equipment.

Shaft deflection is virtually eliminated by large-diameter shafts composed of the highest-quality shaft materials, and by the maintenance of a proper shaft-length to shaft-diameter ratio. One company has minimized shaft deflection by using type 420 Stainless Steel as shaft material and a shaft-length to shaft-diameter ration of only 2.5.

Seals

Over the years, the number one cause of submersible pump malfunction has been the failure of the mechanical seal to keep out water. In years past, submersible pump seals were constructed of thin sections of tungsten carbide that was soldered to a stainless mounting plate. The solder, being soft, was easily worn away. This deterioration was especially apparent when certain abrasives in pumped liquid swirled around the seal.

Improved seal technologies eliminate this problem. In a state of the art submersible pump, seal integrity is maximized by a silicon carbide seal material, in both the upper and lower mechanical seal positions. Seals made of silicon carbide consist of thick sections that are sintered so that the entire seal face and mounting surfaces are one-piece construction. They have no soft areas to wear or leak.

In addition to greater seal integrity, solid silicon carbide conducts heat away from seal faces better than tungsten-based seal components. The thinness of the tungsten on conventional seal faces make them particularly susceptible to heat damage.

Field Installation

The typical approach to seal design by most manufacturers made field replacement almost impossible and always unsatisfactory. Old-style seals had to be removed and installed in pieces and contamination was inevitable. A new design groups both the upper and lower sets of mechanical seals inside an enclosed block seal housing. This approach allows easy servicing because each set of seals is factory set with the correct spring pressure and does not require field modification. Replacing the housing is simple and can be done without sending a pump to a service center. All that is required to replace the housing is to loosen a few bolts, replace the housing and retighten the bolts.

Internal Cooling

The cooling of a pump motor takes on critical importance when it is totally sealed against moisture intrusion. In fact, in IEEE tests it was determined that for every ten degrees in heat reduction, the life of the motor stator (windings) is effectively doubled. That is why today's submersible pumps are engineered with greater attention to heat transfer components. One manufacturer uses closed loop circulation cooling and heat transfer strategies to dramatically reduce stator temperatures. Pump designs that fail to focus on internal heat dissipation will be robbing the end-user of valuable pump life.

Evolution

Unlike electronic equipment and systems that have experienced a "revolution" in operational technology, tried-and-true equipment such as submersible pumps have undergone a natural "evolution" in technology. The features of the most advanced submersible pumps today include the use of ideal shaft-diameter to shaft-length ratios; silicon carbide seals; innovative seal housings; and highly efficient cooling systems. Although these advances have not received the publicity common to the electronic field, these advances in submersible pump technology have moved pumps to a new level of operating efficiency and are bringing submersible pump users a better value.

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