Why Seal-Less Pumps Can Provide Benefits Over Sealed Pumps

WHEN MANUFACTURING OR HANDLING DANGEROUS AND HAZARDOUS CHEMICALS, FULL PRODUCT CONTAINMENT IS NECESSARY AND SEAL-LESS PUMPS CAN IMPROVE SAFETY, AND OPTIMIZE MAINTENANCE AND OPERATIONAL COSTS

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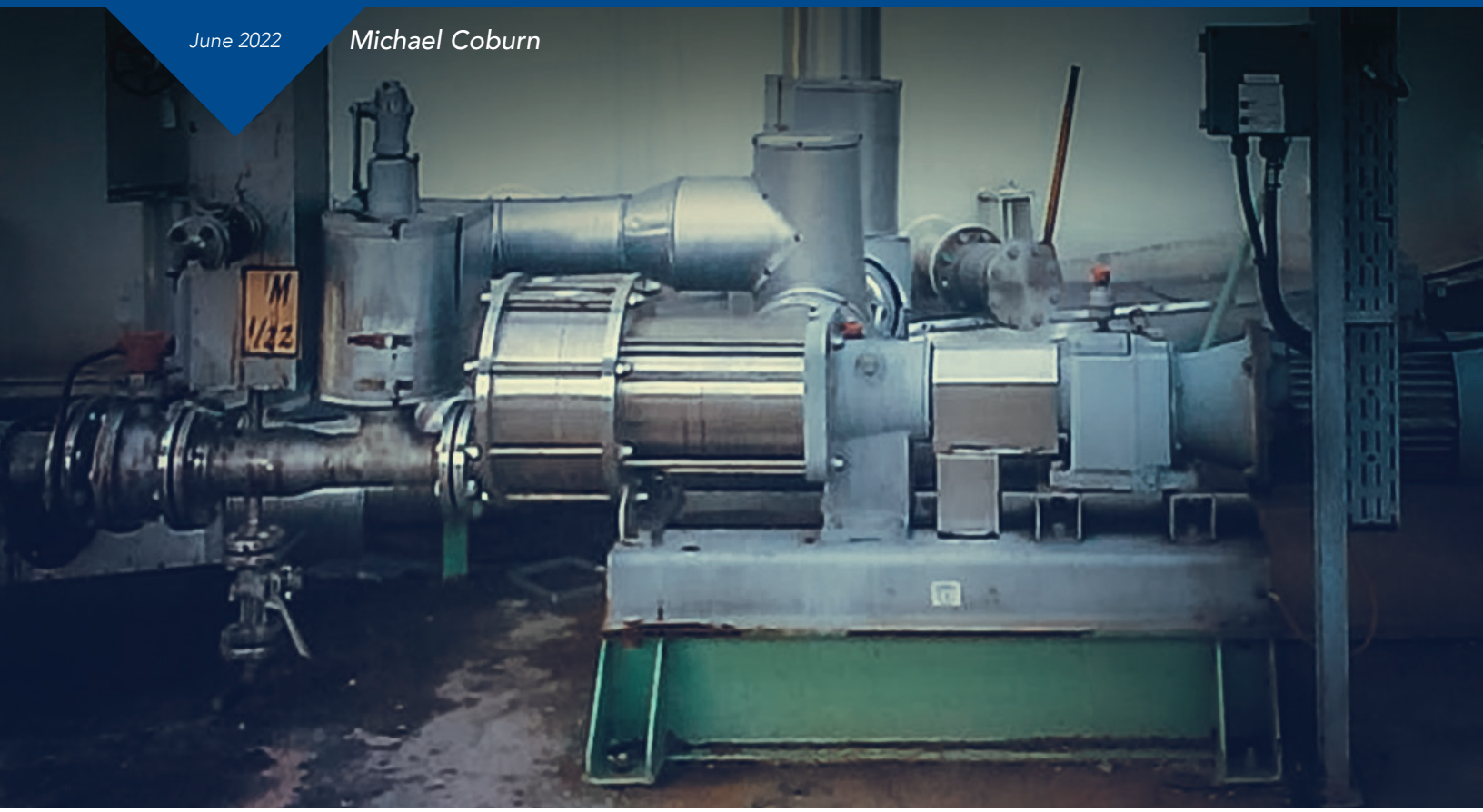

Introduction

The inherent irony that is at the root of many industrial-manufacturing processes is this: oftentimes, "bad" things are needed in order to produce "good" things. Or, to be a little more specific, hazardous things are needed in order to manufacture useful things. Manufacturers who produce chemical-based compounds such as caustics, acids, solvents and polymers should be well aware of this dichotomy.

Hazardous substances like toluene, xylene, ethylene oxide and anhydrous ammonia – along with a host of hundreds of others – that can be harmful to humans and the environment if mishandled are nevertheless indispensable components that must be used in a large number of industries and end products. A tip-of-the-iceberg list of such industries and products includes, but is hardly limited to, petrochemicals, paints and coatings, soap and detergents, biofuels, adhesives, pulp and paper, food processing, and herbicides and pesticides.

In addition to being widely used and potentially dangerous or hazardous if mishandled, many chemical compounds are also extremely expensive. If a leak were to occur during the handling or transfer of these products, large costs would be incurred by the operator through the loss of raw materials, as well as for cleanup and potential environmental remediation. These factors combine to make the full containment of dangerous chemicals a front-of-mind concern for facility operators.

Pumps are critical pieces of equipment used in the manufacture and handling of dangerous chemicals. They are commonly used to introduce raw materials into the production process or to transfer end products for packaging, storage or shipping to end users. Mechanically sealed pumps have become the accepted technology of choice for these transfer activities. However, this white paper will attempt to illustrate how seal-less pump technologies can be a more effective choice when full containment of dangerous and valuable chemicals is an absolute must.

Challenge

When handling dangerous chemicals, there are four main areas of concern that manufacturers must identify and satisfy:

- **Safety:** Ensuring that site personnel, surrounding communities and the environment are not harmed
- **Product Containment:** When dangerous or hazardous products are fully contained and not allowed to leak, valuable raw materials and products are not lost to the environment, improving safety overall
- **Maintenance:** Mechanical shaft-seal failures are the No. 1 cause of pump downtime in chemical-processing activities. Excessive maintenance costs generally are accumulated in two ways – the need to constantly repair, rebuild or replace underperforming pumps or components, and in the downtime that brings production runs to a halt for several hours or days
- **Operating Costs:** An overlooked strain on the bottom line can be found in the form of seal-flush water, with the impact of the seal water on the process and the cost of the flush water needing to be taken into account when creating a budget

The most common pump technologies that are used in the manufacture and handling of dangerous chemicals include diaphragm, sliding vane, lobe, progressive cavity, centrifugal and gear. All of the traditional pump technologies have one thing in common: they rely on various types of mechanical seals or packing rings to prevent shaft leakage. Mechanical seals and packing rings are present in most of the pumps used in hazardous chemical-processing applications, but both have their own potential operational shortcomings:

- **Packing Rings:** This method utilizes braided packing material that includes a set of formed rings that are wrapped around the pump shaft and held in place by an adjustable gland that has been designed to control shaft leakage. To that end, a small amount of leakage is needed for lubrication and cooling, which can be become problematic when handling hazardous chemicals. Therefore, while packing has been widely used in a variety of industries (such as in resin and paint and coatings), it should not be generally considered a best practice for transferring hazardous chemicals.
- **Mechanical Seals:** These seals come in two general variations: single and double. Single mechanical seals can usually adequately address the problem of fluid leakage, but when used with liquids of higher viscosity, the product drag can distort the seal or cause it to break away from the shaft completely. Single mechanical seals also are incapable of containing potentially hazardous vapors. Double mechanical seals can prevent the escape of vapors and are more reliable when handling viscous liquids, but they can be prohibitively expensive to acquire, repair, clean, maintain and replace.

While any of the various types of seals can perform admirably for long periods of time, they will eventually need maintenance or need to be replaced before major shaft leakage can occur. Replacing the seals, not only after they fail but also as a form of preventative maintenance, is costly and will result in downtime that can slow the production process.

The cost of a leak to a manufacturer includes the loss of valuable raw materials or finished products, downtime in production, and the costs and potential penalties associated with a chemical-cleanup process. Leaks of hazardous materials that reach the outside environment can be subject to fines and remediation costs from the U.S. Environmental Protection Agency (EPA), as well as other local and state regulatory agencies. Additionally, other countries have their own sets of regulations, which can often me more stringent than those in the U.S. Spilled hazardous materials also pose safety risks for site personnel and cleanup crews, which raises liability issues, while a major leak that can cause damage to the environment can have far-reaching negative effects.

The Solution

While sealed pumps can perform admirably in the manufacture, transfer and handling of dangerous chemicals and other hazardous materials, the shortcomings that are inherent in their sealed design can make them insufficient for the job. Fortunately for the operators of chemical-manufacturing facilities, there is an alternative technology that can help eliminate some of the major concerns associated with achieving full containment: seal-less sliding vane, internal gear and eccentric disc pumps.

Let's take a look at the advantages of a few specific seal-less pumping technologies:

- **Sliding Vane:** Seal-less sliding vane pumps constructed of corrosion-resistant stainless steel generally feature a magnetic coupling consisting of samarium-cobalt magnets and a unique bearing and head design that allows a small quantity of the pumpage to circulate through the containment can and onto the bearing surfaces. This positive flow of fluid minimizes temperature rise during operation, which helps maximize bearing life. Replaceable 316 stainless-steel end discs allow easy rebuilding of the pumping chamber to like-new condition without having to remove the pump from the piping. Additionally, carbon-graphite sleeve bearings help ensure no metal-to-metal contact during operation. Operationally, seal-less sliding vane pumps offer the same advantages as their sealed cousins: volumetric consistency, self-priming and limited dry-run capability, drain plugs that allow easy draining and easy replacement of worn vanes.
- **Internal Gear:** Technological advancements in internal gear pump design and operation now offer to the market models that have only one fluid chamber. This method of construction removes the adapter plate that is a staple of traditional two-chamber magnetically coupled internal gear pumps, which eliminates product entrapment concerns, especially when transferring high-viscosity liquids. One-chamber operation is achieved through a between-the-bearings design that places the magnets directly on the pump rotor, resulting in a simpler flow path and full leak-free product containment. Some seal-less internal gear pump models are also constructed

of as few as seven parts, which helps contribute to an estimated 50% reduction in maintenance costs when compared to sealed pumps. There are also seal-less internal gear pump brands and models that are interchangeable with 95% of competitive sealed or packed-gear pump brands, making time-saving drop-in replacement a reality.

- **Eccentric Disc:** Seal-less eccentric disc pump models feature no mechanical seals, packing, couplings – or even magnets, with the shaft sealed instead by a unique double stainless-steel bellows. Operationally, seal-less eccentric disc pumps can still offer self-priming, dry-run and low-shear operation, very high suction lift and discharge pressures, the ability to pump both low- and high-viscosity liquids and clean-in-place/sanitize-in-place (CIP/SIP) capability. Additionally, by virtue of the unique eccentric disc operating principle that allows them to pump air, seal-less eccentric disc pumps can achieve product-recovery rates of 90% or more on the suction side and 60% to 80% on the discharge side of transfer lines. This enhanced product-recovery capability can result in thousands of dollars in cost savings annually from the retrieval of still useable raw materials and saleable end products.

These varying types of seal-less pump technologies check all of the right boxes when it comes to overcoming the four major challenges in handling dangerous chemicals or hazardous materials: optimized safety; full product containment; reduced maintenance; and streamlined operating costs.

Conclusion

Sealed pumps have been performing sufficiently in chemical-manufacturing operations for many years. However, operators who are looking for a better alternative are now able to upgrade their facilities with seal-less pumps. These types of pumps will reduce leakage events and improve containment of dangerous or hazardous materials. Maintenance costs can also be lowered to such a level that the lifetime cost to operate the seal-less pump may be half that of a sealed model. Most important to the operator, the use of seal-less pumps can increase the peace of mind that comes with knowing that not only is personal and environmental safety being optimized, but that the bottom line is also receiving a boost.

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