SEALLESS PUMPS
FOR SAFETY RELIABILITY & PROFITABILITY

The magnetic drive pump was invented 70 years ago, yet they remain a niche solution typically used for solving hazardous pumping applications.

While sealless magnetic drive pumps feature fewer leak paths and their component parts boast higher reliability than traditional sealed pump designs, some engineers are still reluctant to use this proven technology, the legacy of a handful of early historical failures.

However, new technologies and tools are now available to help avoid mis-application plus further advance and enhance the safety and reliability of magnetic drive pumps.

The potential failure modes associated with sealless magnetic drive pumps are known and documented. The first is when metallic containment shells are used. Inductive heating can occur because of the eddy currents created by the rotation of the magnetic coupling around the containment shell.

Overheating of the metallic containment shell can happen within seconds if the inner rotor assembly is seized, or more slowly if vapour or gas is allowed into the pump. This unexpected eddy current heat generation may flash the process liquid and disrupt bearing lubrication.

Without lubrication, the bearing system can catastrophically fail, potentially damaging the containment shell. For a magnetic drive pump, this condition can now be addressed in three ways:

- Elimination of a potential failure mode by the use of a composite containment shell
- Use of instrumentation to detect and shut down the pump when causal factors are present
- Mitigating the risk of the pump leaking through containment shell failure with secondary containment/control

An ultrasonic instrument detects vapour in liquid down to 1 percent by volume. It provides early and direct indication of a potentially damaging operating condition.

Composite Containment Shells

The use of a nonmetallic containment shell is the preferred method for preventing this type of failure, since it eliminates the key source of heating that can lead to pump breakdown. Lined process pumps include a nonmetallic containment shell that eliminates eddy current heat generation and its related failures. Metallic magnetic drive pumps have also adopted nonmetallic containment shells. This is a composite shell that is nonconductive and will not generate eddy currents from the magnetic flux passing through it.

Composite containment shells are chemically resistant and exceptionally tough. They feature fire, erosion and impact tolerance that in many cases are superior to metallic options.

Instrumentation

The second method of mitigating risk of a potential containment shell failure is to employ instruments that can enable the pump to detect when causal factors or early failure symptoms are present. Historically, this has included installing power control monitors on the motor to detect a low-load condition from a run-dry situation. Running a sealless pump dry, without liquid, can result in damage, because without process liquid flow, heat removal from the containment shell is lost as well as a loss of lubrication for the internal process lubricated bearings.

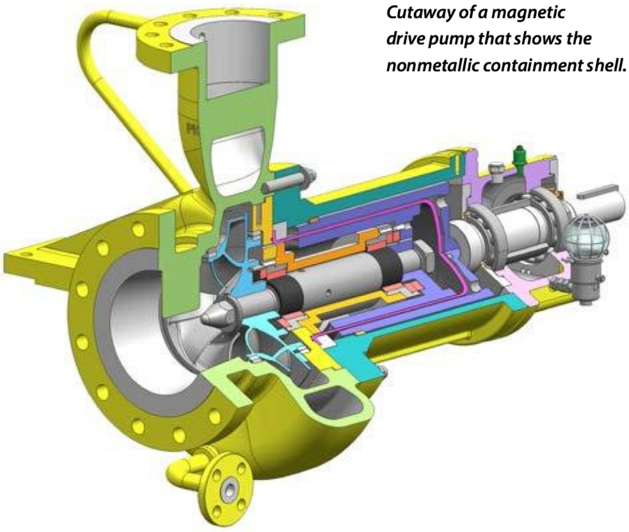
Other monitoring techniques include temperature sensors on the containment shell to detect the temperature rise in the containment shell, leak detection sensors, and low-level or low-flow monitoring of the process liquid to detect if a run-dry or loss of cooling condition might be present.

These are indirect measures of a key operating parameter critical for providing bearing lubrication and heat removal. Direct measurement of the gas vapour content of the process liquid is now available using an ultrasonic sensor that is fitted to the pump housing. One ultrasonic instrument is capable of detecting gas bubbles on the order of less than 1 percent by volume.

Secondary Containment

The final way of mitigating the effects of containment shell failure is via secondary containment or control. In this situation, with a failure of the primary pressure boundary, the leak path of the process liquid is directed into a secondary housing. The secondary housing is either a further containment shell wrapped around the primary shell or the magnetic coupling housing with the inclusion of a leakage restriction device on the outer magnet assembly driving shaft.

A secondary containment shell typically requires thinner primary and secondary containment shells to enable the process fluid in the internal flow regime to provide suitable cooling for both shells.



Cutaway of a magnetic drive pump that shows the nonmetallic containment shell.

Additionally, the secondary containment shell is subject to the same induction heating as the primary containment shell, so a common failure mode is present even with the secondary shell. Using the magnetic drive housing for either secondary containment or control requires the use of a leakage restriction device or a mechanical seal. In this situation, the pump acts as a hybrid tandem sealed pump, with the primary seal being the single containment shell of a magnet drive pump. This arrangement has the advantage of separating the primary and secondary sealing devices such that the initial failure mechanism that caused the primary device to fail does not negatively impact the integrity of the secondary device, in this case the secondary seal. A further benefit of this arrangement is that it allows the use of a nonmetallic containment shell or a thicker and more robust metallic containment shell.

These new technologies are significantly improving the reliability of sealless pumps. The elimination of seal support systems and higher reliability of the magnetic drive pump components over sealed pumps make sealless pumps a compelling alternative choice for process engineers. As environmental safety and the safety of personnel come under increased scrutiny, sealless pumps should be considered as a favourable option to reduce the high operating costs associated with emissions monitoring and seal support systems.

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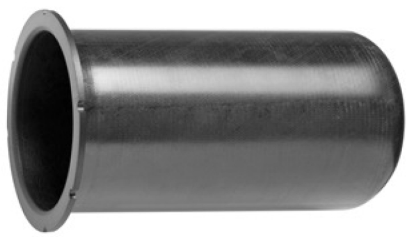

Magnetic drive pumps with nonmetallic containment shells are available to comply with API 685 specification.