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## **Question 2: Have seal-less pumps (magnetic drive or canned pumps) been used successfully in HF and sulfuric acid alkylation units? What services are considered for this equipment?**

**MELDRUM** (Phillips 66)

Yes, sealless pumps have been successfully used in both HF and sulfuric alkylation processes, typically in the acid rerun system for the HF process and fresh acid service for the sulfuric process. However, the API-610 sealed pump is, by far, the most commonly used pump based on the fact that API 610 pumps are familiar within the refinery for the Maintenance and Projects groups and also because of their robust design and relatively low initial cost.

As I reviewed some of Phillips' process design specifications, I found a statement referring to both magnetic drive and canned pumps: "We do not have enough experience with this type of pump to recommend features and styles." It was also mentioned in the specification: "Because of the slightly magnetic nature of nickel copper alloys, the containment shell of the mag-drive pump for HF service should be Hastelloy C-276."

The interest in sealless pumps is due to the lower risk from potential seal leaks. However, it is now quite common practice to use dual seals for acid service. Also, the seal reliability has improved over the years. Therefore, the risk of a sealed pump in HF acid service, in particular, has been reduced. One risk consultant stated that the limited history on sealless pumps in HF acid service results in his refinery using the same failure rate as that of a dual-sealed pump when they conduct their quantitative risk assessment studies. What I have concluded is that when considering sealless pumps for new construction or major equipment replacements, you should work with a risk consultant to determine if the sealless pump is effective at achieving your risk management objectives. I have also provided, in my Answer Book response, several considerations to review as you look at selecting a pump for HF acid service.

**BULLEN** (UOP LLC, A Honeywell Company)

UOP has limited experience with sealless pumps in HF units. The one concern we have is that these types of pumps are different than most of the other pumps in the refinery; so, you really need to have Operations and Maintenance crews who are experienced dealing with this type of pump. A lot of human error can creep in and cause the pumps to fail. The experience we have had has been in relatively small-sized applications such as the acid rerun feed pump. One of our customers in Europe has actually been successfully using three pumps in circulating acid, settled acid, and isostripper reflux operations since 1994. So, it is possible to have a long run with these types of pumps. Also, sealless pumps tend to not meet requirements for API standards; they are ASME (American Society of Mechanical Engineers) standard type pumps; so that can be an issue. As Craig said, dual seals have gotten a lot better in the past 20 years and become more reliable; so, it is questionable whether you are actually safer with the

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sealless system, in terms of reliability and leaks.

**ROBERTSON (AFPM)**

Does anyone else in the audience have experience with sealless pumps?

**CHRIS GREEN (Marathon Petroleum Corporation)**

I work at the Galveston Bay Refinery. We use the mag drive style pump on the rerun to our feed. We had previously experienced a bolting failure on the conventional style pump and the case opened up. We had good reliability. We have been using them since about 2003, and they have proven to be reliable in that service.

**CRAIG MELDRUM (Phillips 66)**

Some consideration for HF acid pump selection:

- Service Conditions: Temperature (mag-drive pumps limited to ~350°F, canned pumps can take up to 1000°F) and solids content of the pumped fluid (sealless pumps can be more sensitive to solids in the fluid)
- Durability: Operation under upset conditions or from poor operations such as dead-headed and run dry
- Cost: Initial pump cost plus the seal cost plus ongoing maintenance costs. Sealed pumps will likely have a lower initial cost, but long-term seal maintenance costs may favor sealless pumps.
- Alignment and Foundation Requirements: Pump-to-driver alignment and foundation requirements are minimal for canned pumps.
- Containment against Catastrophic Failure: Canned pumps have secondary containment by design.
- Failure Scenarios and Mitigation: Sealed pumps are most likely to fail at the seal; sealless pumps are most likely to fail at the bearing.
- Maintenance: Onsite knowledge for repairs versus factory service and spare parts inventory needs
- Technical Support: Factory support to assist in working through any ongoing issues

**PATRICK BULLEN (UOP LLC, A Honeywell Company)**

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There are two basic types of sealless pumps: magnetic drive and canned motor. UOP has limited experience with both types in HF alky units. In general, UOP's experience is that the magnetic drive and canned motor pumps can work in HF alkylation service, but they are sufficiently different from standard single-stage process pumps that require special design considerations, maintenance, and operating procedures for successful operation. UOP is aware of several cases where a refiner installed a sealless pump and experienced serious damage to that pump within a very short time due to issues such as incorrect operating procedures or insufficient spillback or flush supply. This type of damage to a sealless pump is typically VERY expensive to fix and typically requires shipment of the pump back to the manufacturer, causing the pump to be out of service for several weeks.

Most of the sealless pumps used in HF alkylation units have been relatively small sized pumps. One specific service where a few refiners have used a sealless pump is the acid rerun column feed pump.

One UOP licensed unit in Europe has had good experience with canned pumps in HF service. This refiner installed three canned pumps in 1994, and those pumps are still used today. The specific pump services are circulating acid, settled acid, and isostripper reflux. This same refiner had negative experience with a magnetic drive pump in isostripper reflux service. This refiner uses sealless pumps in other applications in the refinery such as FCC sour water.

Another licensee in Europe uses magnetic drive pumps in two very large flow services. One is the acid circulation pump, and the other is the isostripper feed pump. The experience has been good with both of these pumps. These pumps receive special mechanical attention and service, which are probably keys to their successful performance.

It is worth noting that some of these sealless pumps are not built to be compliant with all of the requirements of the API standard for refinery service pumps. Instead, they are built to ASME standards that are used predominantly in the chemical industry.

Many refiners have chosen dual seals over sealless pumps because the reliability of dual seals in acid service has improved significantly over the past 20 years or so. In addition, the dual seals have a lower cost to install on existing pumps, and the maintenance and operation of the dual seals is typically well-understood by the refinery staff.

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