The Advance of Magnetic Drives

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Since its introduction over 50 years ago, magnetic drive pump technology has come a long way.

Even though capabilities of early designs were very limited, end users showed a high level of interest from the very beginning.

The first constructions utilized magnetized AlNiCo alloy systems. Internal journal bearing components were made out of hard metal and carbon. Silicon carbide had not yet found its way into magnetic drive pumps. Compared to today's standards, the magnetic coupling capabilities to transmit torque were rather small. Soft start devices often had to be used to avoid decoupling during start-up. In order to compensate for the low efficiency of the magnetic coupling, the diameter of the coupling had to be large to provide the necessary torque rating for the pump to operate.

Figure 1 shows one of the first magnetic drive pumps. No housing was used to cover the outer magnet ring, and the outer diameter of the driving magnet ring far exceeded the diameter of the hydraulic casing.

Figure 1. A magnetic drive pump from 1958.

With the early introduction of international standards covering mag-drive pumps, together with the growing requirement to monitor for seal leaks of sealed pumps, the industry's interest in the new technology grew fast. Mag-drive pumps gained favor quickly on the European continent and in the U.S. as well.

Looking at the Current State

Today, driven by demand, manufacturers are constantly pushing the envelope and expanding the range of available hydraulics and sealless magnetically driven solutions. Magnetic drive pumps have an established position and are the first choice for many end-users when leakage cannot be tolerated.

State of the art magnetic drive pumps now exceed driving power of 700-hp, flow rates of 15,000-gpm, delivery heads of 3,000-ft TDH, system pressures of 3,000-psi, operating temperatures of 840-deg F without external cooling, and viscosities of over 3,000-cPs. Solutions for more challenging applications containing solids, gas, very low lubricity liquids or low $NPSH_A$ values are available as well.

Figure 2. A new 700-hp single stage centrifugal magnetic drive pump.

The market offers many different types of hydraulics to meet the most demanding pumping requirements: from a large 700-hp single stage centrifugal pump (see Figure 2) to a self-priming design multistage side channel pump with 1.5-ft of $NPSH_R$ (see Figure 3), to a multistage centrifugal pump for high delivery heads and high flow rates (see Figure 4).

All these designs have one thing in common – they avoid the use of a mechanical seal to handle appropriate liquids without the potential to leak into the atmosphere.

Looking at the Latest Innovations

The most recent innovation is a new generation of high performance magnetic couplings (see Figure 5). The new couplings combine the strength of the Samarium-Cobalt magnets with high temperature capabilities of induced AlNiCo magnet systems.

This innovation is a major milestone in the development of magnetic drive technology. In the past, only the less efficient AlNiCo magnet systems were capable of handling temperatures above 575-deg F without external cooling. This new groundbreaking generation of high performance magnetic couplings has the potential to replace the well-known but more expensive AlNiCo systems with a more cost-effective solution.

Many end-users already favor a sealless mag-drive pump for heat transfer applications. Especially for services above 575-deg F, the mag-drive pump now becomes an even more competitive solution.

The introduction of the API Standard 685 for sealless pumps in 2000 paved the way for mag-drive pump applications in refineries and related industries. This standard currently is the only one providing guidance on recommended design features for use in petroleum, heavy-duty chemical and gas industry services.

API 685 addresses heavy duty services and defines a service as *heavy duty* as long as any of the following limits is exceeded:

Max. discharge pressure	275-psig
Max. suction pressure	75-psig
Max. pumping temperature	300-deg F
Max. rotative speed	3600-rpm
Max. rated total head	400-ft
Max. impeller diameter	13-in

Features like a double-wall isolation shell to provide secondary containment, protecting rub rings to avoid damage to the isolation shell coming from the rotating inner and outer magnet ring, a 300-lb center-line supported casing, confined controlled compression gaskets, renewable wear rings, anti-friction bearings designed for 50,000 hours, and non-sparking labyrinth rings are only a few of the requirements API suggests when a mag-drive pump is to be used in a heavy duty service.

Even though API 685 is an American standard, companies outside the U.S. have been applying the standard on a broader range. One reason for this phenomenon might be the fact that the implementation of the API 685 standard often goes together with the construction of a new grassroots plant, but the last refinery built in the U.S. started up in 1976 in Garyville, LA – over 30 years ago!

Today, major oil related grassroots construction projects in the Middle East, Asia and Russia apply the API 685 standard successfully and use mag-drive technology for appropriate applications. Once new grassroots refineries are scheduled to be constructed again in the U.S., the API 685 standard will very likely help to identify sealless mag-drive technology as one of the most cost-effective solutions to achieve zero leakage.

Looking Forward

Forecasting the future is usually a risky business. But forecasting the future for sealless mag-drive technology seems to be somewhat easier. Here's why.

The driving factors responsible for the growing popularity of mag-drive pumps have not changed; instead, they continue to gain momentum. Environmental standards to control pollution tighten worldwide, and continuously growing application coverage increases the pool of available mag-drive solutions.

Today's magnetic drive pump designs are user friendly and allow for easy maintenance. Many years of maintenance-free service convinces even critical users that a mag-drive pump often provides the most cost effective and most reliable solution when leakage cannot be tolerated. **P&S**

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Figure 3. A self-priming multistage side channel magnetic drive pump.

Figure 4. A multistage centrifugal magnetic drive pump for high delivery heads.

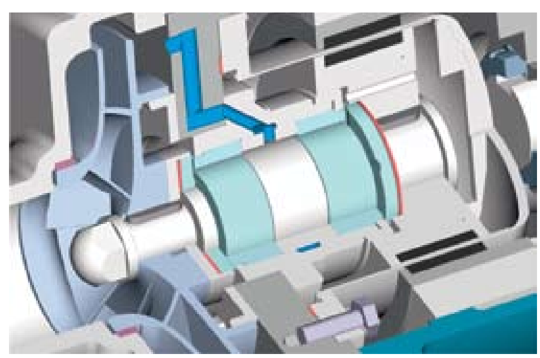

Figure 5. Illustration showing high temperature Samarium-Cobalt magnets.

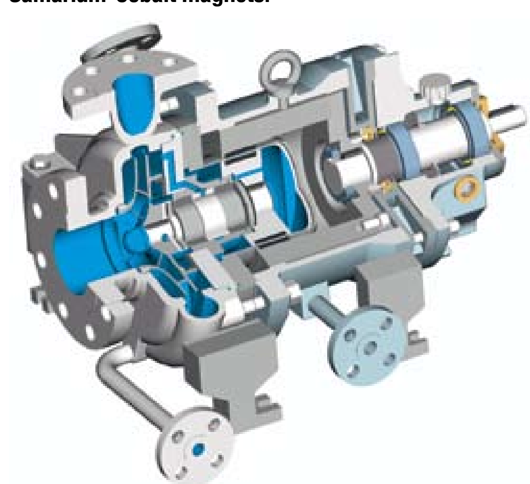

Figure 6. Illustration showing magnetic drive pump with API 685 features.