

How can I select mechanical sealing systems using life cycle costs?

This month's Sealing Sense was prepared by FSA members Scott Boyson & Nang Chau

Mechanical sealing systems can be compared in a number of ways. Obviously, one of the more important areas is reliability. Another area that can be evaluated is life cycle cost or total cost of ownership. Life cycle cost analyses for mechanical seals are often made using labor and material costs and their economic impact on production throughput. An area of evaluation with increased focus is energy costs and carbon footprint.

Estimating Life Cycle Costs

A tool is now available from FSA to evaluate multiple sealing systems and a wide array of parameters to assist in identifying the best sealing system. Alternative mechanical sealing systems can be compared as each alternative will likely have an impact on reliability, cost and energy consumption. In addition, alternatives to mechanical seals, such as compression packing, can also be compared. The FSA's Life Cycle Cost Estimator Tool is available online at <http://www.fluid-sealing.com> and can provide excellent insight into choosing the optimum sealing system.

Data Input

The Life Cycle Cost Estimator Tool can easily be used by inputting specific data or accepting the default data. Up to three sealing systems can be analyzed at any one time. Data inputs are separated into four areas—equipment, plant, seal and support system information. A summary of the data inputs is below:

- Equipment information
 - Equipment repair costs
 - Hours per year of operation
 - Lifespan
- Plant utility data
 - Energy costs
 - Water costs
 - Labor costs

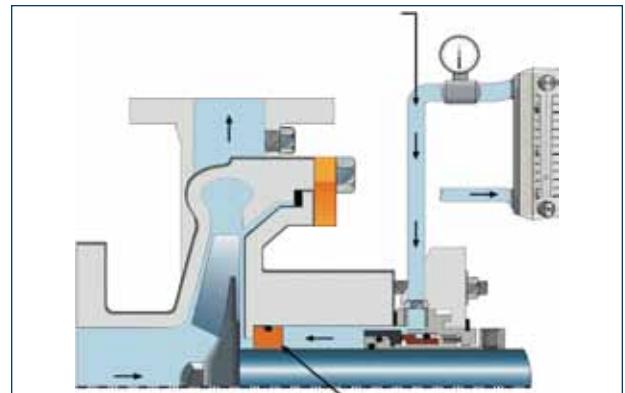


Figure 1. API Plan 32, flush arrangement

- Mechanical seal data
 - Acquisition cost
 - Repair costs
 - Speed, pressure and temperature
 - Estimated mean time between repair (MTBR)
- Seal support system data
 - Acquisition cost
 - Repair costs
 - Temperature and flow

The Life Cycle Cost Estimator provides cost outputs in a number of areas including:

- Operating
- Equipment maintenance
- Seal maintenance
- Support system
- Production loss
- Environmental
- Energy

The cost estimator delivers a net present value cost calculation and a power consumption or energy footprint calculation.

Example

An existing centrifugal pump is being investigated for a new sealing device. The pump returns condensate to the boiler section of the plant. Previous mechanical seals failed due to condensate flashing at the seal faces resulting in poor seal face lubrication and overheating from the resultant frictional heat. The question is which sealing system option is the best choice for the application as each of these options vary in their initial cost, maintenance costs and operating costs.

Using an API Plan 32 flush to cool the process fluid in the seal chamber is among the many options for sealing this pump. An external flush fluid, typically at a lower temperature, is injected into the seal chamber to cool the temperature of the process.

Another option is to use an API Plan 21 and direct fluid from the discharge of the pump into a heat exchanger to cool the process fluid. The cooled discharge fluid is then used to flush the seal chamber and replace the hot process fluid with cooled fluid. Significant cooling can be achieved from this environmental control.

Another option is to use a single seal specifically engineered to reduce frictional heat generation in hot water service. Hot water is difficult to seal without cooling as it is a poor lubricant and can easily vaporize between the seal faces. By engineering a seal to provide greater film thickness at the seal faces and

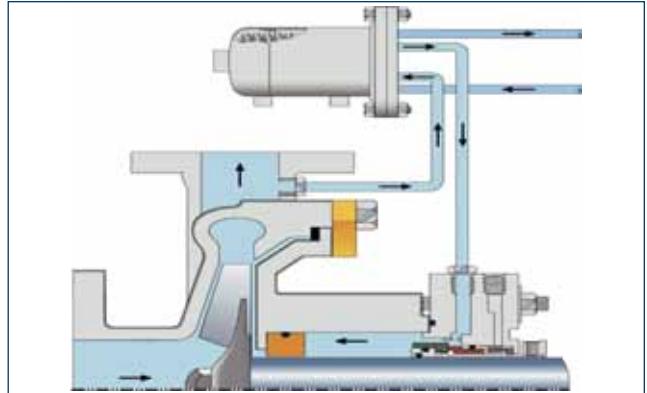


Figure 2. API Plan 21, discharge recirculation arrangement through a heat exchanger

modifying the balance ratio, these issues are minimized without the need for cooling. An API Plan 11 is often used to promote circulation and increase pressure in the stuffing box.

Results

So if we compare three sealing systems, Plan 32 Flush, Plan 21 Discharge Recirculation and Plan 11 Engineered Seal for the following pump, which has the lowest life cycle cost and lowest energy consumption over a 15 year period? The condensate is

Simplify your Station Management using the SC2000

SC2000 CONTROLLER

Your Pump Station Monitoring and Control Solution
The Simplest, Most Dependable Controller In The Industry.

- **Convenient** - Now has Flow Totalization and Wet Well Wash features.
- **Powerful** - Ethernet Modbus TCP and Ethernet Modbus RTU.
- **Reliable** - Thousands operating flawlessly in the field.
- **Versatile** - Operates with 4-20mA signal, Level Probes, or Floats.
- **Practical** - SCADA-Ready Modbus RS232 and Ethernet connectivity.
- **Durable** - Transient-Tough for use in harsh environments!
- **Friendly** - All parameters and input status viewable from display.
- **Effortless** - Designed for both Constant Speed and Variable Speed Lift Stations from One to Four Pumps.

mpe Inc.
MOTOR PROTECTION ELECTRONICS INC.

Proudly Made in the USA

tel • 4 0 7 • 2 9 9 • 3 8 2 5
web • www.mpelectronics.com

circle 134 on card or go to psfreeinfo.com

SHARING COMPETENCE
pfannenbergusa.com

There's a reason we use backward-curved impeller fans.

It's about the right part for the job.

The backward-curved design of our fan is non-overloading and more resistant to fouling than its forward-curved counterpart. Its motorized impeller includes a sealed motor with a single large bearing that doubles the service life from that of a forward-curved fan to over 55,000 hours. And the plenum-style arrangement provides a natural right-angle path and uniform air flow to provide efficient heat transfer.

With over 50 years of experience, every element – including fan selection – of Pfannenberg's thermal management equipment is optimally designed and field-tested to provide efficient, long-term performance.

Pfannenberg
ELECTRIC TECHNOLOGY FOR INDUSTRY

circle 135 on card or go to psfreeinfo.com

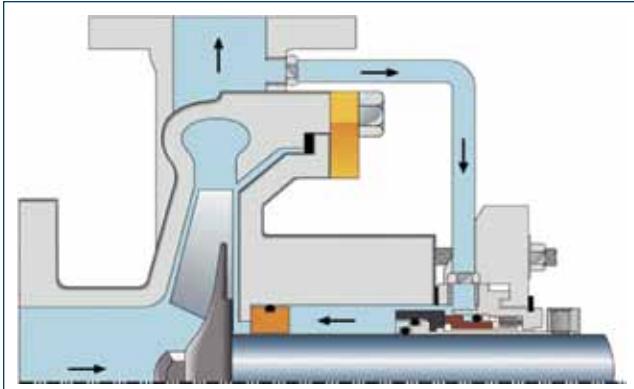


Figure 3. API Plan 11, discharge recirculation using an engineered seal

at 200 degrees F and is being pumped at 1,750 rpm with a 2.50-inch diameter shaft. Cooling and flush water is available at 70 degrees F. Each sealing system is estimated to have a mean time between repair (MTBR) of 36 months, but the engineered single seal's acquisition cost is twice that of the other seal option.

The engineered seal that does not require Plan 21 cooling or Plan 32 flush is clearly a better choice when life cycle costs and power consumption are used in the analysis. Due to the cooling effect of the hot condensate process and the need to reheat the process back to temperature, Plan 32 and Plan 21 are quite costly. The current MTBR is low due to

the fact that the seal is not designed for a fluid operating close to its vaporization fluid and generates too much frictional heat. An engineered seal for this application will increase MTBR and does not require cooling. Other options such as seals with self-contained pumping rings, Plan 23, and dual seals can also be analyzed.

Conclusions

Take advantage of the usefulness of this tool to analyze applications in current plants or future ones as well. By working with a mechanical seal specialist, you can drive increases in plant efficiencies and lower operating costs with real data.

Next Month: *How do I prevent galvanic corrosion in my packing gland?*

We invite your questions on sealing issues and will provide best effort answers based on FSA publications. Please direct your questions to: sealingsensequestions@fluidsealing.com.

P&S

Table 1. Three Seal Plan Comparison

Sealing System	Single Seal Plan 32	Single Seal Plan 21	Engineered Single Seal
Total Life-Cycle Cost	\$ 211,884	\$ 289,471	\$ 13,520
Power Consumption	33,374 KW	46,210 KW	0.15 KW



“Sealing Sense” is produced by the Fluid Sealing Association (FSA) as part of our commitment to industry consensus technical education for pump users, contractors, distributors, OEMs and reps. As a source of technical information on sealing systems and devices and in cooperation with the European Sealing Association (ESA), FSA also supports the development of harmonized standards in all areas of fluid sealing technology. The education is provided in the public interest to enable a balanced assessment of the most effective solutions to pump technology issues on rational total life cycle cost (LCC) principles.

The Mechanical Seal Division of the FSA is one of six with a specific product technology focus. As part of their educational mission, they develop publications such as the *Mechanical Seal Handbook*, a primer intended to complement the more detailed manufacturer's documents produced by the member companies. This document served as the basis for joint development of the more comprehensive Hydraulic Institute publication *Mechanical Seals for Pumps: Application Guidelines*. Joint FSA/ESA publications such as the *Seal Forum*, a series of case studies in pump performance, are another example as is the Life Cycle Cost Estimator, a web-based software tool for determination of pump seal total life cycle cost. The Sealing Systems Matter initiative was also launched to support the case for choosing mechanical seals that optimize life cycle cost, energy usage, reliability, safety and environmental compliance.

The following members of the Mechanical Seal Division sponsor this “Sealing Sense” series:

- Advanced Sealing International (ASI)
- Ashbridge & Roseburgh Inc.
- A.W. Chesterton Co.
- Daikin America, Inc.
- EagleBurgmann Mechanical Seals
- Flex-A-Seal, Inc.
- Flowserve Flow Solutions Div. - Seal Group
- Garlock Sealing Technologies
- Industrias Vago de Mexico SA de CV
- John Crane
- Latty International S.A.
- Metallized Carbon Corp.
- Morgan AM&T
- Nippon Pillar Corp. of America
- Scenic Precise Element Inc.
- SEPCO - Sealing Equipment Products Co.
- SGL Technic Polycarbon Division
- H.C. Starck Ceramics GmbH & Co. KG