Dual Seal Integral Pumping Devices that Increase Pump Reliability and Safety

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What’s the Problem?

• Legislation and environmental issues of concern to modern industry
• Clear indications that the adverse consequences of leakage and/or emissions no longer accepted by society.
• In particular, such leakage is no longer tolerated for toxic, flammable, carcinogenic and explosive liquids.
• Prohibited liquids include some that were, until recently, exempt from governmental rulings and similar regulatory protocols.
• In response, users now often opt to prevent leakage of pumped fluids to atmosphere by installing dual mechanical seals. In dual seals, the cavity is filled with a neutral liquid; the liquid tends to heat up (Fig. 1).
Dual seal with internal pumping device, covered by API Plans 53 & 54
Pros and Cons of Other Options

Widely accepted *externally-pumped* API Plan 54 system is more expensive to run, consumes energy and is often impractical to install. (True also for existing plant upgrade situations.)

Similarly, *thermosiphon-convection systems* are somewhat unreliable and ineffective at efficiently dissipating the heat within the mechanical seal. These systems are particularly prone to miss-installation, where, for example, sags in the piping between the seal and system might prevent fluid convection flow. *The result would be seal overheating.*
Consider Your Plan 52/53 Options:
(1) Bi-directional parallel slot configurations
Unidirectional helical screw devices: (2) must maintain close clearances
(3) A tapered vane pumping ring
This one has wide-open clearances!
H₂O Test Plot for 3 Devices

Head Versus Flow Results For Water At 3600rpm

- Tapered Vane
- Parallel Slot
- Helical Vane
Test Plot (Lube Oil) for 3 Devices

Head Versus Flow Results For Oil At 3600rpm

- Tapered Vane
- Parallel Slot
- Helical Vane
Test Plot (Diesel Fuel) for 3 Devices

Head Versus Flow Results For Diesel At 3600rpm

Head [m] vs. Flow [l/min] for Tapered Vane, Parallel Slot, and Helical Vane.
And when the science checks out and the testing is successful, a good seal manufacturer will find an interested user. (A fall-back position is needed—just for the relatively unlikely event that something will go wrong.) And so……

We are now ready for Case I: A slurry pump seal retrofit
Some good old slurry pumps deserve upgrading
Mechanical seal used before upgrading
A slurry pump site
Barrier fluid flow with tapered vane ring
Case II: Pump (left) vs. Reservoir (right)
Pumping device performance criteria

- Energy requirement as low as reasonable
- Initial cost
- Footprint
- Maintenance cost
- Flow rate produced
- Head produced
- Selection is a compromise

Next slide represents an optimized layout
A reservoir & piping layout per API-682 (below) would have required costly redesign in our Case II example.
Lessons Learned

- Cost and energy savings made feasible by using API Plan 53 instead of some external plans.
- Must insist on 1.5 mm clearance (API-682, Section 8.6.2.3)---it makes sense.
- Be aware of the fact that some manufacturers gain efficiency only by disregarding this important API recommendation—they use risky “tight” clearances.
- Tight clearances increase galling risk.
- Ascertain thorough testing backs up mfr’s claims.
Questions