Dynamic Seals Can Lower Life Costs of Pumps

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Traditional Packing and Mechanical Seal both require clean liquids, most of the time water, for the lubrication of the packing or the seal faces. Finding clean water in a plant can be difficult. Even if you can find it, it may be unadvisable to use it. Water may flow backward in case of a power failure, malfunctions, or interruption of the clean water pump. When a plant water supply is used for sealing purposes, an air gap between the incoming water supply and seal water system is required to prevent contamination. Hence, Plants often use an independent seal water system. This seal water system normally consists of a tank with overflow connections and a float to maintain the air gap, two small pumps with duplex control panel, Y-strainer, relief valves and isolation valves. The cost of a seal water system with installation and piping cost can run up to $20,000.

In addition to the cost of a separate sealing system, the plant also has to consider the cost of power to run the seal water pump and the cost of clean water. A 4X4 pump with 2” sleeve OD can consume 0.5 GPM to 2.5 GPM depending on packing type and lantern ring position. On the other hand, a single mechanical seal can also consume 0.5GPM to 1.5GPM of flush water. This means if the pump runs for 24 hrs a day, the total consumption of sealing water for just one 4X4 pump can be as high as 1000 to 2500 Tons of water per year. Since this sealing water after passing through the packing or single mechanical seal goes back to the process, these 1000 to 2500 Tons of extra water need to be treated before discharging.

A Dynamic Seal may provide the best solution. The dynamic seal is not a stranger to the pump industry. It has been successfully used in the Pulp and Paper Industry for years. Functionally, it is just an auxiliary expeller in the stuffing box mounted on the same shaft [Figure 1]. As the pumped liquid enters the Dynamic Seal Chamber, it is opposed by the centrifugal force of the expeller, thus preventing the leakage through around the shaft. The expeller creates a ring of liquid and air phase and maintains equilibrium between the two phases. Two Lip Seals prevent any leaking during the idle condition of the pump. A bypass line connects the Dynamic Seal chamber to the suction of the pump, which assures the seal chamber pressure remains equal to the pump’s suction pressure. Proper operation and sealing capability of a Dynamic seal depends on the speed of the pump and the suction pressure. Since some wastewater and a Non-Clog pumps can run very slow or be driven by a Variable Speed Drive, often a single expeller may not be enough to insure sealing. To solve this issue, use of a two stage dynamic seal may be required. [Figure 2].

Since the Dynamic seal works like another small impeller, it does consumes some power. In the equilibrium stage the expeller actually pumps very little water and hence the power consumption is very low. Many of us may be concerned about the cost of power draw by a Dynamic Seal. Although they appear to have higher initial cost and seem to have higher power consumption, it is actually less expensive to operate if total cumulative cost is considered over the life of the pump. Let us do a cost comparison of dynamic seal vs. packing and mechanical seal.

Assume the cost of a dynamic seal for a 4X4 pump is $2500. Cost of a Mechanical seal is $1200. Since most of the pump manufacturers offer packing as a standard and the price is already built in the pump price, the initial cost of Packing is zero. However the cost of sealing water, replacement of packing twice a year, changing the sleeve and lantern ring every year can be
significant. Following is a comparison between the operating costs of Conventional Packing, Mechanical Seal and Dynamic Seal.

These simple assumptions were used to create the Life Cycle Cost chart.

1. Sleeve OD is 2”.
2. Pump runs 24 hrs year around.
3. Life of the Pump is 20 years.
4. Packing needs replacement twice a year and the sleeve and lantern Ring need to be replaced once a year. Packing costs $100, Sleeve costs $250, lantern Ring $100 and Labor rate $25/Hr.
5. Replacing just the packing takes 1 hr and replacing the sleeve and lantern ring takes 4 hr.
6. 0.5 GPM of sealing water require for lubricating the packing.
7. Cost of clean water and treating it back is $2.50 per 1000 gallon.
8. Packing draws 0 HP powers.

9. Initial cost of a Single cartridge Mechanical seal is $1200.
10. Seal need to be replaced every two years.
11. It takes 4 hr to replace the seal.
12. Seal require 0.5 GPM for flush water.
13. Seal drag is 0.24 HP for a 2” seal at 1750 RPM.

14. Initial cost of a dynamic seal is $2500.
15. Dynamic Seal need to be replaced every 5 years.
16. Cost of Expeller, Sleeve and Lip Seals are $1500.
17. Dynamic Seal is replaced during major overhaul of the pump. Hence there is no labor cost added for replacement of Dynamic Seal.
18. Dynamic Seal consumes 1.3 HP power at 1750 RPM.
19. No flush water require for Dynamic Seal.
From the chart it is obvious that the total cumulative operating cost of Dynamic Seal overcomes the cumulative operating cost of Mechanical seal after 2\textsuperscript{nd} year and the cumulative operative cost of packing after 5\textsuperscript{th} year. After the 5\textsuperscript{th} year a dynamic seal saves money over both mechanical seal and packing. This is in addition to all the other benefit of Dynamic Seal. What are the other benefits of dynamic seal?

1. It eliminates use of seal water
2. Eliminate pumpage contamination and product dilution
3. Reduces utility costs,
4. Eliminates problems associated with piping from a remote source,
5. Eliminates need to treat seal water,
6. It is less expensive to operate over the life of the pump.

Obviously there are many consideration when selecting the right sealing solution for industrial applications. Dynamic seals may be the best selection when considering pump Life Cycle Cost.