Save Water And Increase Uptime

Patil Sanjay

ABSTRACT

Rising cost and shrinking availability of clean water for operating industrial pumps is a major concern to most Industries and in particular Paper & Pulp Industry, as is the high cost of treating this water for disposal.
For over a half-century, the accepted method of providing cooling and flush water for mechanical seals and packing has been to pipe plant water through the seal or packing, and then to drain. Under this scenario, the normal consumption of water is 15.7 Lakh liters of water per pump, per year considering the flow of 3 LPM of quench/flush water.
A water management system that cools and re-circulates the water can reduce this water consumption to just a few liters per year. This water management system also increases the pump reliability and mean time between failures (MTBF) significantly, with a return on investment (ROI) that is usually around 6-12 months. Additionally, significant energy savings is documented through the use of this system, by greatly reducing or eliminating the amount of energy needed to heat the flush water up to process temperatures, and then to boil/evaporate this water from the product.
All growing countries having same opinions on these water crises.

"Almost three billion people will face severe shortages of fresh water by 2025 if the world keeps consuming water at current rates …" *The United Nations*
"Even where supplies are sufficient or plentiful, they are increasingly at risk from pollution and rising demand. Fierce national competition over water resources has prompted fears that water issues contain the seeds of violent conflict …" *Kofi Annan, UN Secretary-General*
"This crisis is one of governance, essentially caused by the way we mismanage water …" *World Water Development Report (UN)*
"It has been estimated that the annual water volume used by industry will rise from 752 km^3/year in 1995 to 1,170 km^3/year in 2025. It is therefore paramount that new technologies and practices are employed to encourage cleaner production …" *United Nations Association UK*
Due to the shortcomings of the described mechanical seal support methods, AESSEAL plc began developing a range of modular systems which would bring about a revolution in mechanical seal support methodology. One of the first systems to use this revolutionary concept was the SW2™ water management system.

Introduction

Rising cost and shrinking availability of clean water for operating industrial pumps are of concern to many plants, as is the high cost of treating this water for disposal. For over a half-century, the accepted method of providing cooling and flush water for mechanical seals and packing has been to pipe plant water through the seal or packing, and then to drain. Under this scenario, the normal consumption of water is 15.7 Lakh liters of water per pump, per year considering flow of 3 LPM of flush/ quench water for mechanical seal or packing.

AESSEAL India Pvt. Ltd.,
Gate No. 85, Post: Varve, Tal. Bhor, Dist - Pune - 412 205 (M.S.) India

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International context

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For many of the developing countries of the world the problem is a critical one.

Pulp & Paper

The importance of paper in day to day living would be difficult to exaggerate. Most things are either designed on it, made of it, wrapped in it, sold by it or written on it. It was the Chinese who were the first to make paper as we know it, nearly two thousand years ago. They made it by soaking and pounding rags and plant fibres into a watery pulp which they poured onto a woven bamboo screen. It was lifted off carefully and, as it dried, it matted into a sheet of paper.

It is clear that pumps are used on most processes within this industry. The rapid growth of Mechanical seals into this traditionally packed gland industry has been huge. This can be attributed to the following reasons.

- Product loss will cost the industry millions of Rupees, Pounds, Dollars, DM, etc. each year.

Product cost is not only the loss of pulp, as one might first imagine. It also means clean water loss ,the price of which increases in dramatic proportions. It includes fuel to produce steam to maintain the process temperatures and the installation of flushing and barrier water systems to lubricate packed glands. It includes housekeeping costs to clean down machines and work areas and empty drainage sumps. Finally, it includes treatment plants to stop chemical leakage and pulp from being discharged into rivers and waterways.

This, in itself, is an adequate reason to install Mechanical seals; however, take into account the following and the wider picture then emerges:

- Most types of Packing will cause shaft and shaft sleeve damage as it is adjusted to reduce leakage.
- Leakage will enter the bearing assemblies on equipment that is not sealed with bearing isolators.
- Packing needs to be adjusted on a frequent basis to ensure leakage is kept to a minimum.
- This takes maintenance time and therefore money.
- Unreliable equipment may cause plant process stoppages which are very costly.
- Running a piece of rotating equipment with a packed gland is like driving a car with the hand brake on. It requires power to overcome the frictional loadings.

The installation of Mechanical seals can reduce this loading. Tests have proven a power saving of 7% as opposed to a packed gland on a worn piece of equipment.

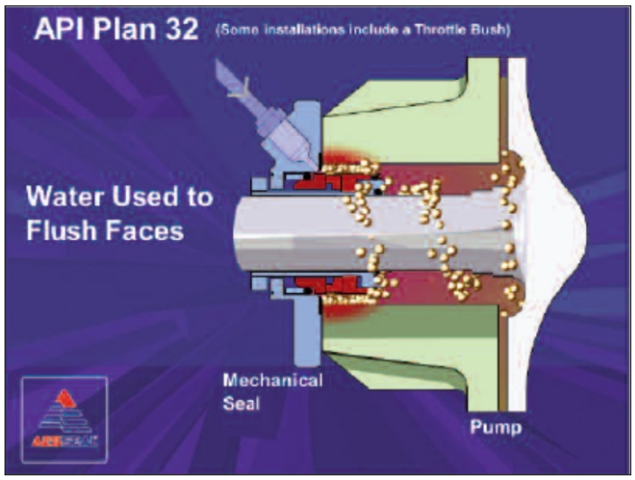
Introduction to Mechanical Seals and Water Management Systems

Over the past several years there has been significant growth in the use of Mechanical seals in the processing industries.

This section explains how mechanical seals and water management systems designed and manufactured by AESSEAL have been used successfully in industry. The information outlines the previous wasteful practices and the benefits of the newly adopted water management systems.

The most common methods of supporting Mechanical seals with water are outlined below.

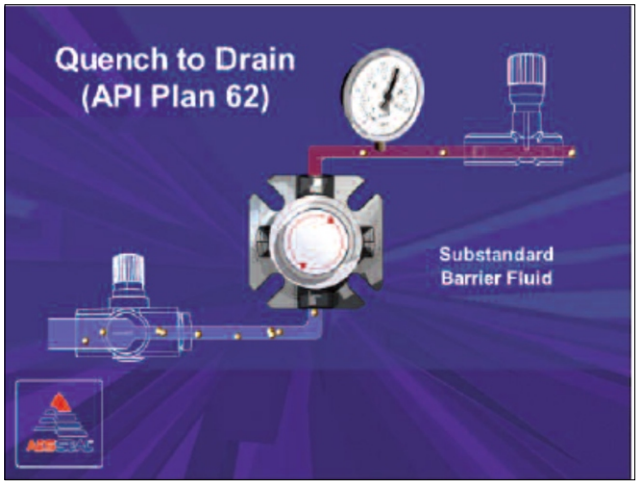
API Plan 32



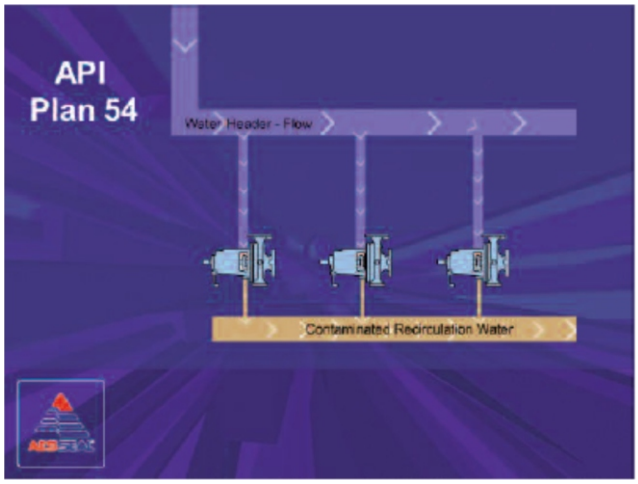
In this case pressurized plant water is taken and injected into the 'flush' port of the seal in an effort to keep contamination away from the seal faces. The two key impacting negatives here are the high water consumption and the high cost of removing the injected water by evaporation further along in the manufacturing process, shown directly below.

Typical water consumption of a single Mechanical seal in this arrangement is in the region of 12 liters per minute (3.17 gallons per minute), which gives a total consumption for one pump of 6.3 million liters per year (1.7 million gallons per year). We should also bear in mind that there is an initial cost attached to this water which multiplies upwards when we consider the cost of steam generation required to drive this flush water out of the process via the evaporator. This figure further escalates when we consider the number of pumps associated in any given production line.

Another method of supporting a Mechanical seal is by using a 'Quench to Drain' arrangement.



In this case, a double mechanical seal is supported by supplying water to the 'Quench' port. This water then cools and lubricates the seal faces, and exits via the 'drain' port. Quench to drain wastes millions of liters per year and the resultant water that passes through the Mechanical seal must be treated as effluent. This effluent treatment adds considerable cost to the process.



The API Plan 54 method involves feeding a number of Mechanical seals from a common water header. This water passes through the mechanical seals and discharges to a common drain. This contaminated water is then treated and in some cases re-circulated back to the common water header tank. Not only does this process incur costs associated with water treatment, but occasionally the whole water header can become contaminated due to process upsets. The costs associated with decontamination can be extremely high.

Water Savings Conclusion

Due to the shortcomings of the described mechanical seal support methods, AESSEAL began developing a range of modular systems which would bring about a revolution in mechanical seal support methodology. One of the first systems to use this revolutionary concept was the SW2™ water management system.

AESSEAL have sold thousands of water management systems, usually in combination with the double seal. The systems are maintenance friendly, requiring no external compressed air or gas pressurization. They are also largely self-regulating and self-operating and do not require any manual intervention for refilling. The total annual operating cost of a Double seal and SW2™ water management system would give a typical return on investment of around 200 days.

In considering all of the above seal support arrangements, we can clearly see that in each case, water consumption at the rate of between 6-18 liters per minute (1.59 - 4.76 gallons/ minute) per seal was the previously accepted norm. This allows for a conservative estimate of an average of 12 liters per minute (3.17 gallons per minute) water consumption to be applied to all pumps run in this manner. Therefore in continuous 24 hour running one pump uses 6,307,200 liters per year (1.7 million gallons per year). By retrofitting a water management system (which uses only 32 liters / 8.45 gallons per year) to each of these applications we are saving 6,307,168 liters / 1,666,178 gallons per year for every water management system that we manufacture. For the past three years we have on average produced and supplied 3,000 of these units each year.

The Cost of Water

The following figures are costs of fresh water, and do not include the

Country	Water Cost Per Gallon			
	£	$	ε	INR
Germany	0.001273448	0.001910172	0.0015931	0.105696169
Denmark	0.001093791	0.001640687	0.0013686	0.090784676
Belgium	0.001027741	0.001540291	0.001284	0.08530251
Netherlands	0.000832232	0.00124967	0.001041	0.069075297
France	0.000819022	0.001231176	0.0010251	0.067978864
UK	0.000787318	0.001180978	0.0009855	0.065347424
Italy	0.000507266	0.000760898	0.0006341	0.042103038
Finland	0.000459709	0.000689564	0.000576	0.038155878
Ireland	0.000420079	0.000628798	0.0005231	0.034866579
Sweden	0.000385733	0.000581242	0.0004835	0.032015852
Spain	0.000380449	0.000570674	0.0004756	0.031577279
USA	0.000340819	0.000509908	0.0004254	0.028287979
Australia	0.000332893	0.000499339	0.0004174	0.027630119
South Africa	0.000314399	0.000470277	0.000391	0.026095112
Canada	0.000266843	0.000398943	0.0003329	0.022147952
China	5.28402E-05	7.92602E-05	6.605E-05	0.004385733
India	5.28402E-05	7.92602E-05	6.605E-05	0.004385733
Average Cost	0.000549848	0.000824773	0.0006875	0.045637423

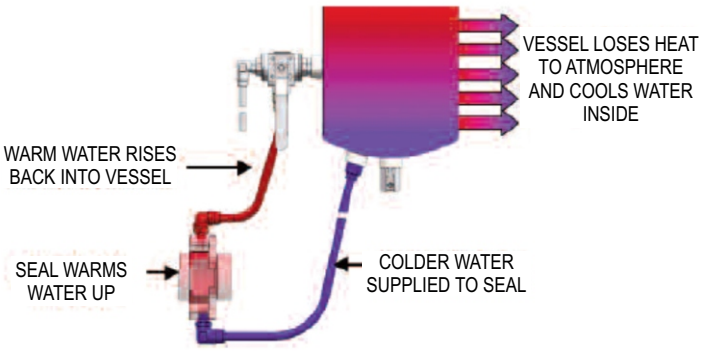
5 Billion Gallons @ Worst Case Cost of 16 Countries Listed	£120,500,000	$180,750,000	150750000	INR 10,001,500,00
5 Billion Gallons @ Best Case Cost of 16 Countries Listed	£5,000,000	$7,500,000	6250000	INR 415,000,000
5 Billion Gallons @ Worst Case Cost of 16 Countries Listed	£54,975,000	$82,450,000	68700000	INR 4,562,925,000

cost for preparation of the water, nor do they include the cost of water treatment, after it has been used.

Water Management Methodology

Rather than running water straight through the seal to drain, the SW2™ Standard Water management system removes heat and lubricates the mechanical seal faces by use of the 'thermosyphon effect'.

Colder water is supplied to the mechanical seal, which is in turn heated up by the seal faces. This 'warmer' water then rises back into the vessel, raising the bulk temperature of the vessel.



The vessel then loses heat to the atmosphere which results in an 'equilibrium temperature' being reached.

In order to prevent contamination of the system, a positive pressure is applied to the clean water in the system. This is achieved by connecting the system to the plant mains water supply and adjusting the integral water pressure regulator to the required pressure. This also ensures that if a small trace of water is lost into the process across the seal faces, this will be immediately replaced by water from the mains supply.

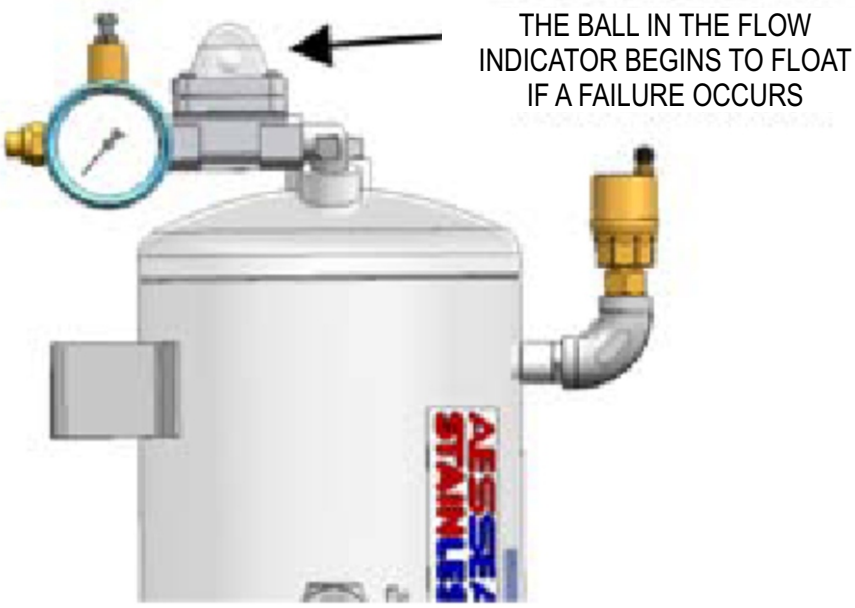
The AESSEAL SW2™ water management system also alerts the user to seal failure by way of a water flow indicator. This clever device contains an integral ball which appears only if there is a seal failure, which is incredibly important in larger plants which make use of hundreds of mechanical seals.

There is also the option of losing even more heat to the atmosphere by employing finned tube. There one meter lengths of tube boast a massive 0.5 meters squared of surface area each. Adding two lengths of finned tubing to a SSE10 vessel triples the effective cooling surface area.

An integral non-return valve ensures that in the unlikely event of the vessel becoming contaminated, no liquid can enter the mains water supply from the system. The modular concept of the AESSEAL plc SW2™ water management system ensures that additional instrumentation can be added to the system to give immediate seal failure indication. This can be in the form of a pressure switch (below) or even a flow switch.

Case Reference: Mondi Ltd

Mondi Ltd, an Anglo American group company, is a large South African producer of pulp, paper, packaging board, sawn-timber and



Typical Water Management System

related products. It owns or leases 526,000 hectares of forest land and has an annual turnover of approximately US$2 billion.

Since the first reel of newsprint rolled out of the Merebank mill in 1971, Mondi has grown into a major supplier of paper products to South Africa and the world.

Many of the pumps used by Mondi are sealed using pump packing in conjunction with the 'flush' method in order to support the packing. As discussed, not only does this method waste huge quantities of water, but the packing constantly needs replacing and can cause major damage to the pump shaft. The packing also causes extra resistance, which needs to be overcome using extra electrical power.

Having seen the methods employed in this industry throughout the years, AESSEAL plc has engineered and developed a complete sealing solution for this industry, which replaces the pump packing with a much more energy efficient double mechanical seal in conjunction with a water management system to support the mechanical seal. This technique was gratefully embraced by Mondi when it was presented to them. The savings in terms of water, energy and labor were immediate. One particular application in which pump packing was replaced with the AESSEAL plc complete sealing solution is shown overleaf.

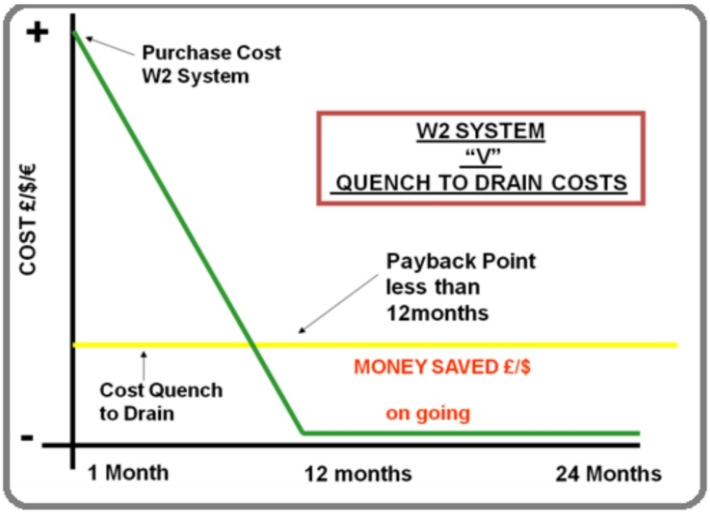
Due to the successes experienced within Mondi, AESSEAL plc was awarded with a most prestigious award by Mondi themselves.

AESSEAL® Cost / Water Savings

Items of Cost	Qty Per Yr:	Value		Expenses per Annum	
Packing Material	9	$98.59	INR 6,014	$887.31	INR 54,126
Labour for Packing	9	$25.61	INR 1,562	$230.49	INR 14,060
Product Loss/Downtime/Lost Production	1	$15,923.07	INR 9,71,307	$15,923.07	INR 9,71,307
Flush Water	1	$1,500.5	INR 91,535	$1,500.57	INR 91.535
Extra Power for Gland Packing and Lip Seals	1	$1,500.5	INR 91,535	$1,500.57	INR 91.535
Machine Repairs:					
Shaft Sleeves	2	$110.77	INR 6,757	$221.54	INR 13,514
Bearings	4	$138.46	INR 8,446	$553.84	INR 33,784
Lip Seals	2	$2.77	INR 169	$5.54	INR 338
Other (Main Shaft) and Spiraltrac	1	$2,007.68	INR 1,22,468	$2,007.68	INR 1,22,468
Labour Hours to Repair pump	20	$41.54	INR 2,534	$830.80	INR 50,679
Heating Costs	1	$2,458.55	INR 1,49,972	$2,458.55	INR 1,49,972
Water Treatment	1	$92.38	INR 5,635	$92.38	INR 5,635

Total Cost per Unit per Year	$ 24188.47 / INR 14,75,496
The Total Cost of the AESSEAL Upgrade for this Application was:	$ 3946.16 / INR 240715
Actual Return on Investment per Year (for this Application)	$ 20242.31 / INR 1234780
The AESSEAL upgrade break even within 59.55 days	

AESSEAL® has successfully dovetailed into Mondi's water saving initiative by installing equipment that eliminates water consumption into stuffing box glands, saving billions of liters of water over the past six years.



Typical Return on Investment

Results

In this single application;
Water Saving: 2,689,194 liters per year (710,410 galls (US) per year) Water Cost Savings : INR 69,192 per year ($1,500.57 per year) Total Cost Savings : INR 9,33,395 in the first year ($20,242.31 in the first year)

In subsequent years the annual saving will increase, as the upgrade has already been carried out.

Conclusion

Due to the shortcomings of the described mechanical seal support methods, we can adopt to use environment friendly water savings technology. One of the first systems to use this revolutionary concept is the SW2™ Water management system.

This allows for a conservative estimate water consumption to be applied to all pumps run in this manner. By retrofitting a water management system (which uses only 32 liters / 8.45 gallons per year) to each of these applications we are saving thousands liters / gallons per year