Waste Water Management & Saving

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ABSTRACT

Waste water treatment in domestic region is a generally unseen but expensive process, which often gets taken for granted by most people. As long as water goes down the drain without a problem, the average person doesn't worry too much about what happens to the water and its contents after it disappears from view.

That's as it should be, because this would indicate there are no major problems with most sanitary sewer systems. Behind the scenes however there is a complex process manned by thousands of employees that are working for waste water treatment plants around the world. They are constantly testing, maintaining and improving waste water treatment facilities, to ensure that what is returned to the environment complies with strict local and global standards.

In industry there is a tendency to adopt a similar "out of sight, out of mind" approach. In some instances not truly considering the additional cost to production that comes along with building and running an efficient industrial effluent plant.

In the absence of an onsite plant, effluent is often added to the city sewer system and a tax or levy is paid by the company to the water authority to deal with the diluted waste on their behalf. In the past, these costs also had a habit of get overlooked in the "cost of production" calculations.

More enlightened producers not only factor-in the cost of acquiring and cleaning their water at each stage but take the view that, just with any cost, if it is carefully managed it can be considerably reduced. It is a little realised fact but Industrial effluent clean up costs can be up to ten times the cost of the original clean water.

The same producers now realise that the AESSEAL® SW02™ Water management system allows them to greatly reduce their water consumption and with the introduction of the SW02™ System which they can simultaneously reduce their waste water and waste product knowing that all three factors will massively impact upon their bottom line.

AESSEAL plc presented the complete sealing solution to a waste water treatment plant in the Eastern States of the USA, who decided to trial the technology on their site. One particular application on which the pump packing method was replaced with a double mechanical seal and an SW02™ water management system.

Introduction

The pollution of waterways, drinking water supplies and other environmental issues are dominating our newspapers, television screens and political reports every day. The treatment and disposal of waste water and sewage and the production of quality drinking water has never before been so much in the public eye.

The extraction of contaminants and the returning of a clean, high quality water to our rivers and waterways, in addition to the filtration and purification of potable waters is, therefore, of paramount importance.

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To this end, the installation of reliable, leak free equipment can be utilized to contain products and prevent unnecessary leakage of unwanted contaminants. These contaminants may cause, at best, housekeeping and 'clean up' problems and increased costs, and at worst, pollution in their own right.

When the operating of leak-free rotating equipment is under consideration, a cost effective solution to gland sealing must be considered and in this document we aim to suggest ways in which this area can be addressed.

Industrial Waste Water

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Waste water is cleaned using physical and biological processes similar to those that occur in nature, but which have been accelerated to produce clean water in just a few hours. (See the figure below of the treatment process.) By the end of the treatment process, the water meets ocean swimming standards. After treatment and disinfection, the water enters an outfall pipeline and is usually discharged through a pipeline to a large body of water, such as an ocean. The last section of the outfall can contain many portals through which the water exits. The portals create an area of rapid mixing that allows nonsaline water to be quickly assimilated with the saline ocean water.

The AESSEAL® SW02™ water management system allows them to greatly reduce their water consumption and with the introduction of the SW02™ System they can simultaneously reduce their waste water and waste product knowing that all three factors will massively impact upon their bottom line.

Mechanical Seals and Water Management Systems

Over the past quite a lot of 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.

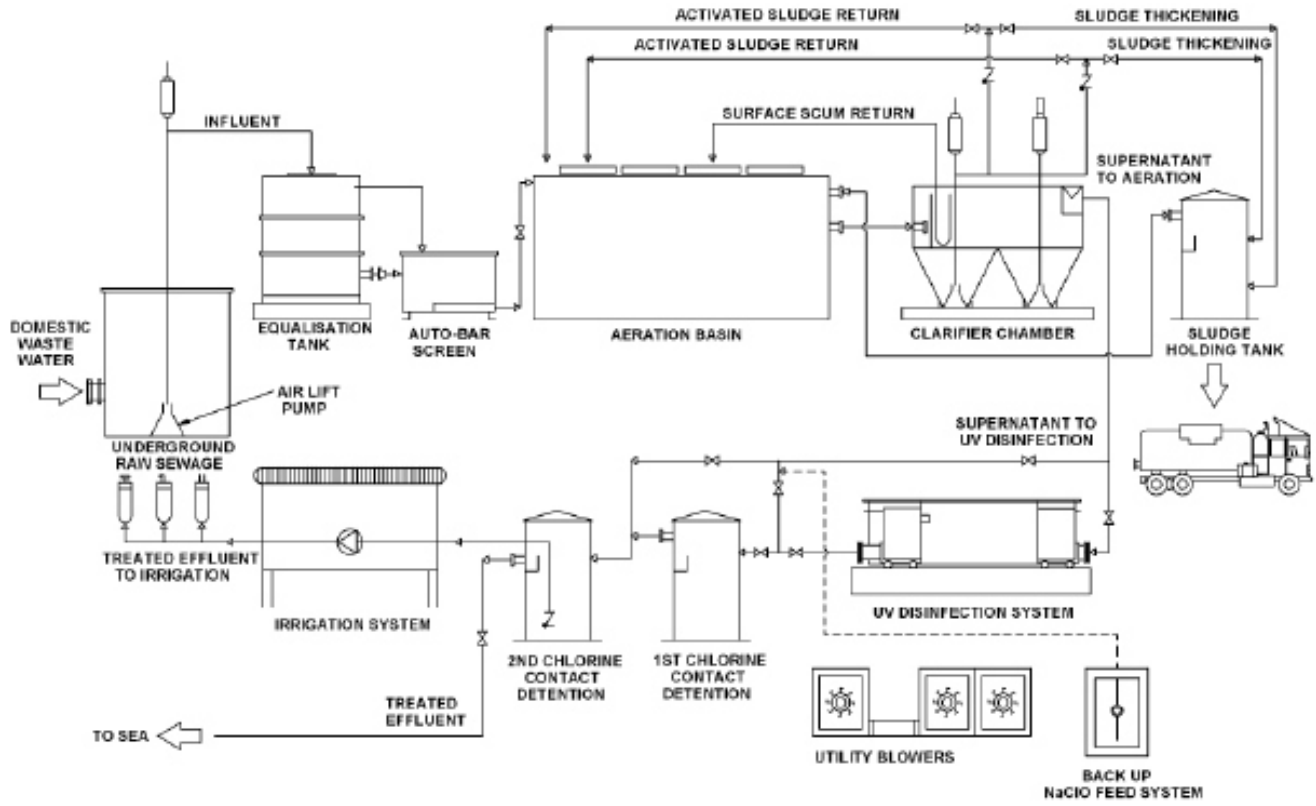

Fig 1. Waste Water Treatment Process

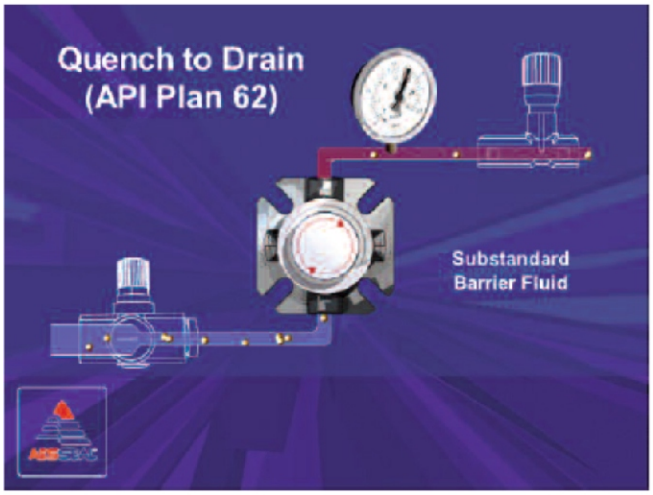

Fig 2. API Plan 62

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

One of the methods 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.

Water Savings & SW02 System

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 SW02™ 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

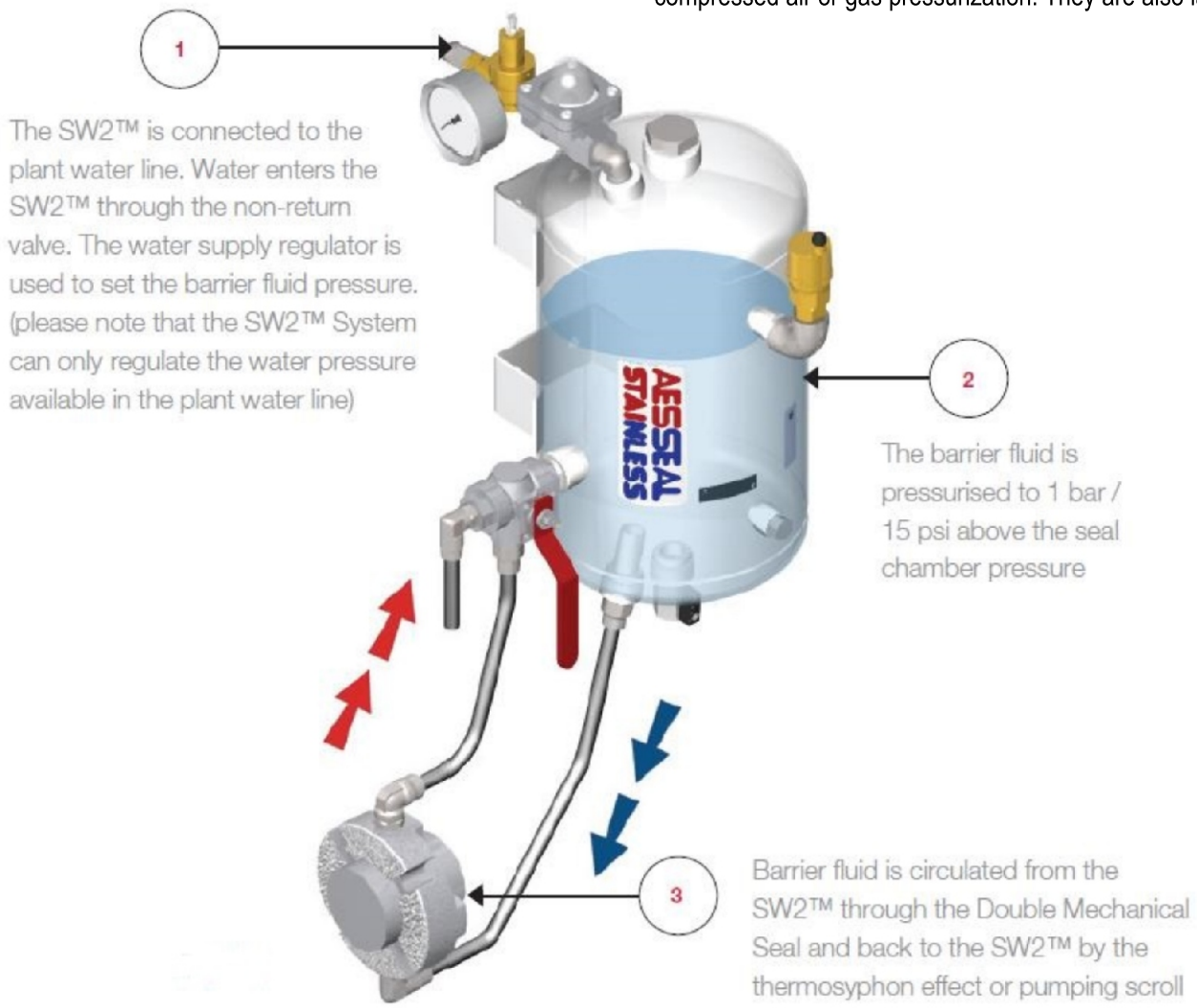

Fig 3. WMS Operating Principle

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.

Water Management Methodology

Rather than running water straight through the seal to drain, the SW02™ Standard Water management system (WMS) 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

Input	Value	Input	Value
AESSEAL* COST	£666.67 / $1, 200.00 / €1,000.00	Flush Water Temperature	21.5°C / 70.7°F
Additional System Cost	£555.56 / $1, 000.00 / €833.33	Process Fluid Temperature	26.67°C / 80.0°F
Packing Cost (per lb)	£42.37 / $76.26 / €63.55	Flush Water Cost per 1,000 Gal (3,785 Ltrs)	£0.28 / $0.50 / €0.42
Density of Packing	0.38 lb/ft	Cost of Stream	£0.00 / $0.00 / €0.00
Packing Rings per Shaft	5.00	Efficiency : Fluid Heat by Steam	0.00%
Pump Shaft Size	3.00"	Water : Steam Ratio for Evaporation	0.00
Time Taken to Pack Pump	2.00 Hours	Steam Recovery after Evaporation	0.00%
Time Between Packing Adjustments	1.00 Month	Annual Operating Hours	8,400.00 Hours
Time Taken to Adjust Packing	0.25 Hours	Labour Rate (per hour)	£27.78 / $0.50 / €41.67

Input	Previous Pump Packing	AESSEAL* Total Sealing Solution
Expected Life of Sealing Solution	6.00 Months	72.00 Months
Time Between Pump Repairs	24.00 Months	72.00 Months
Time Between Pump Steeve Replacements	24.00 Months	72.00 Months
Pump Sleeve Cost	£194.44 / $350.00 / €291.67	£194.44 / $350.00 / €291.67
Pump Bearing Cost	£180.56 / $325.00 / €270.83	£180.56 / $325.00 / €270.83
Other Replaced Parts Cost	£250.00 / $450.00 / €375.00	£300.00 / $450.00 / €375.00
Pump Repair Time	12.00 Hours	12.00 Hours
Flush Water Flow Rate	9.46 LPM (2.50 GPM)	0.00 LPM (0.00 GPM)
Flush Water Lost into Pumping chamber	25.00%	0%

Description	Previous Pump Packing	AESSEAL* Total Sealing Solution
Sealing Cost	£238.57 / $429.42 / €357.85	£66.67 / $120.00 / €100.00
Pump Repair Cost	£562.50 / $1,012.50 / €843.75	£159.72 / $287.50 / €239.58
Flush Water Cost	£349.97 / $629.94 / €824.95	£0.14 / $0.25 / €0.21
Re-heating Cost	£0.00 / $0.00 / €0.00	£0.00 / $0.00 / €0.00
Evaporation Cost	£0.00 / $0.00 / €0.00	£0.00 / $0.00 / €0.00
Type in One - Off Costs below:		
Product Loss Cost	£0.00 / $0.00 / €0.00	£0.00 / $0.00 / €0.00
Product Downtime Cost	£0.00 / $0.00 / €0.00	£0.00 / $0.00 / €0.00
Total Annual cost	£1,151.03 / $2,071.85 / €1,726.54	£226.53 / $407.75 / €339.80

All figure above are in GBP, USD & Euro

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 SW02™ water management system (WMS) also alerts the user to seal failure by way of a water flow indicator. This clever device contains an integral ball which

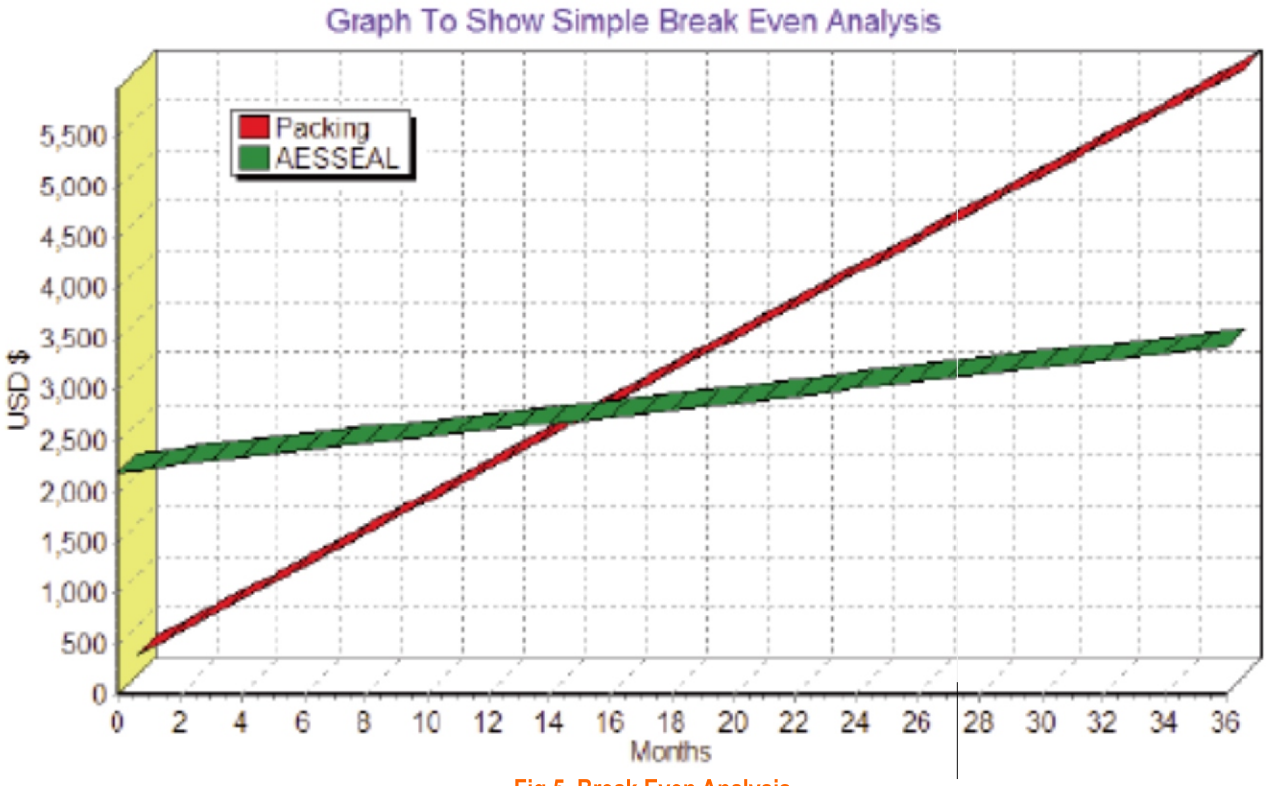

Fig 5. Break Even Analysis

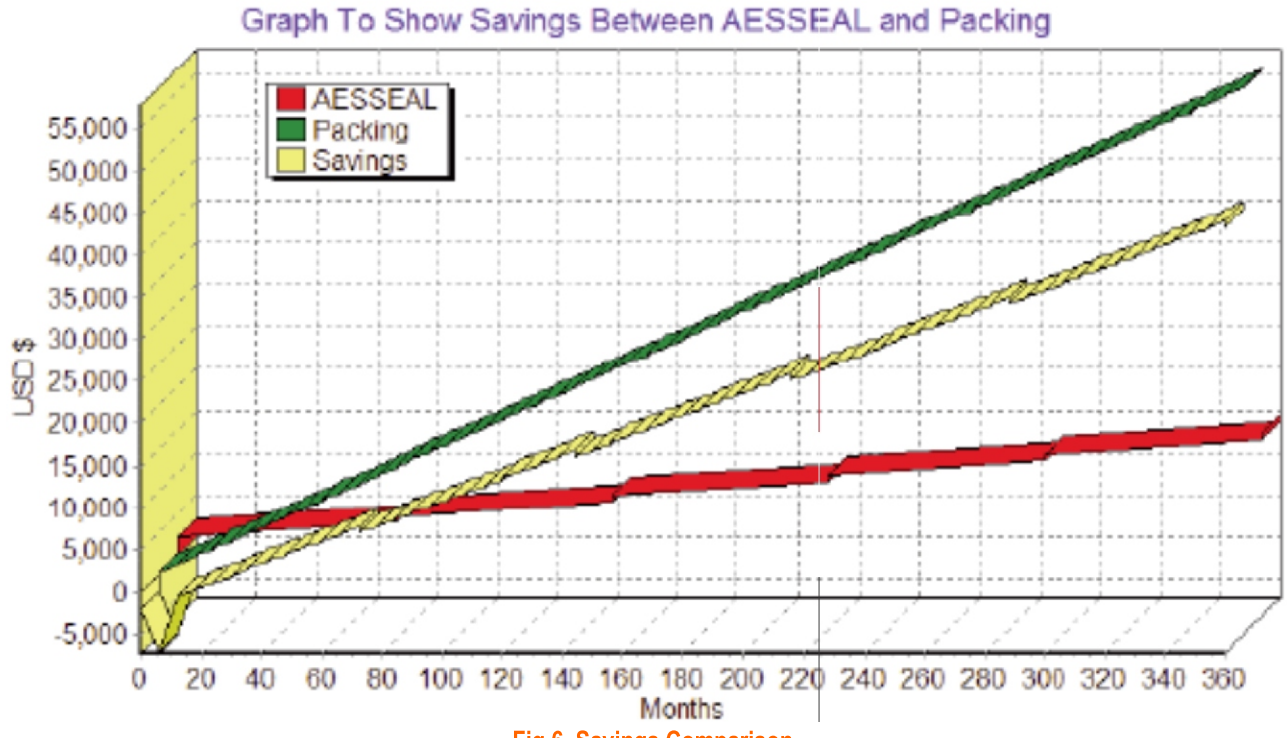

Fig 6. Savings Comparison

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 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 (WMS) 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.

1. Case History: Waste Water Treatment plant

As can be seen from the illustrated process, pumps are utilised in numerous locations around a waste water treatment plant. AESSEAL plc have discovered that the common practice employed when sealing these pumps is to use pump packing, or the quench to drain method when a mechanical seal is used. Both these methods have been proven time and time again to be unreliable and wasteful. AESSEAL plc presented the complete sealing solution to a waste water treatment plant in the Eastern States of the USA, who decided to trial the technology on their site. One particular application on which the pump packing method was replaced with a double mechanical seal and an SW02™ water management system is shown below:

Input Values for ROI Calculation

Below are the figures for the Inputs values for Return on Investment for the Case History in Waste water treatment plant

Annual cost breakdown

Annual cost breakdown is illustrated bellow for typical Gland packing pump and compared with AESSEAL solution which had been applied.

Results to the Case History

In this single application what we have observed is as below:

WATER SAVINGS	4,767,140 liters per year
	1,259,530 galls (US) per year
WATER COST SAVINGS	£349.83 per year €524.74 per year $629.69 per year
TOTAL COST SAVINGS	**£924.50 per year** **€1,386.75 per year** **$1,664.10 per year**

Conclusion

This system not only saves waste water generation as well as it reduces using nitrogen or air to provide pressure for the mechanical seal system. In turn it saves water & air to the plant. 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 SW02™ Water management system. 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 to the plant.

References

1. **AESSEAL® Systems Guide**: How to save 113 Billion Litres / 25 Billion US Gallons of water per year. Issue 6-08/2011, PP 6, 7, 29, 30, 31 Most WMS designs reproduced within this publication are protected by international patents or have patents pending.

2. **AESSEAL GUIDE LITRAURE:** A Guide to Sealing the WATER AND WASTE INDUSTRY. L - UK/US - W/WATER 03, (2002) PP 2