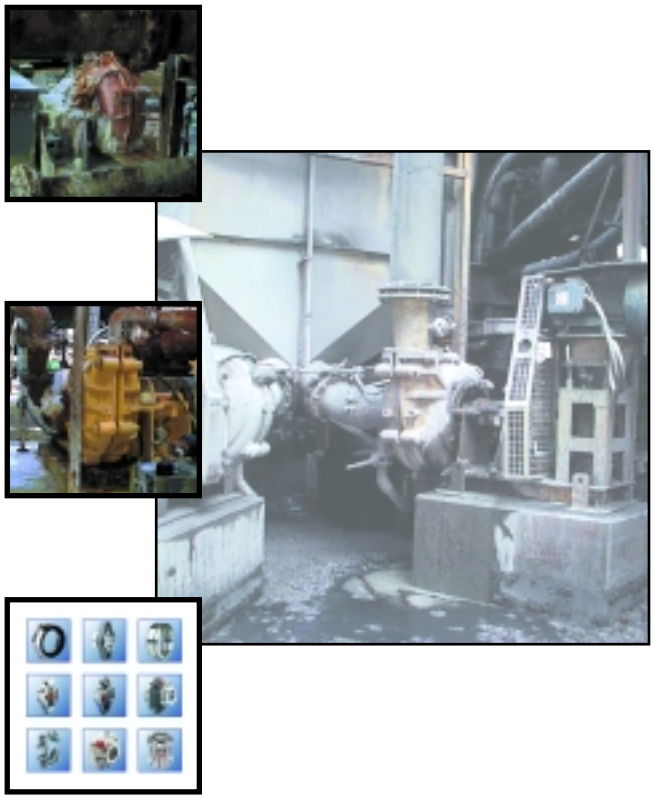
AESSEAL®
ENVIRONMENTAL TECHNOLOGY

A Guide to Sealing
SLURRIES



- SLURRIES
- SLURRY TYPES
- SEALING METHODS
- PUMP TYPES
- INDUSTRY SPECIFIC
- ENVIRONMENTS
- SOLUTIONS
- CASE HISTORIES

ENVIRONMENTAL TECHNOLOGY

A GUIDE TO SEALING SLURRIES

Introduction

A slurry is best defined as a liquid suspension of solids that does not change its characteristics when affected by either temperature and/or pressure.

Slurries are often described in terms of percentage solids and fall into categories: they may be fibrous, non-fibrous, abrasive or non-abrasive.

Slurries are not limited to the minerals processing industry (albeit this is probably the most demanding). Most industrial processes that require rotating equipment are handling slurries in one form or another.

Sealing slurries is not black magic. When selecting seals against particular applications thought must be given to the following points:

- *Solids content can be expressed as a percentage (Wt%). This normally refers to the weight of the solids and the mother liquid in terms of percentage and not in terms of volume. (See section on slurry types.)*
- *Identify the slurry type: Clogging, Non Clogging, Abrasive, Non abrasive, Corrosive or Non Corrosive.*
- *Particle sizes that can penetrate lapped seal faces will result in premature failure. Identify the particle size distribution.*
- *If converting directly from a packed gland, care must be observed in the Mechanical Seal environment.*
- *Consider process operation in terms of batch processing, stop start applications, site services available (Dual Seals) and level of operation.*
- *The design and condition of the rotating equipment is probably more significant in the world of Minerals Processing.*

The above points will be dealt with in more detail throughout this paper, to assist in correct seal selections for optimum seal life.

SEALING SLURRIES

AESSEAL®
ENVIRONMENTAL TECHNOLOGY

AESSEAL plc Disclaimer

EXCEPT AS EXPRESSLY PROVIDED HEREIN, AESSEAL plc SHALL NOT BE LIABLE FOR THE BREACH OF ANY WARRANTY, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF MERCHANTABILITY OF FITNESS FOR A PARTICULAR PURPOSE, OR FOR ANY DAMAGES OR OTHER LIABILITY ARISING OUT OF OR IN CONJUNCTION WITH CUSTOMERS' USE OF SUPPLIER PRODUCTS OR AESSEAL plc OR THE AUTHORISED DISTRIBUTOR DESIGNING, MANUFACTURING OR SELLING SUPPLIER PRODUCTS. IN NO EVENT SHALL AESSEAL plc BE LIABLE FOR DIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION LOST SALES OR PROFIT, LOST PRODUCTION OR OUTPUT, INJURY TO PROPERTY OR REPUTATION, OR ANY OTHER DAMAGES WHETHER ARISING IN CONTRACT OR TORT OR OTHERWISE (WHETHER OR NOT ATTRIBUTABLE TO THE FAULT OR NEGLIGENCE OF AESSEAL plc). UNDER NO CIRCUMSTANCES SHALL ANY RECOVERY OF ANY KIND AGAINST AESSEAL plc BE GREATER IN AMOUNT THAN THE PRICE OF THE PRODUCT TO THE END USER.

This information corresponds to our current knowledge on the subject. It is offered solely to provide possible suggestions for your own experimentations. It is not intended, however, to substitute any testing you may need to conduct to determine for yourself the suitability of our products for your particular purposes. This information may be subject to revision as new knowledge and experience becomes available. Since we cannot anticipate all variations in actual end-use conditions, AESSEAL plc makes no warranties and assumes no liability in connection with any use of this information. Nothing in this publication is to be considered as a licence to operate under or a recommendation to infringe any patent right.

CONTENTS

Description **Page**

ACKNOWLEDGMENT

David Hulme

Contact Details: AESSEAL plc, Rotherham, U.K.
Tel: Telephone: +44 (0) 1709 369966
E-mail: SMTP:aesdwh@dial.pipex.com

We acknowledge the co-operation of Warman® International Ltd. in the publication of this document.

SLURRIES

We have been sealing slurries successfully for many years throughout many industries, these include:

- Water and Waste Water Industries
- Pulp and Paper
- Sugar Refining
- Power Generation
- Chemical Processing
- Mining
- Minerals Processing

This section is designed to help understand the word "Slurry" and assist in the identification of slurry types and terminology.

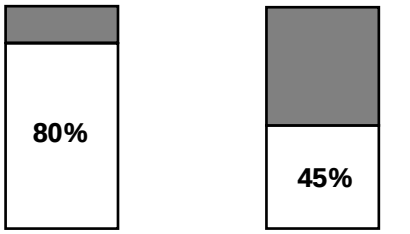
Percentage Solids by "Weight"

Confusion often arises in the terms "Solids Content". This is generally expressed in terms of "Weight" not "Volume". Therefore we must be aware of the Specific Gravity of the solids to understand the consistency of the slurry to be sealed. For instance:-

Slurry	Particle Size d50	Solids SG Dry Solids	Max Con By Weight	Slurry SG Wet Solids	Max Con By Volume
Cement	.030	2.65	70	1.77	46.8
Magnetite	.040	4.80	80	2.70	45.0
Coal Tailings	.150	1.80	45	1.25	31.2
Silica Sand	.300	2.65	40	1.33	20.0
Bottom Ash	5.00	2.00	20	1.11	11.1
Gravel	13.00	2.65	15	1.10	6.2

The above table shows large variations by weight, but smaller variations by Volume.
The concentration by volume is more important as it shows the true solids content of the slurry to be sealed and allows a more accurate assessment of the "sealabilty" of a given slurry.

Example Magnetite



It is therefore necessary to ascertain the correct information prior to seal and environmental selection.

AESSEAL®
ENVIRONMENTAL TECHNOLOGY

SLURRY TYPES

1. Fibrous Slurries

Many fibrous slurries have solids with a specific gravity the same as or slightly less than the liquid media. As a result, the centrifugal action caused by the shaft and seal rotation does not always sling the fibres away from the seal. In fact the opposite can occur which can result in the seal chamber being packed with fibre. The use of non-clogging seal designs is of utmost importance, as is consideration for the seal environment when dealing with this type of slurry.

Typical Market Sectors

• Water and Waste Treatment	Raw Sewage and Digested Sludge
• Pulp and Paper	Paper Stock (see Platinum Award)
• Textiles	Dye Liquors (synthetic or cotton fibres)

2. Abrasive Slurries

Liquids carrying abrasive particles represent the most common type of slurry applications found in industry. Percentage solids, concentration and particle size create a combination which will result in failure if not properly managed.

Single seal applications can suffer from product build up on the atmospheric side of the seal, deterioration of the seal faces, internal mechanical damage and dry running, subject to the mechanical seal environment.

The use of double mechanical seals can offer protection to the mechanical seal faces, but does not overcome the environmental problems.

Thought must be given to pump design, reducing the velocity in the seal housing and removing the possibility of the slurry being able to "pack" around the internal seal rotary.

Common Slurries within this Category:

- Diatomaceous earth
- Titanium dioxide
- Thickener Underflows
- Coal
- Sand and Gravel
- Drilling Mud

Whilst each of these slurries are unique, they all present similar sealing problems.

3. Thermally Sensitive Fluids

These types of slurries are dependent on temperature control to keep the slurry in a stable state. Being of thermal nature, upper and lower temperatures must be controlled. Some of these fluids can contain abrasive particles in addition to being thermally sensitive.

These types of slurries therefore require attention not only to the seal environment, but care must also be applied in proper control of external services to either heat or cool the seal to maintain stability. Failure to implement or maintain these controls frequently results in rapid failure, particularly with a single mechanical seal.

The key in applying single mechanical seals to thermally sensitive fluids is to ensure that the product stays in the liquid state. This is often controlled by utilising jacketed seal housings and quench to drain on the atmospheric side of the seal. Product thickening or solidification can result in excessive drive mechanism wear, seal hang-up and loss of fluid film.

Typical products in the category:

- Black Liquor
- Molten Sulphur
- Pitch
- Asphalt

4. Dissolved Solids

Fluids which contain dissolved solids are generally abrasive due to crystallisation of the solids. This occurs either when the product temperature is lowered or some of the fluid is evaporated. Crystallisation can occur as the product is subjected to high shear at the seal faces or as evaporation occurs during normal operation across the seal interface.

Stationary and rotating seal faces are subject to abrasive wear and seal hang-up. These two major problems are best addressed by the use of quench to drain or double mechanical seals. The internal environment for this category is not so important as for the slurries mentioned above.

Typical products in the category:

- Plating Solutions
- Caustics
- Sugar Solutions
- Brine
- Pulp Liquors

SEALING METHODS

Taking into consideration the different types of slurry, the solids content, the type and size of solids, the process operation, the availability of site services and the design of the seal housing environment makes it complicated to choose seals for these applications.

We can however simplify the selection process by finding out the correct information prior to seal selection.

CHECK LIST

- Is the unit presently packed, sealed by expeller or mechanically sealed?
- If the unit is packed:

Question: What is the usage of shaft sleeves and packing per annum?

Question: What is the pressure and quality of the seal water presently being used to lubricate the packing?

Question: What is the bearing housing or bearing cartridge life?

Question: What does it cost to maintain this piece of equipment over a twelve month period taking into consideration parts, labour and downtime costs?

Question: Is flush water acceptable to the process?

If the answer to the last question is YES we must consider the use of a single mechanical seal with throttle bush restriction. This can greatly reduce the amount of seal water presently being used, requires little or no modifications to the pump and produces a cost saving solution to the end user.

The flush requirement velocity should be set at 10 -15 Ft/sec and 1-2 bar above stuffing box pressure. This quantity can be adjusted by altering the radial clearance between the shaft sleeve and internal bore of the neck ring.

Example

Shaft sleeve diameter = d1_ (inches)
Throttle bush bore = d2_ (inches)
Velocity = V (Ft/sec)

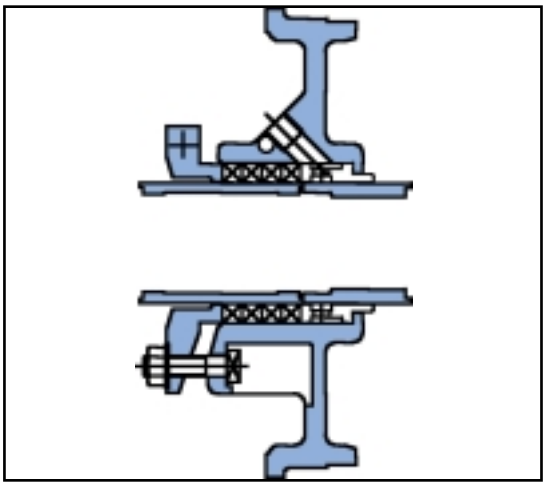
Gallons per minute = 2.04 (d2_ - d1_) x V

Assume 2" sleeve with .005" radial clearance

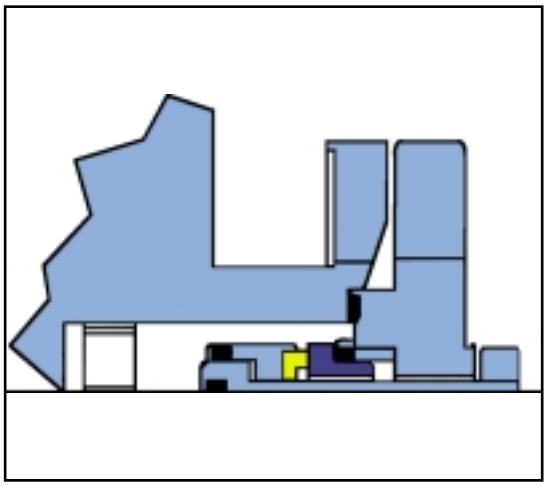
(4.04 - 4.00) = .04 x 2.04 x 15 = 1.22 Gals/min

AESSEAL®
ENVIRONMENTAL TECHNOLOGY

Typical Packed Gland



Single FMG to suit a Slurry Pump with neck bush



From the typical packed gland arrangement you will notice that the lantern ring is located at the bottom of the stuffing box, with the water flush connection feeding directly into the product.

The single seal with neck bush can reduce the water usage and save in terms of spares and maintenance costs. Note: the drilling in the neck bush is to remove any chance of "gas trapping" in the stuffing box.

This arrangement is operating successfully on a (130mm) Slurry Pump on a thickener underflow duty. The previous arrangement of packing meant the pump was being removed every 8 - 12 weeks and this installation has a pay back time of less than 9 months.

CHECK LIST

- Is the unit presently packed, sealed by expeller or mechanically sealed?
- If the unit is sealed by mechanical expeller:

Question: Is the pump operating on a stop start duty?

Question: Is the suction head of the system within the capability of the expeller design?

Question: Over a period of time is the expeller wearing to such a degree that the dynamic characteristics are overcome by suction pressure?

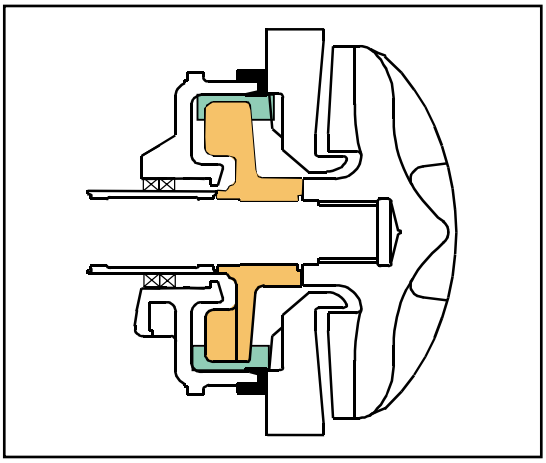
Question: Is the expeller operating to its design capability without leakage to atmosphere and offering acceptable mean time before failure?

If the answer to the last question is YES do not waste your time. If we have a YES to one of the first three questions then mechanical sealing becomes an available option.

AESSEAL®
ENVIRONMENTAL TECHNOLOGY

Let us now consider the design and operation of the: **Hydro Dynamic Seal**

The Expeller



The hydro dynamic seal, also known as the centrifugal seal, has a number of advantages over the packed gland seal when pumping slurries. Since the centrifugal seal requires no sealing water, no dilution of the slurry takes place. This is because the centrifugal seal keeps slurry away from the gland when the pump is running, resulting in no wear on the shaft sleeve.

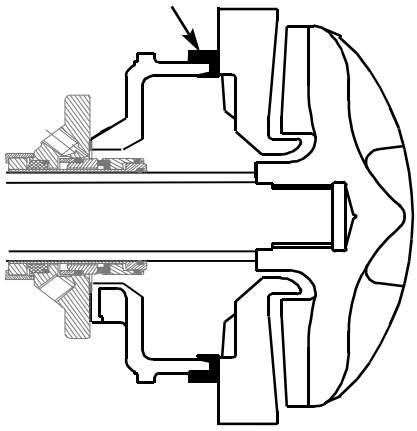
The centrifugal seal comprises small vanes on the back of the impeller and a second small impeller (called an expeller) which is mounted in a separate chamber behind the main casing. The outboard packings are required to seal the unit when the pump is stationary. On stop start duties this is often the problem if poorly maintained. The liquid in the space behind the impeller and in the separate chamber is rotating and therefore develops a pressure that balances the main pumping pressure. For the centrifugal seal to work effectively there must be a rotating ring of liquid. The pressure developed is a function of speed and diameter. In cases where the suction pressure of the unit is capable of overcoming this developed pressure, leakage will occur.

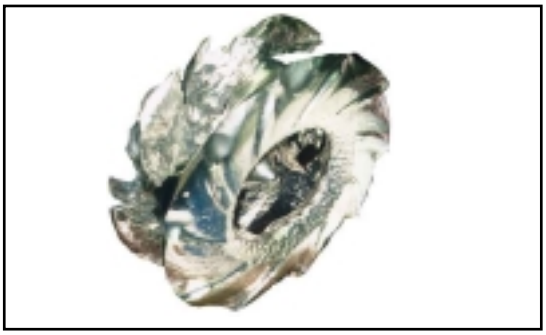
Note: Never try to modify this arrangement whilst the expeller is still fitted to the pump. This will only result in failure due to dry running.

Dependant on the materials of construction of the expeller housing, modifications can be made to accommodate the mechanical seal. The seal is operating in a large volume of liquid and is protected from velocity by means of the frame plate liner.

This application was fitted to a Slurry Pump on a minerals processing plant. The 85mm CURC™ TC/SIC was commissioned in 1994 sealing sand slurry, with a Specific Gravity of 4.5 and a Density of 1.5, with a particle size of 120 Microns. The abrasive nature of this product means the impeller is changed every six months.

The Frame Plate Liner





The CURC™ seal has now been in continuous operation for 5 years. This picture shows the condition of the impeller after 6 months operation. We must take into account that the impeller is operating in a very high velocity area and by design we have removed this velocity from around the seal. No flush has been used.

AESSEAL®
ENVIRONMENTAL TECHNOLOGY

We have covered conversions from packed gland (if seal water can be used) and conversions from hydrodynamic seals when the materials of construction will allow.

CHECK LIST

- Is the unit presently packed, or mechanically sealed?
- Is the unit presently packed but seal water cannot be used?

Question: What is the usage of shaft sleeves and packing per annum?

Question: What is the bearing housing or bearing cartridge life?

Question: What does it cost to maintain this piece of equipment over a twelve month period, taking into consideration parts, labour and downtime costs?

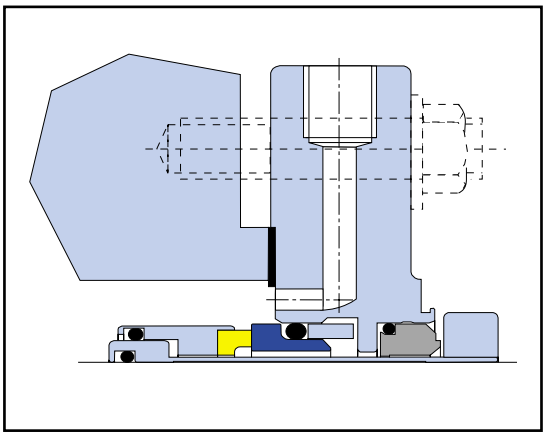
Question: Does leakage from the unit have any implications in terms of environmental legislation?

We can now establish a cost effective sealing solution

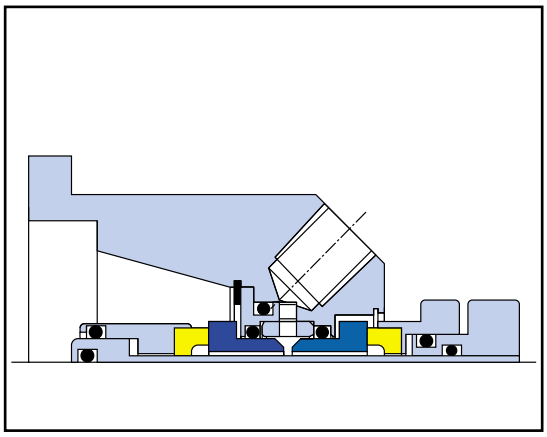
Fitting a seal (single or double) in a standard stuffing box at this point will inevitably end in premature failure. This environment in a slurry pump can promote erosion, overheating, seal face hang-up and rapid wear.

Question: What category of slurry are we dealing with?
Fibrous; Dissolved Solids
Thermal sensitive; Abrasive

We have been sealing fibrous, dissolved solids and thermal sensitive slurries for many years. Success in these fields has mainly been due to the mechanical seal environment being designed for the particular application. In some cases the OEM has also played a very important part. From experience we probably would not consider the use of a standard stuffing box without flush when sealing Sludges and Paper Stock. We do however still use our standard technology albeit in a different environment.



CURC™



PCP™

Let us now consider abrasive and non-abrasive slurries in the Minerals Processing Industry.

CHECK LIST

- Is the unit presently packed, or mechanically sealed?
- Is the unit presently packed but seal water cannot be used?

Question: What is the solids content (%Wt)?

Question: What is the solids content (% Volume)?

Question: What size are the solids (if dealing with abrasive slurries)?

Question: What is the range of solids sizes and percentages?

Question: Is the unit prone to dry running?

Question: Consider vibration/cavitation.

Question: Consider the machine type and manufacture.

From this information we can determine whether a mechanical seal is appropriate for the application. This will be determined by the machine type and stability of operation.

Example

Subject to the materials of manufacture, if the slurry is very abrasive it will wear the rotating components. Rotating assemblies often go out of balance as the slurry wears the impeller and other rotating parts. Efficiency can also be affected, which in turn can cause vibration and internal recirculation problems, resulting in frequent impeller adjustments having to be made on certain types of equipment.

This effect of unbalance, wear and instability often means the unit is operating away from its "Best Efficiency Point" and results in cavitation. Should the slurry, due to this cavitation, be allowed to penetrate the mechanical seal interface it will most certainly result in premature failure.

Once we have determined the stability of the equipment we can proceed to seal selection.

Single or Double

There is no doubt that double seals operating in the correct environment and supported by adequate systems properly maintained will increase the service life of the unit. This is not however the best commercial or technical solution to all applications.

Single Seals

Success with single seals will depend mainly on the environment, solids content and the particle type, size and distribution.

Assuming the environment is correct (see chapter on Environments) we must then consider the following:

AESSEAL®
ENVIRONMENTAL TECHNOLOGY

CHECK LIST

- Can the particles due to size penetrate the mechanical seal interface?
- If not:

When the particle size, environment and machine stability will not allow migration to the seal interface, single hard faced seals can be used. However when dealing with **Super Saturated Solutions** (Caustic, Brine etc) the solids which have passed the seal generally return to their crystalline form. This can be overcome by the use of Quench to Drain, (CURE™).

CHECK LIST

- Can the particles due to size penetrate the mechanical seal interface?
- If yes:
- Are the particles abrasive?
- If yes:
- Examples:

Quartz based minerals	(Sand)
Sulphide based minerals	(Pyrites)
Aluminium based minerals	(Kaolin)

If we are dealing with abrasive media particles of less than 50 microns we should be selecting **Double Seals for these applications.**

PUMP TYPES

We have considered "Sealing Methods" now we have to consider the pump types and designs we are likely to encounter on a day to day basis, throughout all industries.

These can be split into the following categories:

End Suction (Horizontal and Vertical)

Over 80% of all pumps used in industry are the single stage, end suction, centrifugal type. Over the years this type of pump has gone through many transitions, the most dramatic change being the seal housing design.

This change from packed stuffing boxes to open seal chambers has allowed this type of unit to be employed in a far greater cross section of process operation. Many units however are still being used with the standard stuffing box arrangement and have been successfully sealing **without any modification.**

Typical Examples:

- Water and Waste Treatment
- Plating Solutions
- Brine
- Sugar Solutions
- Caustics
- Many applications in Pulp and Paper

Axially split casing

Used predominately in moving large quantities of clean liquids, there has been no changes to the stuffing box design of this type of unit.

Progressive Cavity

This type of unit was designed specifically for handling solids, fitted originally with a packed gland. With the requirements of the end user to utilise mechanical seals on this type of unit, designs are now in place to optimise the mechanical seal environment. This is achieved by removing the original stuffing box and replacing with a fully machined gland cartridge seal.

Typical Examples

- Digested Sludge
- Food Processing
- Coatings
- Kaoline

Industry Specific

Industries such as Pulp and Paper utilise in their production pumps specifically designed for this type of application. The original concept was to use packed glands, followed by single seals supported via a water flush. There have been dramatic changes. Manufactures are now supplying large parallel bore and taper bore options to this type of unit.

Typical Example

- Paper Stock, Paper Pulp

Minerals Processing

The heavy duty pumps in this industry are normally selected for their ability to handle solids, in terms of solid size and concentrations. Pumps used in "heavy" or highly abrasive slurries often have rubber linings and/or are made from highly erosion resistant alloys.

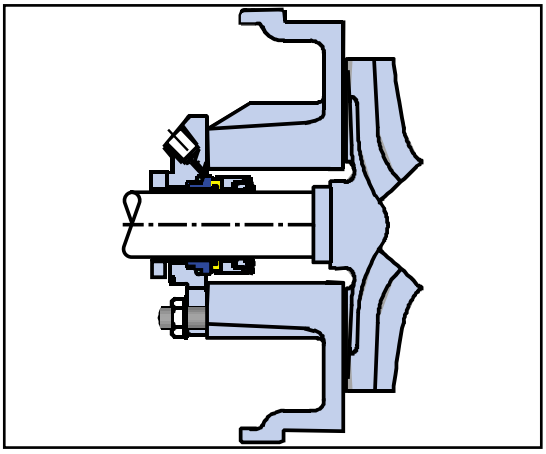
Typical Examples

- Tailings
- Thickener Applications
- Froth Flotation
- Centrifuge Applications
- Filtration

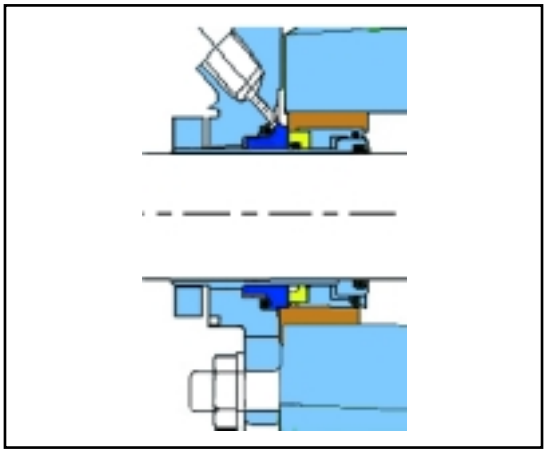
It is in this type of application that we need to be aware of the problems in mechanical sealing and this will be dealt with in the following section **ENVIRONMENTS.**

ENVIRONMENTS

When dealing with slurries, particularly in the Minerals Processing Industry, the environment of the mechanical seal is probably the most important aspect. Fitting seals into standard stuffing boxes will, without doubt, result in premature failure. This is often the case when standard process pumps are applied to slurry handling, as the following example demonstrates.



Example 1



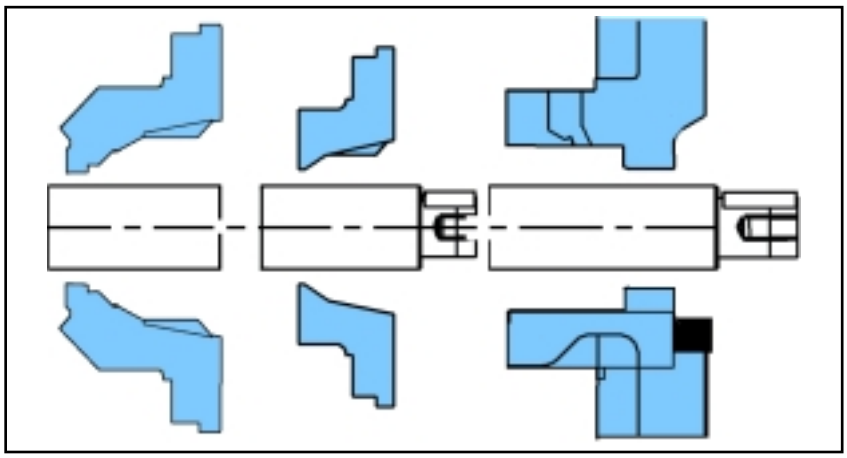
Example 2

Although effort has been made to modify the existing stuffing box by removal of the neck ring (example 1) it is still possible for the slurry to de-water during operation. This in turn results in the solids "packing" around the internal rotary (example 2) resulting in erosion of the internal metal components and dry running.

This particular example occurred on a re-slurrying pre-coat duty in a pharmaceutical company in the South of England. The seal failed within two weeks of intermittent operation.

Solution **The stuffing box was modified, and the seal changed to a CDSA™ supported via a P2 system.**

Modifying existing stuffing box arrangements is not always possible due to the amount of metal available in the cross section and the length or depth of the box. Should this be the case Pump Manufacturers are now, in most cases, able to supply a solution to this problem. The examples below demonstrate how, by design, the environment can be changed.



Typical PCP™ *Din* *ANSI big bore*

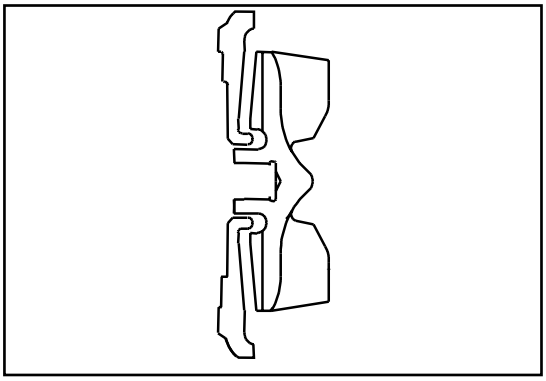
AESSEAL® ENVIRONMENTAL TECHNOLOGY

On pumps designed specifically for slurry applications, the standard would be to offer a packed gland unit supported by a standard stuffing box arrangement. This type of unit can only be sealed when the end user is willing to accept product dilution and is able to supply flush water of the correct quality and pressure.

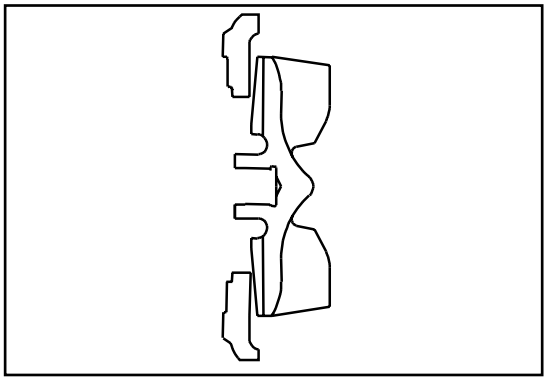
The next choice is to utilise the hydro dynamic seal arrangement. This however is restricted in terms of suction pressures and its performance is relative to speed. The next major problem occurs when hydro dynamic units are employed on stop start duties. The static suction pressure can overcome the packing resulting in excessive leakage.

The use of mechanical seals fitted to slurry pumps has been driven by the end user for a number of years. There are many designs available, which have been developed by the pump companies in conjunction with the mechanical seal manufacturer.

One modification is to open the pump back plate. This can be seen in the cross sections shown below.

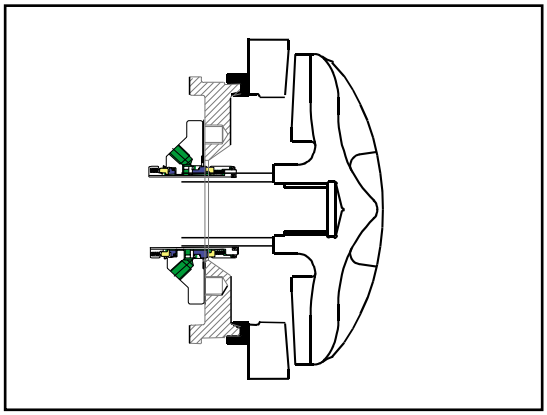


Standard



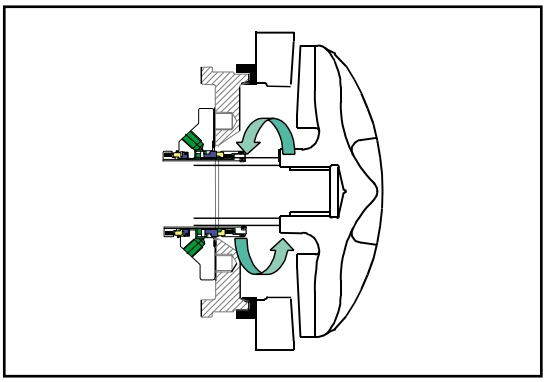
Modified

This design allows the product to circulate around the seal, producing a non- clogging design, assisting in cooling and face lubrication. This can be seen better in the example shown. This arrangement can work satisfactorily when sealing non-abrasive slurries.

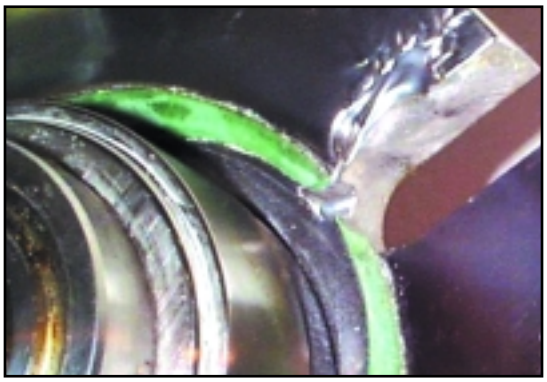


Modified back plate

However when dealing with highly abrasive applications, when it is known that the slurry being pumped is "erosive", opening up the liner can be detrimental to the operation of the mechanical seal and its metal components. The vanes on the rear of the impeller induce a high velocity around the seal and its components, often resulting in erosion of the stationary back plate and in some instances erosion of the seal gland plate.



High Velocity Area



Erosion of the seal gland plate (2 weeks operation)

Changing the metallurgy would seem to be the simplest answer, however the machinable alloys available on these thinner cross sections are not always suitable and will only extend the life by a matter of weeks not months. Also producing seals and back plates in Ferralium, for example, increases the cost by a factor of 2.5.

This application was on a Warman Pump located on a plant in Cornwall

Pump type	Warman® 3 x 2 CAH	60mm
Duty	DOR Tailings	
SG	1.2	
pH	6	
Solids Content	25%	

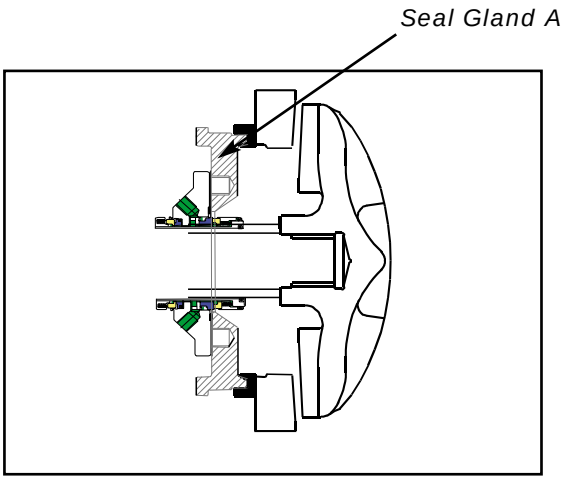
Quartz and mica with a small % of Kaolin. Temperature ambient with sulphuric injection.

This pump was originally fitted with an expeller seal supported by lip seals operating on a ceramic sleeve. The shaft sealing would fail between 2 to 4 weeks of operation. Using the principle of the "open frame plate liner", the unit was fitted with a stainless steel SiC/SiC CURE™ mounted in a stainless steel seal plate holder. The seal was supported by a clean water quench to drain. This sealing system failed due to gland and seal plate erosion after 2 weeks of operation. The seal faces had not deteriorated in any way.

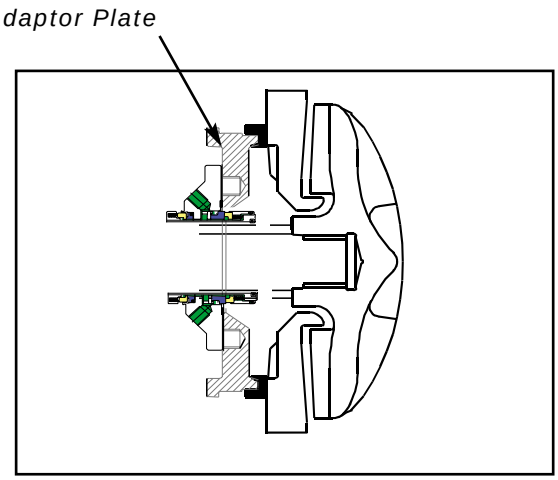
SOLUTION

On the 9th September 1998 the unit was rebuilt using the same seal specification, with changes to the pump components and the mechanical seal environment.

The non- standard frame plate liner was changed for a standard unit to reduce the velocity around the seal and to protect the seal plate holder. However by making these changes we had reduced the volume of liquid around the seal and the chamber would be prone to "gas trapping".

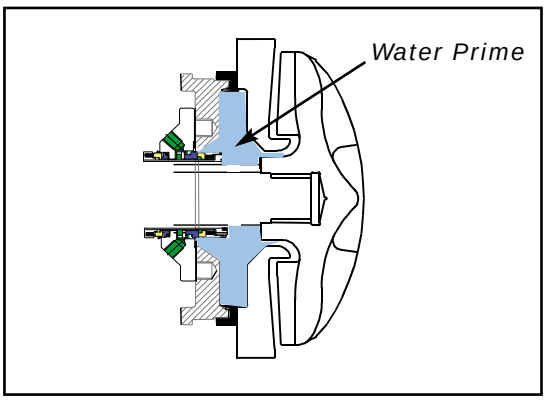


Open Frame Plate Liner
(Expeller removed)



Standard Frame Plate Liner
(Expeller removed)

To overcome the gas trapping effect the chamber was primed manually, with water, prior to operation.



Due to the pressures equalising between the Volute and Seal Housing there is little or no interchange between the pumped fluid and the seal chamber liquid. Considering that we have reduced the velocity, this arrangement was still in operation in June 2000. The seal life in this instance went from 2 weeks to 22 months.

AESSEAL®
ENVIRONMENTAL TECHNOLOGY

The solids content of any slurry can be viewed in two ways:

1 There are slurries which are entirely a by-product of the process and in most cases they are disposed of in liquid form.

2 In certain slurries the solids are the final product. In these cases the final treatment may be via centrifuges, rotary/plate, frame filters and dryers.

Plate and Frame filters often require two-stage pumping to complete the cycle of operation. It is in this area where most end users experience shaft sealing problems.

The first stage pump has to operate at high flows and low heads when first started, climbing up the performance curve until it reaches a low flow condition. During this period the first pump is often subjected to cavitation. The second pump is then employed to deliver a lower flow condition at a much higher head. (See figure 1)

Taking into consideration that this process is operated on a batch basis it often, by operation, causes problems with mechanical seals:

1 The first stage can suffer from cavitation.

2 The second stage is operating at higher differential pressures.

3 The pumps are stopped at the end of the batch so failure to flush out the solids, prior to shutdown, results in the solids settling in the volute. During the next cycle as the pump starts it has to move the slug present at the bottom of the volute, resulting in excessive shaft deflection. (See figure 2)

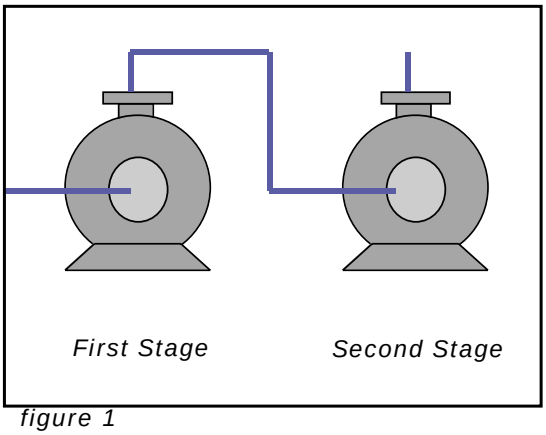


figure 1

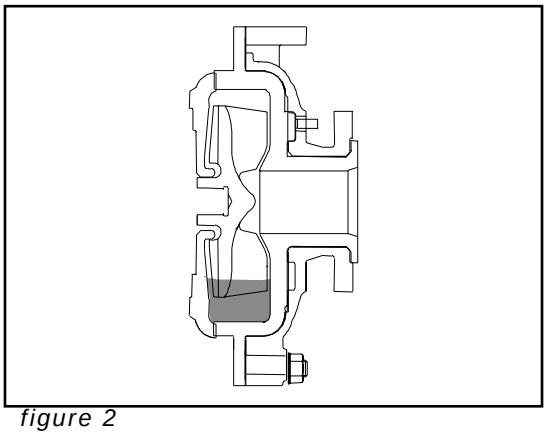


figure 2

The Solution

1. Find out exactly the process conditions.

2. Watch the units during a batch run. This will assist in the evaluation of the amount of cavitation.

3. Use double balanced seals on the second stage.

4. Insist on the units being flushed at the end of each batch if settling occurs.

5. The second stage unit often operates at higher pressures than the plant can supply either in terms of water or air. To support the barrier fluid consider the use of a Pumppac.

This is proof that the environment around the mechanical seal is critical to achieve seal life in arduous duties.

AESSEAL®
ENVIRONMENTAL TECHNOLOGY

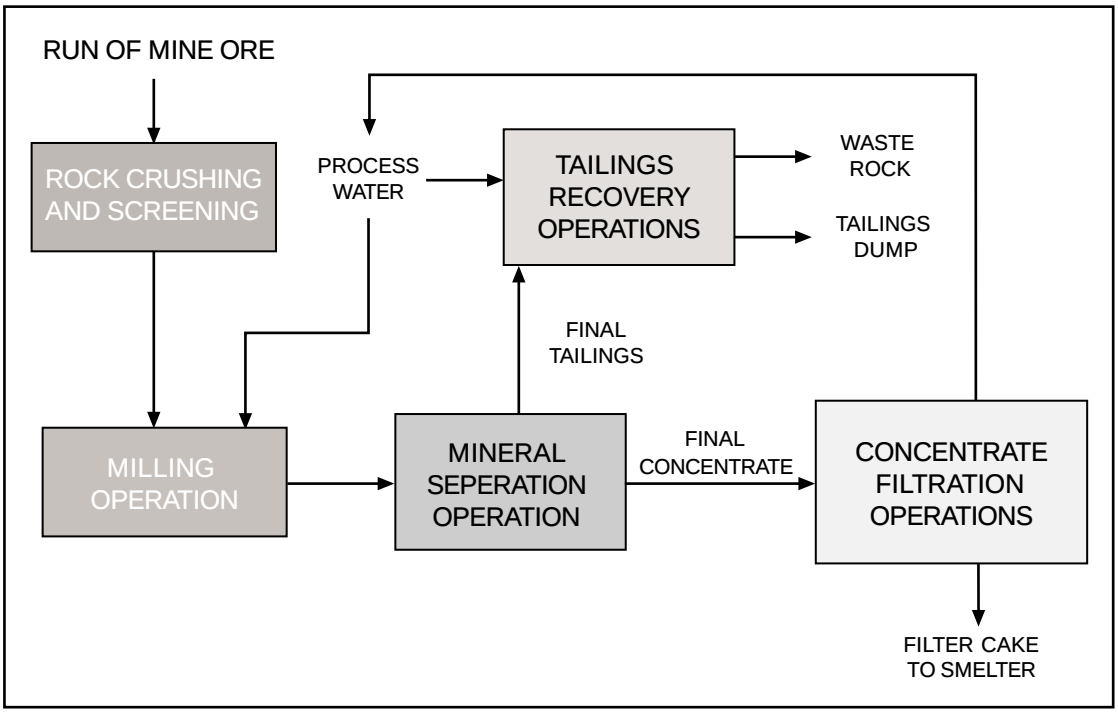
SUMMARY

Sealing slurries to obtain maximum performance and extended seal life is achieved by ascertaining the correct information from the end user. Selections can also be assisted by the AESSEAL® database.

Here are a few selections available. Most of course are recommending the CDSA™. In many cases it is also possible to use the CURE™ if site services are available.

Product	Seal	Faces	Elastomer	Case History
CEMENT	CDSA™	TC/TC/CRO2/C	VITON®	1034J
CERAMIC SLIP	CDSA™	TC/TC/CRO2/C	VITON®	
CLAY (CALCINED)	CDSA™	TC/TC/TC/C	VITON®	
DIATEMACEOUS EARTH	CURC™	TC/TC	VITON®	1029J
FIBRE PULP (SECONDARY)	CDSA™	TC/TC/TC/C	VITON®	
GYPSUM SLURRY	CDSA™	SIC/SIC/SIC/C	VITON®	793H
GYPSUM SLUDGE	CDSA™	TC/TC/CRO2/C	VITON®	173B
KAOLIN	CDSA™	TC/TC/CRO2/C	VITON®	1032J
LIME	CDSA™	TC/TC/CRO2/C	EPR	
PAINT (AQUEOUS)	CDSA™	TC/TC/CRO2/C	VITON®	852H
PAPER STOCK	CDSA™	TC/TC/CRO2/C	AFLAS®	
THICK JUICE SUGAR	CDSA™	TC/TC/CRO2/C	VITON®	
TITANIUM DIOXIDE	CDSA™	TC/TC/CRO2/C	AFLAS®	
ZINC OXIDE	CDSA™	TC/TC/CRO2/C	VITON®	

GENERAL MINERAL PROCESSING OPERATIONS



AESSEAL®
ENVIRONMENTAL TECHNOLOGY

To Re-cap

1. Identify the slurry type.
2. Ascertain the % solids by weight and volume.
3. Check the particle size distribution (the engineer does not often have this information).
4. Choose face materials relative to machine type and performance.
5. Understand the process. Trace through the full system to determine "dry running", "settling solids" and "batch operation" .
6. Ask questions about the life of existing equipment. "How long does the pipework last?"
7. Determine if the slurry is erosive.
8. Determine what sealing arrangement is presently being used.
9. For packed glands ask "What life does the customer get from the packings and sleeve"? Be careful here, it can be seen as a normal to change these items every 12 weeks.
10. For users of hydro-dynamic seals, check if they have problems when the unit is shut down.
11. Check what annual costs are involved, including man hours, to maintain this equipment.
12. When a flush of the correct pressure and quality is available and product dilution is not a problem, use a single mechanical seal with a neck bush.
13. Check the equipment design. Do not fit even double seals in standard stuffing boxes when packing of the solids may occur.
14. When dealing with small micron particle sizes, firstly determine if the particles are aggressive, if not then use the CURE™. The quench fluid to the CURE™ must be maintained, or clogging and eventual seal hang-up will occur.
15. Abrasive particles will deteriorate the seal faces. Use only pressurised double seals when abrasive particles are present.
16. By design increase the volume around the seal rotary.
17. Try to reduce the velocity around the seal and seal plate holder.
18. Introduce a compatible media prior to the commissioning of the unit. This reduces the interchange from the product being pumped to the mechanical seal environment.

It is not possible to produce seal selections for "Slurries". Sealing success is purely dependant on finding out the correct information prior to any seal selection.

SINGLE OR DOUBLE	**GET TO KNOW THE PROCESS DETAILS**
PARTICLE SIZE	**GET TO KNOW THE PRODUCT DETAILS**
SYSTEM	**GET TO KNOW THE SITE DETAILS**
SEAL	**GET TO KNOW THE PUMP DETAILS**
FACE COMBINATIONS	**GET TO KNOW THE OPERATIONAL DETAILS**

95% OF ALL APPLICATIONS ARE AVAILABLE ON THE AESSEAL® DATABASE.

AESSEAL®
ENVIRONMENTAL TECHNOLOGY

CASE HISTORY

Case History Number 1027J

Maintaining a packed gland can be very expensive and time consuming. Changing sleeves and packing every 6 to 8 weeks and taking into consideration the premature failure of the bearing cartridge can cost up to £5.000 ($8,000) on a yearly basis. One such example in a Gold processing plant was a Warman® 8 x 6 FAH 130mm (5.125") operating on a Ball Mill Tailings application. The slurry at 24% solids with sub micron particles of Quartz and other run of the mine elements was posing a problem to the end user. The standard stuffing box was slightly modified and the unit fitted with a FMG CURC™ (Z5208/WSCS) TC/TC/V. To reduce the amount of seal water required the stuffing box was fitted with a close fitting neck bush. The seal is serviced with a clean water flush at 9 bar (135 psi) (Plan 32) . Pay back on this installation is less than 6 months and the expected life in excess of 1 year.

Case History number 1028J

A contractor involved in the design of an Incinerator Plant in Holland soon ran into trouble during his commissioning and guarantee period. The original specification was single B W seals in a Warman® 1_ x 1 BAH . Although the seals had been mounted in a Duplex gland, the single seal was failing due to dry running and lack of fluid film. The nature of the slurries being handled meant that suction line blockages, particularly on the stop start duties, were the main cause of failure. On 12 units AESSEAL® fitted 50mm (2.000") CDSA™ (Sic/Sic/A C/CrO/A) seals supported with a P2 system operating at 2 bar (30 psi). The units were commissioned in February 1999 and we expect life from these units to be in excess of two years.

Case History number 1029J

A chemical plant in Scotland was using a Warman® 3 x 2 CAH to circulate a Bentonite Slurry. This slurry at +5% solids and a S.G. of 1.7 had been giving the client many problems. The unit was sealed on 4 different occasions by 4 different seal manufacturers. The longest seal life was no more than 2 weeks. AESSEAL® eventually had the opportunity to seal this troublesome unit, converting the Warman® pump with standard ex stock conversion parts and fitting a 60mm (2.375") CURC™ (TC/TC/V) in June of 1999. After 6,000 hours of operation the installation is no longer giving the client any problems. Expected seal life in this application can be estimated in excess of 10,000 hours. Changing the environment in this particular case increased the seal life.

Case History number 1030J

Production of building blocks in the South East of England gave this particular company a major problem in sealing the cocktail of Sand Lime and Cement. With a specific gravity of 1.4 and a slurry content of 47.7% the original packed gland on a 4 x 3 Warman® CAH was lasting only 7 to 14 days. The pump is also purged after batches with water at 90º C (194º F). The stuffing box back plate was removed and replaced with Warman seal plate conversion parts. The original frame plate liner was retained without modification. Using a standard 60mm (2.375") CDSA™ TC/TC/Chr/C/AFLAS®, energised via an AESSEAL® W2 system at 2.5 bar, the life of this unit was increased from the original 7 to 14 days to in excess of twelve months.

Case History number 1031J

A chemical company in Cork Ireland had been operating a number of 1_ x 1 BAH Warman® Slurry Pumps. This slurry at 20% solids, 75º C (167º F) with traces of sulphuric acid was being sealed with a single seal incorporating quench and drain. This bespoke slurry seal was lasting no longer than 2 –3 months. The cost of a new seal or repair was so high that the client was looking for a more cost effective and reliable solution. In May of 1999 AESSEAL® fitted a 50mm (2.000") CDSA™ (Sic/Sic/V//Car/Sic/V) and W2 system operating at 3 bar (45 psi). The pump was converted using standard Warman conversion parts and the frame plate liner was also changed to reduce the velocity in the seal area. The seal operates for 24 hours per day and during the 8 months since initial commissioning the client has purchased 4 more seals and systems.

Case History number 1032J

A manufacture of China Clay in the South West of England was using a packed gland PCP pump to transfer his final product, this posed three major problems:

1 Dilution of the final product
2 Premature bearing failure due to water ingress
3 Excessive wear to the pump shaft resulting in expensive pump refurbishments

In August 1998 AESSEAL®, in conjunction with the pump repairer, fitted a 70mm (2.750") CDP (ref AZA 4810) Sic/Sic/Sic/Car/V to the standard stuffing box. The pump used was operating on a very low suction pressure and the AESSEAL® utilised a low pressure quench to drain. The unit was removed some 12 months later to refurbish the pump component parts. The mechanical seal was refurbished and re installed on the unit. Besides increasing the MTBF, the cost of the refurbishment was greatly reduced because no bearing or shaft parts were required.

Case History number 1033J

A Company in South Africa pumping a sand slurry at 20% solids with a particle size of 120 micron consulted AESSEAL® to solve a system problem. The CH Warman® pump 4 x 3 DAH was originally supplied with an expeller seal. Being on a second stage duty and being subject to stop start conditions the leak from the gland was resulting in premature cartridge failure. The expeller was removed and fitted with a new sleeve and the expeller housing was modified and fitted with a standard 85mm (3.375") CURC™ TC/TC/V. The impeller in this unit is changed every 6 months due to the erosive nature of the slurry. The same seal was re-fitted each time on 8 different occasions without refurbishment. Expected life in this environment has been estimated in excess of 5 years.

Case History number – 1034J

A company manufacturing Cement in the South of England had been having problems with a standard packed gland on a Warman® 6/4 DAH 85mm (3.375"). This method of sealing the cement slurry, with a specific gravity of 1.3 and solids content of 25%, was eroding the shaft sleeve and the flush water to the lantern ring was causing dilution of the product. One of our competitors was given the opportunity to seal this unit, but without thought to the sub micron content and mechanical seal environment the seal dramatically failed within one week of operation. The pump was refurbished using bearing cartridge parts from Warman® and AESSEAL® Warman® conversion parts to accept an 85mm (3.375") CDSA™ TC/SIC/CHOX/CAR/V supported via a W2 system and energised by the local ring main at 3 bar (45 psi) pressure. The unit was commissioned in May 1997 and was still in operation some 3 years later. During this successful period the client has been systematically converting all his Warman® packed gland pumps to AESSEAL® units.

Case History number – 1035J

In the business of Minerals Processing, by the nature of the process, the end user is often faced with re-working or disposing of residue. In the South West of England one particular plant had such a problem. The company was using a Warman® Rubber lined pump to transfer a China Clay Residue. This residue contains varying amounts of Sand, Quartz, Mica and Feldspar. The original arrangement of expeller, supported by lip seals operating on a ceramic sleeve, was lasting no longer than 2 – 3 weeks. This resulted in loss of production and expensive rebuilds.

Two reputable seal companies on two different occasions attempted to seal this unit and both failed. The problem was passed back to the service division of Warman® who in turn contacted AESSEAL® for assistance.

The pump was converted with standard Warman® conversion parts and a 60mm (2.375") CURC™ Sic/Sic/V was fitted. We were called back to the unit within a matter of weeks. The Seal Plate Holder and Seal Gland Plate had been subjected to excessive erosion and the external components of the cartridge were contaminated causing the seal to "hang up".

To remove the erosion problem we reverted to the standard frame plate liner. This reduced the velocity around the stationary seal metal parts.

We also changed the seal for a CURE™ and utilised the quench and drain connections at approximately 2 litres per min at 2/3 bar (10 psi). The change to the environment of this application allowed the unit to operate for 18 months without any problems.

AESSEAL®
ENVIRONMENTAL TECHNOLOGY

NOTE:

Due to AESSEAL's policy of continuous improvement the following seal types have been upgraded.:-

SCI	*upgraded to*	*SCUSI*
CSAI	*upgraded to*	*CURC*
CAPI	*upgraded to*	*CURC*
CAPO	*upgraded to*	*CRCO*
CMDS	*upgraded to*	*CDSA & DMSF*

All information featured in these Case histories has been obtained directly from Plant Engineers.

Although we have confidence in the accuracy of this information, it is not offered as a guarantee for seals manufactured by AESSEAL plc.

Any prospective user of our product should verify the information stated to their own satisfaction.

Further information is available on all the case histories contained in this booklet upon request.

Issue 'A' on a case history refers to information which was current on the 31st. January, 1989

Issue 'B' refers to information which was current on 31st. January, 1990.

Issue 'C' refers to information which was current on 31st. January, 1991.

Issue 'D' refers to information which was current on 31st. January, 1992.

Issue 'E' refers to information which was current on 31st. January, 1993.

Issue 'F' refers to information which was current on 31st. January, 1995.

Issue 'G' refers to information which was current on 31st. January, 1998.

Issue 'H' refers to information which was current on 31st. October, 1999.

Issue 'I' refers to information which was current on 31st. March, 2000.

Issue 'J' refers to information which was current on 31st. November, 2000.

Where the statement 'The seals are still working' is made, this means that the customer is or was still using AESSEAL® Mechanical Seals at the time the case history was updated; as denoted by either
Issue 'A', Issue 'B', Issue 'C', Issue 'D', Issue 'E', Issue 'F', Issue 'G', Issue 'H', Issue 'I' or Issue 'J'.

For more detailed information, please contact our Applications Department.

AESSEAL®
ENVIRONMENTAL TECHNOLOGY

ENVIRONMENTAL TECHNOLOGY

The AESSEAL® Group of Companies

AESSEAL plc, Rotherham, U.K.	Telephone: +44 (0) 1709 369966
AESSEAL plc, Derby, U.K.	Telephone: +44 (0) 1332 366738
AESSEAL plc, Peterborough, U.K.	Telephone: +44 (0) 1733 230787
AESSEAL plc, Scotland, U.K.	Telephone: +44 (0) 1698 849808
AESSEAL plc, Middlesbrough, U.K.	Telephone +44 (0) 1642 245744
AESSEAL plc, Essex, U.K.	Telephone: +44 (0) 1708 256600
AESSEAL plc, Pontypridd, U.K.	Telephone: +44 (0) 1443 844330
AESSEAL (MCK) Ltd., Lisburn, U.K.	Telephone: +44 (0) 28 9266 9966
AESSEAL (MCK) Ltd., Co. Cork, Ireland.	Telephone: +353 (0) 214 633477
AESSEAL Inc., Knoxville, Tennessee, USA.	Telephone: +1 865 531 0192
AESSEAL Inc., Seneca Falls, New York, USA.	Telephone: +1 315 568 4706
AESSEAL Inc., Kingsport, Tennessee, USA.	Telephone: +1 423 224 7573
AESSEAL ESP LLC, Cedar Rapids, Iowa, USA.	Telephone: +1 319 393 4310
AESSEAL Deutschland AG.	Telephone: +49 (0) 60 74 881293
AESSEAL Italia SRL.	Telephone: +39 (0) 33 197 0556
AESSEAL Pty Ltd., Gauteng, South Africa.	Telephone: +27 (0) 11 466 6500
AESSEAL Pty Ltd., Confluid Branch, Amanzimtoti, South Africa.	Telephone: +27 (0) 31 903 5438
AESSEAL Malaysia SDN. BHD.	Telephone: +603 8062 1233
AESSEAL Nederland.	Telephone: +31 (0) 76 564 9292
AESSEAL Ibérica S.L.	Telephone: +34 977 55 43 30
AESSEAL Danmark, Greve, Denmark.	Telephone: +45 56 64 14 00
AESSEAL France S.A.R.L.	Telephone: +33 (0) 3 2017 2850
AESSEAL Turkiye, Istanbul, Turkey.	Telephone: +90 (0) 212 237 40 47
AESSEAL Canada Inc.	Telephone: +1 807 624 2727
AESSEAL China Ltd.	Telephone: +86 574 8770 1888

FOR FURTHER INFORMATION AND SAFE OPERATING LIMITS CONTACT OUR TECHNICAL SPECIALISTS AT THE LOCATIONS BELOW.

THE QUEEN'S AWARDS FOR ENTERPRISE 2000

INVESTOR IN PEOPLE

WINNER OF THE NATWEST SUNDAY TIMES COMPANY OF TOMORROW AWARD

USE DOUBLE MECHANICAL SEALS WITH HAZARDOUS PRODUCTS. ALWAYS TAKE SAFETY PRECAUTIONS

- **GUARD YOUR EQUIPMENT**
- **WEAR PROTECTIVE CLOTHING**

WARNING

AESSEAL plc
Mill Close
Templeborough
Rotherham
S60 1BZ
United Kingdom

Telephone: +44 (0) 1709 369966
Fax: +44 (0) 1709 720788
E-mail: seals@aesseal.com
Internet: http://www.aesseal.com

AES / DOC / IN 4505 01/2002

Distributed by:

USA Sales & Technical advice:
AESSEAL Inc.
10231 Cogdill Road
Suite 105
Knoxville, TN 37932
USA

Telephone: 865 531 0192
Fax: 865 531 0571

ALL SIZES ARE SUBJECT TO MANUFACTURING TOLERANCES.
WE RESERVE THE RIGHT TO MODIFY SPECIFICATIONS AT ANY TIME.

Reference Issue • L - UK/US - SLURRY - 02