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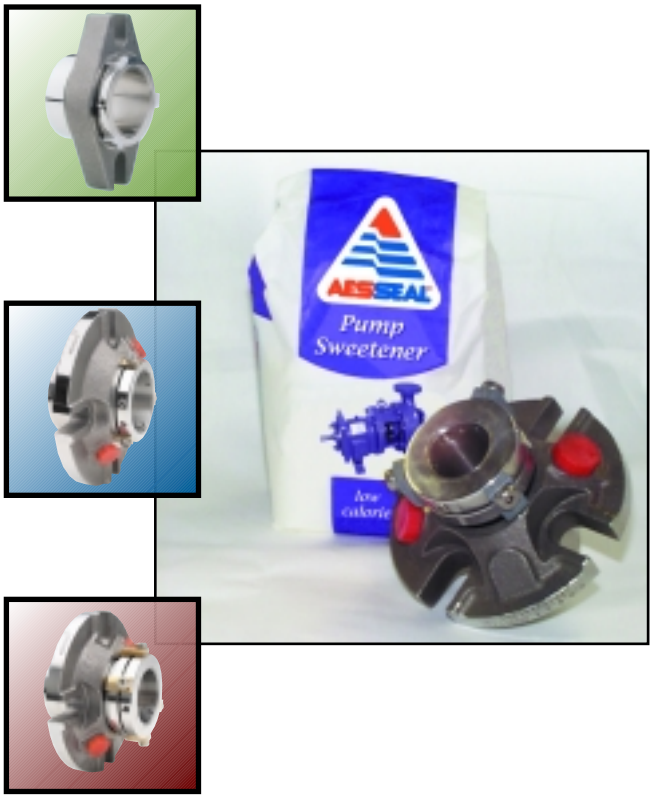
ENVIRONMENTAL TECHNOLOGY

A Guide to Sealing

THE SUGAR INDUSTRY



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A GUIDE TO SEALING THE SUGAR INDUSTRY

Introduction

The true "factory" that produces sugar is the beet or cane mill. The processes used in extracting sugar from both beet and cane are similar and the type of equipment used is common to both disciplines.

Within all sugar factories there are numerous pieces of rotating equipment requiring sealing devices. With the ever increasing demands for improved efficiency, reduced waste and effluent, together with improved equipment reliability there is now an industry shift from traditional sealing methods.

The use of modern high quality cartridge mechanical sealing devices and associated support systems is now becoming the industry norm. The use of such seals guarantees plant uptime.

Based on experience gained over the last 20 years in the Sugar and Syrup industries AESSEAL® has successfully sealed most applications in the modern sugar mill. When correctly installed and supported, up to 6 seasons / 3 years without any maintenance required can now be confidently expected.

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SUGAR INDUSTRY

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SUGAR INDUSTRY

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THE PROCESS

A Sugar refinery can be conveniently divided into 6 main plant areas:

Extraction

Clarification / Carbonisation

Decolourisation

Evaporation / Crystallisation

Separation / Drying

Utilities, Heat, Power, Effluent Treatment

(Detailed in other AESSEAL® leaflets)

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Preparation & Extraction

The crop of cane or beet is delivered to the mills by road or rail. The crop is weighed so that the farmer can be paid. The mass also forms part of the plant efficiency calculations.

The crop is washed and cut up into small pieces.

Sugar cane is cut up to a size of 50mm x 20mm (2.000" x 0.750"), it is then fed through the shredder which opens up the inner part of the crop for extraction purposes.

Sugar beet is sliced into thin sections commonly known as "cossettes".

Extraction

Two methods of extraction are used or a combination of both. These two methods are known as the "diffusion process" (washing) and the "milling process".

Diffusion

The prepared crop passes through a huge vessel called a diffuser. Hot water or a combination of thin juice and water is constantly sprayed onto the prepared crop, leaching the sucrose from the crop.

Milling

The prepared crop passes through heavy rollers, which squeeze out the juice. This process is repeated down a line of mills. The dry fibre (bagasse) can be used to fire the boilers or can be added to molasses to make animal feed, paper and industrial solvents. Particleboard can also be produced from this waste dry fibre.

During the crushing process water or thin juice is pumped onto the crop fibre to dilute and displace the juice trapped in the fibre. This is known as "imbibition".

After the diffusion/milling process the raw juice containing water, sand and other particulate is screened (juice screening) and pumped to the juice heaters and then on to the clarification process.

EQUIPMENT TO BE SEALED - PREPARATION/EXTRACTION AND MILLING

Pump Type	General Information	Seal	System
COSSETTE PUMPS	NORMALLY LARGE PUMPS. ONE OF THE MOST IMPORTANT TO SEAL AS LOSSES FROM GLAND ARE NOT RECOVERABLE.	CURC™ TC/TC/VITON	FLUSH OR QUENCH TO DRAIN
SLUDGE PUMPS	THESE ARE OFTEN PUMPING SAND, STONES AND OTHER DEBRIS AND CAN OFTEN BE PROGRESSIVE CAVITY TYPE PUMPS.	(PCP) CURC™ OR CURE™ TC/TC/VITON	
RAW JUICE PUMPS	70°C (160F)	CDSA™ TC/TC/TC/C AFLAS	
THIN JUICE PUMPS	70°C (160F)	CURC™ FLUSHED TC/TC/AFLAS	
DIRTY WATER PUMPS		CURC™ TC/TC/AFLAS	
HOT WATER PUMPS	70°C (160°)	Convertor II™ C/SIC/AFLAS	

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Clarification / Carbonisation / Purification

The most common form of clarification is to mix calcium hydroxide (milk of lime) with the raw juice. This is then heated to around 90°C (194°F), higher in some factories. The addition of carbon dioxide reacts with the lime to form calcium carbonate (chalk). This neutralises the sugar acids and forms a precipitate that settles out in the clarifiers.

This precipitated sediment, now known as mud is then transferred to tanks and is pumped through a filter press filtration process to recover any remaining sucrose. The filtrate is recycled back to the mixed raw juice tank. The mud solids are known as filter cake and are washed from the filter using hot condensate. The cake is then trucked away to be used as fertilizer and land conditioner.

EQUIPMENT TO BE SEALED - CLARIFICATION / CARBONISATION / PURIFICATION

Pump Type	General Information	Seal	System
RAW JUICE PUMPS		CDSA™ TC/TC/TC/C AFLAS	
LIME PUMPS	TYPICALLY HEAVY DUTY SLURRY PUMPS USED TO TRANSFER WATER AND LIME TO CARBONATION STAGE.	CDSA™ TC/TC/TC/C/AFLAS	W3 SYSTEM
MUD PUMPS	3-4% MUD, 90% CLEAR JUICE, 6-7% WATER. CIRCULATES FINE MUD, SUGAR SOLUTION AND WATER AFTER THE FILTER PRESS PUMPS. HIGHLY ABRASIVE, HENCE HEAVY DUTY SLURRY PUMPS REQUIRED. NORMAL OPERATING CONDITIONS. TEMPERATURE 80°-85°C (176°F-185°F) DISCHARGE PRESSURE TYPICALLY 5–6 BAR G (75-90 PSI)	CDSA™ TC/TC/TC/C/AFLAS	W3 SYSTEM
FILTER PRESS PUMPS	THESE PUMPS FEED THE FILTER PRESSES. THEY TEND TO BE HEAVY DUTY SLURRY PUMPS. OPERATING CONDITIONS ARE OFTEN HARSH, RUNNING AGAINST CLOSED VALVES AND CLOGGED FILTER PRESSES. THIS WILL CAUSE HEAVY VIBRATION AND PUMP SHAFT DEFLECTION, HOWEVER, THIS CAN BE SUCCESSFULLY SEALED FOR MANY YEARS.	CDSA™ TC/TC/TC/C/AFLAS	W2 SYSTEM
FILTRATE PUMP		Convertor II™ C/CHOX/AFLAS	
VACUUM PUMPS		CURC™ (FMG) C/CHOX/AFLAS	
CONDENSATE PUMPS	120°C (250°F)	CDSA™ TC/TC/TC/C AFLAS	W3 SYSTEM

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Decolourisation

Pressed Liquor is taken from the Carbonization Process and passed through three tanks containing resin.

These three processes remove the remaining colour. The decolourized solution is known as Fine Liquor.

After 40 – 50 hours the resin needs to be cleansed of the impurities that have been collected. This is achieved by cleansing the resin with weak doses of Hydrochloric Acid, Caustic and Hot Water. This mix of chemicals is highly corrosive, erosive and toxic, but is easily sealed using a double Seal.

EQUIPMENT TO BE SEALED - DECOLOURISATION

Pump Type	General Information	Seal	System
NEUTRALISING PUMPS	**THESE ARE NORMALLY CENTRIFUGAL PROCESS PUMPS.**	**CDSA™ SIC/SIC/CHOX/C**	**W2 THERMOSYPHON SYSTEM**

Note:
Sometimes an Exotic Alloy seal will be required depending on acid type and concentration in the neutralizing pumps.

Evaporation Crystallisation

All the previous processes have been carried out in liquors that are high in water content. Before the next stage can take place the water content must be reduced.

This is done by evaporation and the resulting syrup is Fine Liquor.

Pumps tend to be normal process type and transfer the syrup from one evaporator to the next.

Falling Film Evaporators

A bank of cooling towers gives this process away.

Superheated steam is added to the sugar solution and passed through typically six evaporators, the first being at around 130°C (266°F), and the last at 96°C (204°F). The sugar content is raised from 15% to 67% brix, 85% pure. This Fine Liquor is then fed to the vacuum and Crystallising Pans by PCP type pumps.

Vacuum Pans

The job of the vacuum pans is to grow the sugar crystals.

There are three grades of sugar crystal and molasses termed A, B, and C which are mixed together to form the sugar crystals.

The sugar grades ABC refer to the whiteness of grain.

Grade A – Almost pure white
Grade B – Whitish
Grade C – Used as a mixing blend where whiteness is not important

Crystallisation

Steam is again added under vacuum conditions, where the syrup boils at 80°C (176°F) due to the vacuum. This helps to prevent the creation of new impurities.

As the liquor boils, the sugar gradually crystallises and after 2 hours the crystals have grown to around 0.5 – 0.6mm (20-24 thou).

They are then passed to a mixing vessel.

EQUIPMENT TO BE SEALED - EVAPORATION/CRYSTALLISATION

Pump Type	General Information	Seal	System
EVAPORATOR PUMP TRANSFER (PROCESS OR SLURRY)	PROCESS TYPE PUMPS OFTEN RUN WITH LOW NPSH.	CDSA™ TC/TC/TC/C/AFLAS ALTERNATIVE CURE™	W3 QUENCH DRAIN
FINE LIQUOR PUMPS	POSITIVE DISPLACEMENT OR PCP.	CDSA™ TC/TC/TC/C/AFLAS	

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Separation / Drying

The mixture of liquor and sugar crystals is known as Massecuite and resembles White Porridge. It is now centrifuged to separate the White Sugar Crystals from the liquor.

The sugar is now dried and stored in silos, while the syrup is returned to the process for further crystallization stages.

At this stage small pumps are used to transfer the syrup back to the evaporation stage to be re-dissolved into the liquor to make the feed for the first crystallization stage.

The resulting liquor from the final crystallization stages is Molasses, which is stored or used in Animal feed.

Blending

All sugar plants have an area where the finished product is stored and blended, for example Edible Syrup, Treacle, Food Syrups etc. There are many applications for sealing in this area. The Molasses is stored in large tanks and blended to customer requirements. Each tank utilizes a PCP type pump which will normally be packed and leaking. This is a finished product of high value and wastage is frowned upon.

EQUIPMENT TO BE SEALED - SEPARATION / DRYING / BLENDING

Pump Type	General Information	Seal	System
MASSECUITE PUMPS	THESE ARE NORMALLY POSITIVE GEAR OR LOBE PUMPS.	CRCO™ WITH FOOD GREASE OR CURE™	BUFFER RESERVOIR
MOLASSES MOTHER LIQUOR	PUMP TYPES IN BLENDING ARE PCP OR POSITIVE. DISPLACEMENT PUMP i.e. ROTARY LOBE.	CDSA™ (SPACE PERMITTING) DOUBLE SEAL WITH FREE STANDING SYSTEM ALTERNATIVELY: CURE™	THERMOSYPHON P2 WATER DILUTION CAN NOT BE TOLERATED FOOD GRADE ANTIFREEZE & WATER

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GLOSSARY

Massecuite - Mixture of Liquor and sugar crystals, visually resembles White Porridge.

Magma - Mixture of impure sugar crystals which is mixed with Hot Impure Syrup 46°C (115°F) Visually resembles Brown Porridge.

Molasses - Dark syrup

Campaign - Production or maintenance

Brix - Consistency

Juice Run - Before campaign begins to produce varying sugar grades

C - Carbon

TC - Solid Tungsten Carbide

SiC - Solid Silicon Carbide

CHOX - Chrome Oxide

Seal Supply and Specification

Tungsten Carbide faces are preferred on the product side. Syrup can cause sticking together of the faces and the high shear forces induced by torque break out during start up can cause seal Silicon Carbide faces to shatter.

On double seals preferred outboard faces are Carbon against Tungsten Carbide.

Aflas is normally recommended due to a superior hot water service performance.

Single seals (CURC™) should be offered for stages prior to evaporation. These are then normally flushed into the product, or fitted with a labyrinth and run quench to drain.

Double seals (CDSA™) should be offered for all syrup duties, especially during the latter stages where losses are more critical. All PCP type pumps, Acid pumps and high temperature such as Carbs - use the CDSA™.

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Case Histories

Case History 1213J

In a Sugar factory in the UK, 100mm (4.000") CMAX was fitted to a new Hydrostal pump, used for pumping sliced cossettes into the Diffuser.

The shaft rotates at 900 r.p.m. and product temperature is 75°–80°C (166°-176°F). The pump shaft can have up to 2mm (80 thou) axial movement, so the Cossettes are not damaged during transportation.

The mechanical seal has been working without fail for 2 campaigns, however, due to the abrasive nature of the product, the pump casing has worn through.

The stand-by pump has a packed gland, and within 2 weeks of operating had worn the sleeve, requiring repacking every second day and needed a large catchment tray under the pump to collect the liquid spewing out.

A CMAX A capable of 3mm (120 thou) movement in either direction was utilised.

Case History 1214J

In a Sugar factory in the UK, 60mm (2.375") CDSA™ seals complete with Thermosyphon Systems were fitted to Girdlestone pumps on the Evaporators. Solid Tungsten Carbide faces inboard and Tungsten against Carbon outboard with Viton elastomers made up the seal. The pumps transfer juice at 15% sugar and high water content through 6 falling film evaporators. As the process continues the water content is reduced so that by the last pump the juice is 67% sugar.

The initial pump operating temperature is 130°C (266°F), reducing to 96°C (204°F) at the last pump.

The seals have to date endured 6 Production Campaigns without failure.

Case History 1215J

In a Sugar factory in the UK, 60mm (2.375") CDSA™ seals were fitted to Warman 4/3 CAH pumps used for pumping Lime and Water to the Carbonation stage.

The seals were configured as TC/TC/TC/C/Aflas and were supported by a W2 Thermosyphon System.

Typical seal life is 6 years continuous running.

Case History 1216J

In a Sugar blending factory, 50mm (2.000") CDSA™ seals were fitted to Mono PCP pumps, used for transferring finished product from storage tanks to the canning area. A free standing Thermosyphon pot filled with water and food grade antifreeze was also used. Previous seal use was rubber bellows seals, which lasted only a matter of weeks due to product crystallisation around the seal faces. The improved sealing arrangement paid for itself within 2 months due to no product loss or maintenance downtime.

Case History 1217J

In a Sugar factory in the UK, 95mm (3.875") CDSA™ seals were fitted to Warman PC150 pumps, used for transferring Thin Juice from the Diffuser to the Carbonation stage.

Previous attempts to seal this pump with a single seal resulted in failure due to the high temperature 80°–85°C (176°-185°F) and product crystallisation. A water flush could not be guaranteed, so CDSA™ seals were used with Pot systems.

Seal life has been greatly improved with seal life now approaching 4 campaigns without failure.

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Case History 1218J

In a Sugar factory in the UK, 60mm (2.375") CDSA™ seals were fitted to Warman 3/2 CAH pumps. These pumps transfer Mud from one tank to the Filter Press tanks. The product is highly abrasive, has a temperature of around 80°C (176°F), cavitates, runs against closed valves, vibrates and clogs the pipes.

Seal life of 3 years continuous running can be achieved.

Case History 1219J

In a Sugar factory in the UK, 60mm (2.375") CDSA™ seals complete with Thermosyphon Systems were fitted to Warman 4/3CAH pumps transferring Carbonated liquor to the Filter Presses.

As the Presses become fuller, the pumps vibrate and cavitate.

Operating temperature is around 75°–80°C (167°-176°F), speed is variable.

Seal life is currently 4 years continuous running.

Case History 1220J

In a Sugar factory in the UK a 70mm (2.750") CRCO™ was fitted to a Broquette pump transferring Molasses to the Crystallisers. The pump is slow running and the product cannot be contaminated by water due to high brix content. The seal was filled with low temperature grease so that if it started to dry run the grease would melt and provide lubrication. The seal is currently still running after 2 campaigns without failure.

Case History 1221J

In a Sugar factory in the UK, CDSA™ seals were fitted to Girdlestone pump transferring Thick Juice from the Evaporator Stage. These seals replaced metal bellows cartridge seals which had failed due to corrosion of the metal bellows. Our CDSA™ seals have been operating for 3 campaigns without failure.

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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*

The original products evolved into more modern seals which were designed to enhance application performance. The product model reference in the case study is for the most modern design, even though at the time of installation the actual installation was the predecessor model.

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.

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

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

WARNING

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