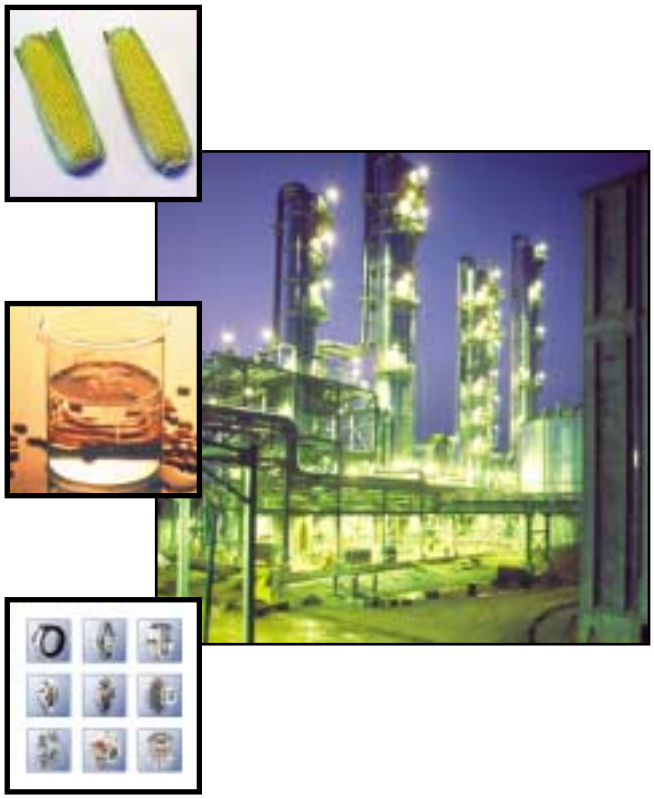
AESSEAL®

ENVIRONMENTAL TECHNOLOGY

A Guide to Sealing

WET CORN MILLING & REFINING



- CORN PRODUCT
- CORN USAGE
- PRODUCTION PROCESS
- REFINING PROCESS
- MECHANICAL SEAL SELECTION
- CASE HISTORIES

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ACKNOWLEDGMENT

We acknowledge the co-operation of Corn Refiners Association Inc. of America in the publication of this document.

ENVIRONMENTAL TECHNOLOGY

Introduction

Over the past several years there has been a significant growth in the use of mechanical seals in the Food Processing Industry. Seals manufactured by AESSEAL® have been used successfully in a variety of applications. The growth in mechanical seal use, can be attributed to the following factors:

a. Traditionally, many sites used mechanical packing in their pumps. The introduction of smaller pumps operating at higher speeds made mechanical packing a less desirable sealing alternative.

b. More stringent Health and Safety regulatory controls have made product leakage unacceptable. Fluid leakage poses a health and safety threat as well as being a housekeeping nuisance.

c. As the cost of raw materials has increased, the need for reliable fluid sealing has increased. Yield loss of expensive process fluids can be reduced by positively sealing the process equipment.

d. Mechanical packing damages the rotating equipment. Shaft sleeve wear and bearing failure caused by excessive leakage are common complaints. Additionally, chemical attack of the concrete base and ductile iron pump components occurs when corrosive chemicals are allowed to leak from packed glands.

e. Periodic maintenance attention is required to constantly monitor and adjust packed glands.

f. Reduction in costly flush water can occur when using properly designed and specified mechanical seals. The cost of clean water, process evaporation and waste water treatment makes the conversion to mechanical seals beneficial and cost effective.

g. Many seal chambers operate under vacuum conditions. Positive sealing from properly designed mechanical seals eliminates air ingress through the seal housing.

This booklet explains how mechanical seals, designed and manufactured by AESSEAL®, have been used successfully in the Corn Wet Milling Industry. The information outlines the various stages of corn processing by using generic flow charts accompanied by a brief explanation of the process steps.

CORN WET MILLING

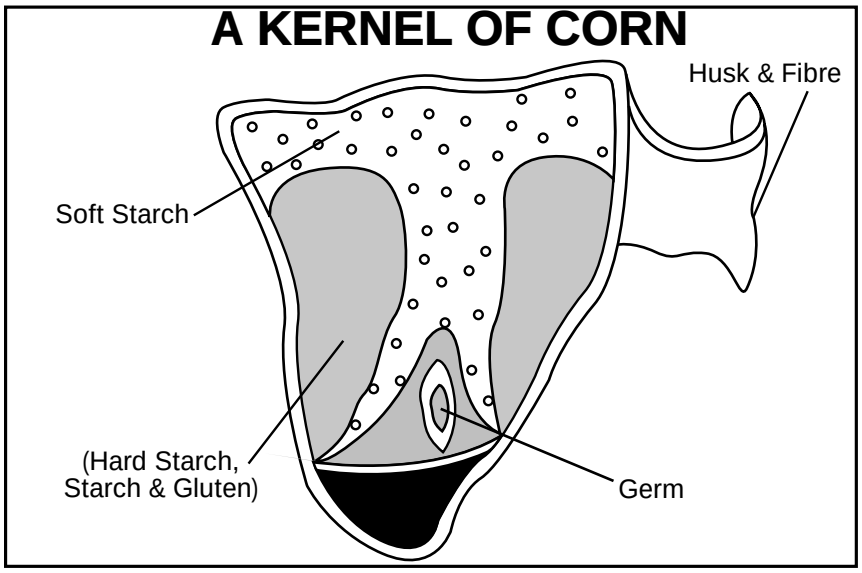
The basic component used in the production of starch is corn. European manufacturers refer to corn wet milling as maize processing. References to “maize” occur occasionally in the attached case history information.

Other raw products such as wheat, rice, barley, sago and potatoes can be used in the milling process. The scope of this booklet focuses on the production of corn products. Application comparisons and correlations to related industries are easily made from the basic information presented.

Corn refiners use shelled corn that has been stripped from the cob during harvesting. Refiners then separate the corn into its components starch, oil, protein and fibre and convert them into higher value products.

The illustration below details the various components of a corn kernel. The corn kernel varies in quality, typically a standard analysis would yield the following:

Starch:	67.6%
Protein/Gluten:	4.6%
Oil:	2.7%
Fiber:	22.8%
Shrinkage:	2.3%
TOTAL:	100.0%



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CORN PRODUCTS

For more than 150 years, corn refiners have been perfecting the process of separating corn into its component parts to create a myriad of value added products. The corn wet milling process separates corn into its four basic components: starch, germ, fibre and Gluten.

Starch: Starch is used in its natural state or it is modified for specialty starches and converted into syrup.

Germ: Germ is converted into corn oil. Fibre removed through pressing is used as cattle feed.

Gluten: Gluten consists of a mixture of proteins used primarily for poultry feed enrichments.

Fibre/Steep: The fibre and steep mixture is used for livestock feed.

Corn sweeteners are by far the most important refined corn product as they supply around 55% of the U.S. nutrient sweetener market.

The second major refined corn product is ethanol, which is gaining increasing acceptance as a burning option for motor fuels.

The third major corn product is starch which most of the American population rely on for their starch needs.

Other important products such as corn oil and animal feed are produced.

World Corn Production

Production	**1998/99**	**1999/00**
Argentina	*13,500*	*15,500*
Brazil	*32,200*	*32,000*
Canada	*8,952*	*9,096*
China	*132,954*	*128,000*
Egypt	*5,605*	*6,100*
Hungary	*6,000*	*7,000*
India	*10,780*	*10,500*
Indonesia	*6,500*	*6,200*
Mexico	*17,600*	*19,000*
Philippines	*4,894*	*4,500*
Romania	*8,500*	*10,500*
South Africa	*7,100*	*9,000*
Thailand	*4,300*	*4,100*
Ukraine	*2,300*	*1,700*
Yugoslavia	*8,200*	*7,000*
European Union	*35,117*	*37,015*
Others	*52,887*	*53,001*
United States	*247,882*	*239,719*
TOTAL	**605,271**	**599,931**

Source: U.S. Department of Agriculture, Foreign Agricultural Service Based on local marketing years in thousands of metric tons.

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CORN WET MILLING - THE PRODUCTION PROCESS

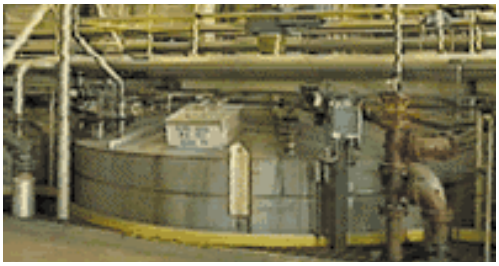
There are several basic steps to accomplish this process. First the incoming corn is inspected and cleaned. Then it is steeped for 30 to 40 hours to begin breaking the starch and protein bonds. The next step in the process involves a coarse grind to separate the germ from the rest of the kernel. The remaining slurry consisting of fibre, starch and protein is finely ground and screened to separate the fibre from the starch and protein. The starch is separated from the remaining slurry in hydrocyclones. The starch can then be converted to syrup or it can be made into several other products through a fermentation process. All these processes are shown in the following sections.

1. Inspection and Cleaning

After delivery by truck, rail, or river barge, corn is held in large silos awaiting the start of the production process. Unwanted debris is removed as the product enters the next stages of production.

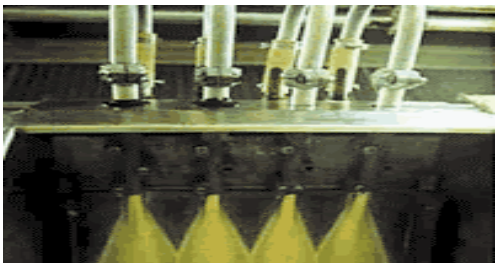
2. Steeping

The purpose of steeping is to soften and condition the corn kernel for subsequent milling and to prevent germination and fermentation. Corn is soaked in water at a controlled temperature, normally 118°F. (47.8°C.), for approximately 30-50 hours. Sulphur dioxide (SO_2) is added to prevent bacterial growth and to reduce the bond between gluten and starch. This batch steeping process occurs in large tanks fitted with side-entry agitator units.



3. First Grind Mill

The Grind Mill, which consists of studded drums rotating in opposite directions, is designed to crack the corn kernel separating the starch without damaging the corn germ. Kernels not fully opened are reground in a second mill as required.



4. Germ Separation

The oil-bearing germ is lighter than other particles and is segregated in a series of cyclone separators. A combination of mechanical and solvent processes extracts oil from the germ. The oil is then refined and filtered into finished corn oil. The remaining mixture of corn, starch and husks is filtered, to remove husks, and processed into cattle feed.

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5. Germ Washing

The starch slurry is removed through a germ washing stage. Further purification occurs as the germ pours through multiple cyclone separator units.

6. Primary Separator

The starch and gluten are segregated in the primary separator. Typical equipment consists of a Centrifuge and Ventbox. The product passes through a gluten filter which uses a filter cloth in a rotary drum to reduce the water content of the gluten slurry.

7. Dorroclone Starch Washing

The remaining starch is washed in the Dorroclone Starch Washer. Slurry concentrations are increased resulting in a high percentage of solids (i.e. typically more than 40%).

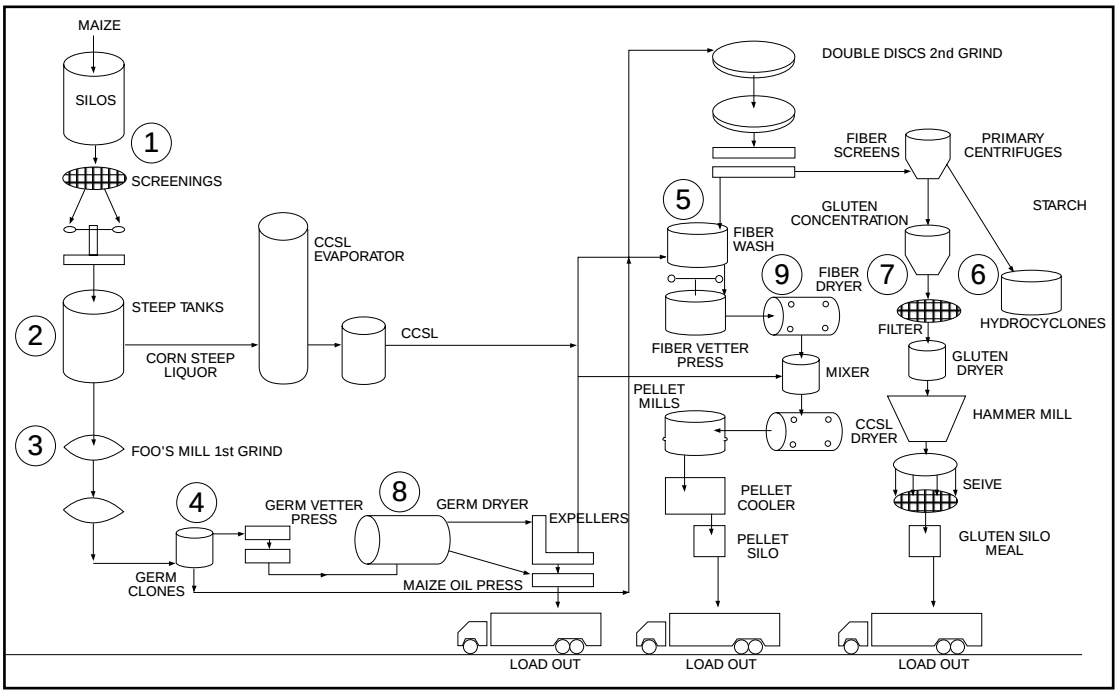
8. Germ Dryers

The germ is dried and transferred to oil presses. The clean oil expelled from the cake is stored or loaded on tankers. The cake is recycled or transferred to the fibre dryer.

9. Concentrated Corn Steep Liquor Dryer and Fibre Dryer

Fibre is pressed, dried and thickened through the addition of cake mixtures. The Veta Press, fibre dryer and paddle mixers comprise the typical pieces of equipment used in this production stage. Concentrated Corn Steep Liquor (CCSL) and residual waste products go to the CCSL dryer. The dried product is extruded through a rotary pellet mill and stored in silos for distribution as cattle cake.

CORN WET MILLING PROCESS



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CORN REFINING - THE PRODUCTION PROCESS

After the starch is cleaned and separated it can be sold in its raw state or it is further refined and converted to glucose syrup.

Starch slurry is converted to glucose (sugar) syrup and refined to different grades of sweetness which are expressed as a dextrose equivalent (D.E.). Acid hydrolysis makes low D.E. syrups and acid/enzyme hydrolysis makes high D.E. (sweeter) syrups.

10. Converter

The converter breaks down the long chain starch molecules into smaller polysaccharide units. The starch suspension is mixed with diluted hydrochloric acid at elevated temperatures and is pressure fed through agitators for even, consistent chemical dispersion.

The acid chemically digests the starch in the presence of live steam to form sugar. Process temperatures of 226°F to 284°F (130°C to 140°C) are increased for high D.E. syrups. The product passes through a vacuum flash cooler reducing the temperature as it is pumped to the Hydrolysate Tank where its pH is checked.

11. Separation Filter System

The liquor is pumped to a Centrifuge where soluble and insoluble proteins are separated. Centrifuged “mud” and fats are combined with CCSL. The mixture is pumped through rotary vacuum filters (RVFS) to absorb pre-coat from the filters.

Carbon is introduced to achieve maximum filtration. The pre-coat consists of fine carbon particles combined with starch slurry and syrup.

The filtered liquor is pumped to Enzyme Tanks for storage. After analysis, the syrups are ready for purification and evaporation.

12. Carbon Columns

The liquor is further refined by pumping it through columns containing activated charcoal (Highly Porous Carbon) which clarifies the liquor. The columns produce a clear colorless liquid. Separate columns are maintained for high D.E. and low D.E. syrups.

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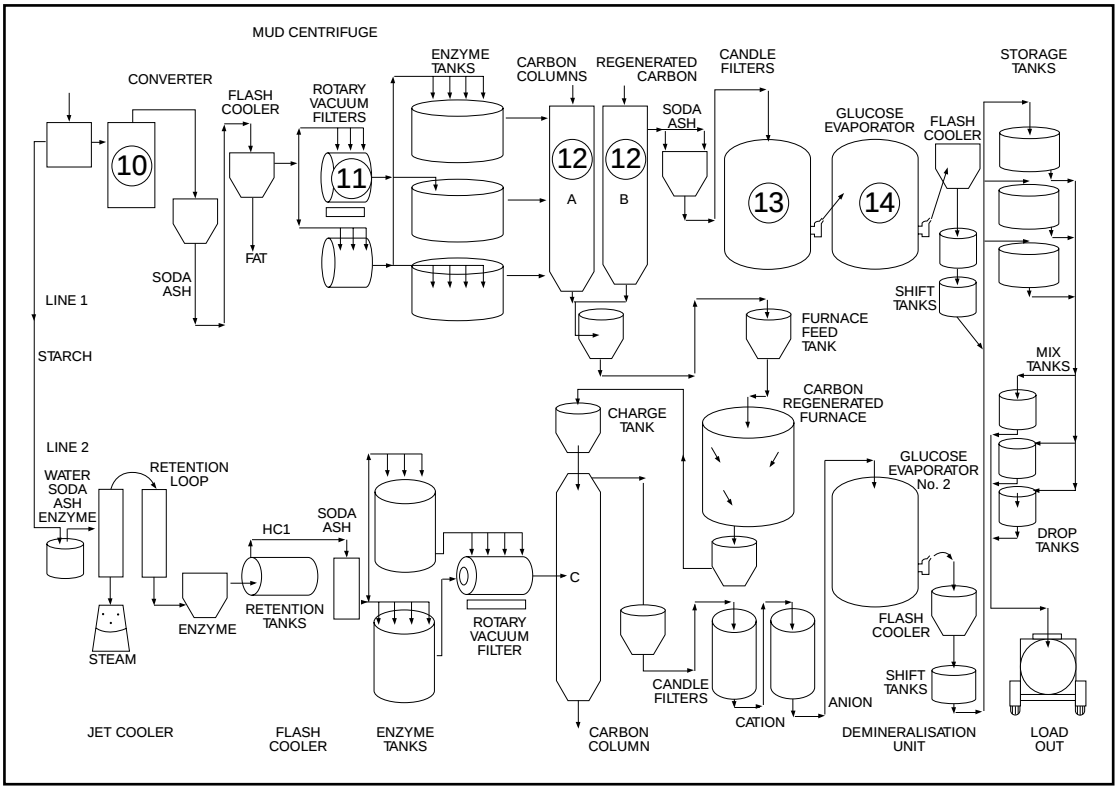
REFINERY PROCESS GLUCOSE PRODUCTION



13. Check Filter Feed Tanks/Neutralization

The syrup is still acidic at this stage of the process. Check filters remove fine particles from the carbon columns as the syrup passes through the pre-coat bed. Each coat process lasts approximately 48 hours and close inspection ensures the filtrate is clear in color and free of specks and impurities.

Transfer is made to Neutralizer Tanks where sodium carbonate is added to neutralize the acidic liquor. The liquor is then pumped to the Evaporator Feed Tank.

14. Syrup Evaporators

The liquor is pumped into the Quadruple Effect Single Pass Falling Film Evaporators. Vapors are extracted, condensed in the Flash Cooler Condenser and transferred to the First Effect Separators Chamber before passing through the remaining three effect chests. The concentrated output, corn syrup, is the end product.

Final syrups are stored separately in holding tanks, depending on D.E. grade. Blending to the customers' requirements and distribution for final sale occurs via the drop tank.

The condensate is pumped to the hot well tank and recycled as wash water for starch and hydroclones in the wet mill.

CONCLUSION

The refining of corn syrup is a complex process requiring maximum equipment reliability. As with the processing of most commodity raw materials, yield recoveries, production efficiency and process predictability are critical to manufacturing profitability.

Careful evaluation of equipment design and components used in production rotating equipment is essential. Enhanced productivity gains are possible through the selection of properly designed components.

AESSEAL® has achieved significant savings for corn processing industry sites by adopting the following design objectives:

1. Simplify the installation procedure by utilizing cartridge seal designs. Seals are hydrostatically tested at the factory and pre-set for easy, reliable installation.

2. Maximize performance with properly designed and balanced double seals. Many pumps operate with low pressure or vacuum conditions in the stuffing box. Changes in process pressures and/or barrier fluid pressures can limit the performance of O.E.M. type seals. Back to back O.E.M. seal designs in particular need high positive barrier fluid pressures to load the internal faces. These higher barrier pressures lead to rapid face wear and the possibility of greater product contamination and barrier fluid loss. AESSEAL® has designed seals that can operate effectively with both positive and negative barrier fluid pressure differentials.

3. Face and Component Design:
   Modular interchangeability ensures the availability of the optimum face combination in the seal. Use of hard face combinations has proven extremely reliable in high solid slurry applications.

4. Internal Face Support - Special Applications:

   The use of bearing seals in side entry agitators is an innovative development from AESSEAL® Face contamination and subsequent wear is reduced when the seal is supported by an internal bearing.

5. Development of double cartridge seals (DMSF™) with integrated circulating pump ring (forced convection) provide enhanced performance when compared with traditional double seals reliant upon thermosyphon effects for cooling.

   Please contact your local AESSEAL® distributor for complete information and assistance.

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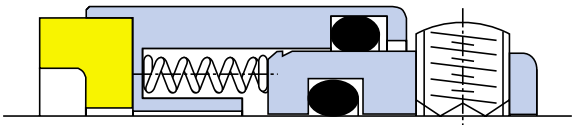
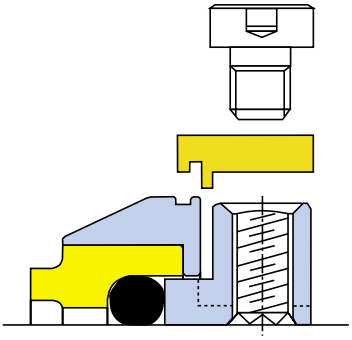
MECHANICAL SEAL SELECTION FOR MILLING AND REFINERIES

SAI™ - Internal Balanced Mechanical Seal



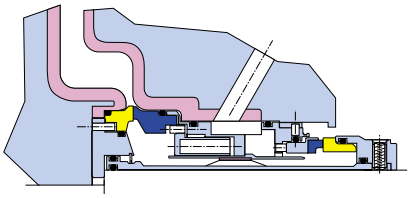
PRODUCT	TEMPERATURE	METALLURGY	FACES	ELASTOMER	SEAL TYPE	PLANT LOCATION
SUMP WASTE	<40C (104F)	AISI 316L	TC/TC	AFLAS®	SAI™	REFINERY

CS™ / CSC™ Range - External Balanced Mechanical Seal with Non-Metallic Parts



PRODUCT	TEMPERATURE	METALLURGY	FACES	ELASTOMER	SEAL TYPE	PLANT LOCATION
HYDROCHLORIC ACID FEED	<50C (122F)	NONE	C/CER	VITON®	CS™	REFINERY
CONCENTRATED HYDROCHLORIC ACID PUMP	60 C (140F)	AISI 316L	PTFE/CER	VITON®	CST + CERAMIC STAT.	REFINERY

LSEAL™ - True Cartridge Double Mechanical Seal for Plastic Lined Pumps which is be used as an alternative to the CS™ / CSC™ Range



PRODUCT	TEMPERATURE	METALLURGY	FACES	ELASTOMER	SEAL TYPE	PLANT LOCATION
HYDROCHLORIC ACID FEED	<50C (122F)	NONE	C/CER	VITON®	CS™	REFINERY

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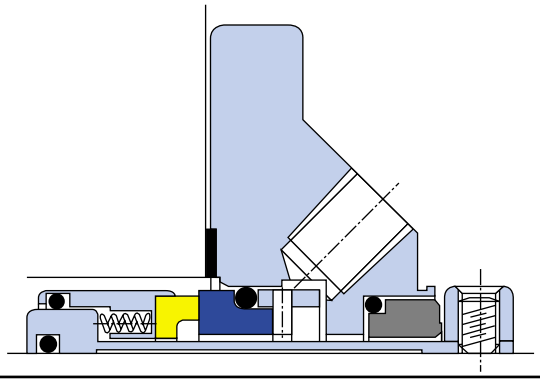
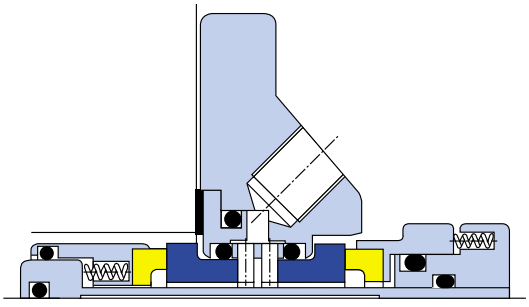
CURC™ – Cartridge Single Seal



PRODUCT	TEMPERATURE	METALLURGY	MINIMUM REQUIRED	BEST AVAILABLE OPTION	PLANT LOCATION	SYSTEM
ENZYME CONVERTOR SUPPLY PUMP	50 C (122 F)	AISI 316L	CURC™/TC/TC/AFLAS®	CDSA™/TC/TC/TC/C/AFLAS®	REFINERY	-
ENZYME HYDROHEATER FEED PUMP	50 C (122 F)	AISI 316L	CURC™/TC/TC/AFLAS®	CDSA™/TC/TC/TC/C/AFLAS®	REFINERY	-
ENZYME TRANSFER PUMP	50 C (122 F)	AISI 316L	CURC™/TC/TC/AFLAS®	CDSA™/TC/TC/TC/C/AFLAS®	REFINERY	-
FIBRE WASH	<40C (104F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W2 SYSTEM
GLUCOSE ION EXCHANGE FEED PUMP	50 C (122 F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
GLUCOSE PRECOAT FEED PUMP	50 C (122 F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
GLUCOSE SUPPLY PUMP	50 C (122 F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
GLUTEN FILTRATE PUMP	50 C (122 F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W2 SYSTEM
GLUTEN STORAGE/ DISCHARGE PUMP	50 C (122 F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W2 SYSTEM
GLUTEN WASH WATER PUMP	50 C (122 F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W2 SYSTEM
HEAVY GLUTEN PUMP	50 C (122 F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W2 SYSTEM
LIGHT STEEPWATER EFFLUENT PUMP	50 C (122 F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W2 SYSTEM
LIQUOR TRANSFER PUMP	50 C (122 F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W3 SYSTEM OR SSE25™-W2
MAIN OIL LOAD	<50C (122F)	AISI 316L	CURC™/C/TC/VITON®	CURC™/C(ANT)/SIC/VITON®	MILLING	-
RESIN CARBON FILTER SUPPLY PUMP	50 C (122 F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
RESIN PRECOAT PUMP	50 C (122 F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
RESIN SWEETENING TANK PUMP	50 C (122 F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
RESIN TRANSFER PUMP	50 C (122 F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
STEEP LIQUOR	<70 C (158F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W3 SYSTEM OR SSE25™-W2
WATER CIRCULATION (CORN/WET MILLING)	<50C (122F)	AISI 316L	CURC™/C/CR02/VITON®	CURC™/C/TC/EPR	MILLING	-
CORN STEEP LIQUOR	<70 C (158F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W3 SYSTEM OR SSE25™-W2
SYRUP TRANSFER	<80 C (176F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W3 SYSTEM OR SSE25™-W2

CDSA™ – Cartridge Mounted Double Seal



PRODUCT	TEMPERATURE	METALLURGY	MINIMUM REQUIRED	BEST AVAILABLE OPTION	PLANT LOCATION	SYSTEM
AMMONIA STORAGE DISCHARGE PUMP	50 C (122 F)	AISI 316L	CDSA™/TC/TC/CR02/C/VITON®	DMSF™/C/TC/TC/C/AFLAS®	CARAMEL	SSE10™-W2 SYSTEM
AMMONIUM BISULPHATE	50 C (122 F)	AISI 316L	CDSA™/TC/SIC/SIC/C/VITON®	DMSF™/SIC/SIC/SIC/C/VITON®	CARAMEL	SSE10™-W2 SYSTEM
CATALYST SUPPLY PUMP	50 C (122 F)	AISI 316L	CDSA™/TC/SIC/SIC/C/AFLAS®	DMSF™/SIC/SIC/SIC/C/VITON®	REFINERY	SSE10™-W2 SYSTEM
PROCESS CONDENSATE	<110C (230F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	CDSA™/C/SIC/SIC/C/AFLAS®	REFINERY	SSE10™-W3 SYSTEM OR SSE25™-W2
SODIUM CITRATE TRANSFER PUMP	50 C (122 F)	AISI 316L	CDSA™/TC/TC/CR02/C/VITON®	DMSF™/C/TC/TC/C/VITON®	REFINERY	SSE10™-W2 SYSTEM

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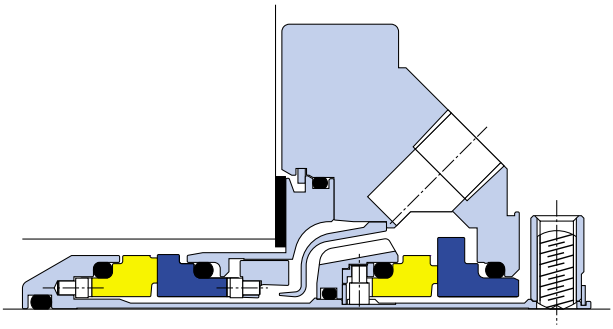
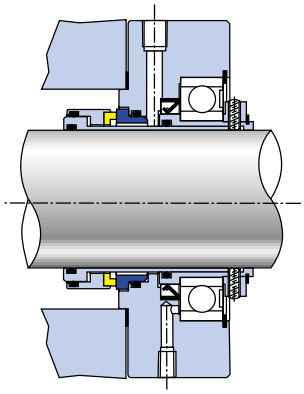
DMSF™ – Double Monolithic Stationary Flow (Patent Pending)



PRODUCT	TEMPERATURE	METALLURGY	MINIMUM REQUIRED	BEST AVAILABLE OPTION	PLANT LOCATION	SYSTEMS
CARBON SYRUP TRANSFER	<90C (194F)	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W3 SYSTEM OR SSE25™-W2
CAUSTIC MAIN FEED	<60 C (140F).	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
CORN STEEP TANK LIQUOR	<70 C (158F)	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W3 SYSTEM OR SSE25™-W2
DEXTROSE CIRCULATING PUMP	50 C (122 F)	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
DRY MILL LIQUOR	<80 C (176F)	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W3 SYSTEM OR SSE25™-W2
EFFLUENT WASTE	<60 C (140F).	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
GERM CLONE STEEP LIQUOR TO EVAPORATORS	<70 C (158F)	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W3 SYSTEM OR SSE25™-W2
GERM CLONES	<40C (104F)	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W2 SYSTEM
GLUCOSE SHIFT PUMPS	<50C (122F)	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
GLUTEN TRANSFER	<60 C (140F).	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W2 SYSTEM
LOADING TRANSFER	<40C (104F)	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
MAIN STARCH TRANSFER	<60 C (140F).	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
MUD AND FAT TRANSFER	<80 C (176F)	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W3 SYSTEM OR SSE25™-W2
QUENCH TANK TRANSFER	<60 C (140F).	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
REFINERY LIQUOR	<80 C (176F)	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W3 SYSTEM OR SSE25™-W2
SIDE ARM TRANSFER	<110C (230F)	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W3 SYSTEM OR SSE25™-W2
SODIUM BISULPHITE CIRCULATING PUMP	60 C (140F)	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W2 SYSTEM
STARCH HYDROCYCLONE	<80 C (176F)	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W3 SYSTEM OR SSE25™-W2
STARCH TRANSFER	<60 C (140F).	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
SYRUP LOAD PUMPS	<40C (104F)	AISI 316L	CDSA™/TC/TC/CRO2/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM

CSWIB™ (Mixmaster I™) - Cartridge Single With Integral Bearing



AESSEAL®
ENVIRONMENTAL TECHNOLOGY

Systems used in Wet Corn Milling

1. All systems will have standard push in hose kits for pressures and temperatures up to 160psig @ 176ºF (11 bar @ 80ºC).

2. Any system to be used above this should be hard piped i.e. 1/2" compression fitting and copper-nickel pipe or a stainless steel option is also available if the site requires it.

Starch plants

For seals up to 2.000" at pressures up to 160psig with TC/TC faces running at 3600RPM

Or

For seals up to 4.000" at pressures up to 160 psig with TC/TC faces running at 1750 RPM the following Systems should be offered;

SSE10™-W2 system with a CDSA™ seal at temperatures up to 140ºF (60ºC) which is approximately 80% of duties.

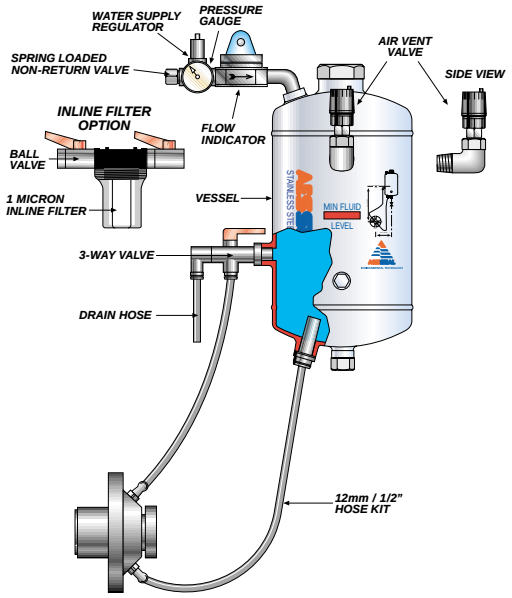
SSE10™-W3 system or an **SSE25™-W2** system with a DMSF™ seal at temperatures between 140ºF-250ºF (60ºC-120ºC) which is approximately 20% of duties.

Hot Oil Plants

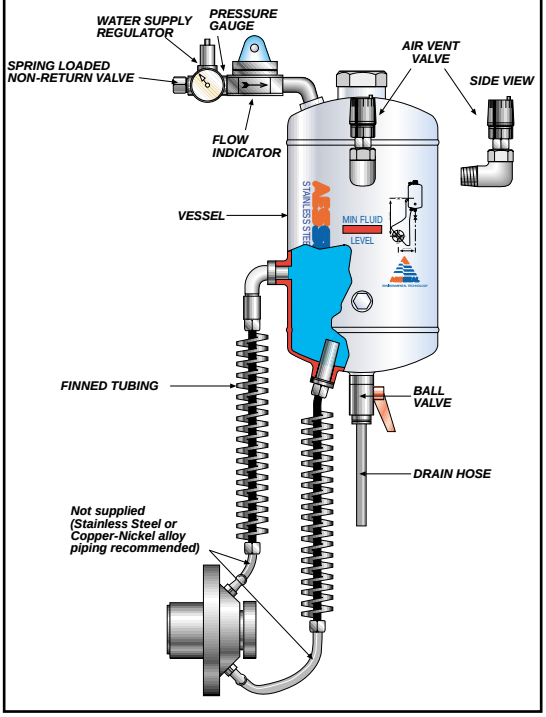
SSE10™-P2 system (which does not need to be pressurized) with a DMSF™ seal at temperatures up to 356ºF (170ºC).

System Diagrams

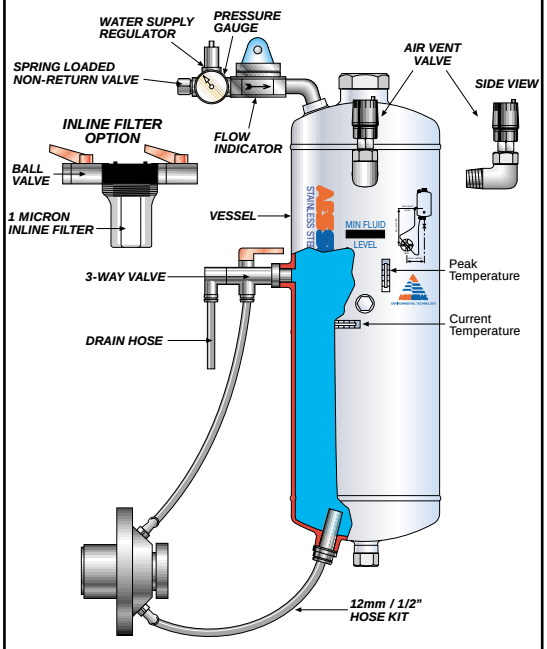
SSE 10 SYSTEM W2
STANDARD WATER MANAGEMENT VESSEL
CODE VSE/SW02



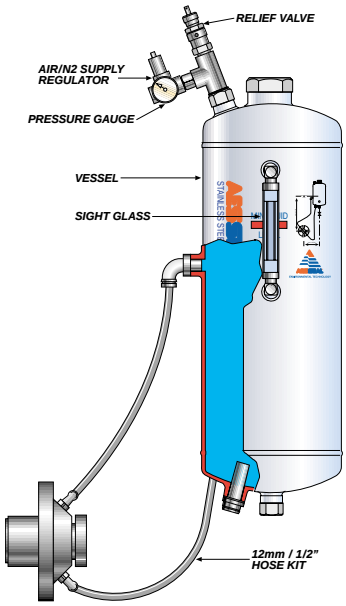
SSE 10 SYSTEM W3
HOT WATER MANAGEMENT VESSEL
CODE VSE/SW03



SSE 25 SYSTEM W2
STANDARD WATER MANAGEMENT VESSEL
CODE VSE/SW02



SSE 25 SYSTEM P2
BASIC PRESSURE SYSTEM
CODE VSE/SP02



CASE HISTORIES INDEX

SEAL TYPE

CURC™/CRCO™:	126B, 172B, 174B,176B, 294C, 297C, 345E, 410F, 419F
CDSA™/BCDSA™:	134C, 137E, 139E, 289C, 290C, 411F, 412F, 413F, 414F, 415F, 416F, 417F, 418F, 420F, 422F
CSWIB™:	312D, 407F
SCIX™:	228C
CAPOH™:	288C

EQUIPMENT

Alfa Laval:	294C
Allis Chalmer:	289C, 414F
Durco:	137E, 176B, 290C, 415F
Girdlestone:	134C, 413F, 417F
KSB:	139E, 411F, 412F, 416F, 418F, 419F, 420F, 421F
Lightnin Mixers:	312D, 407F
Mono:	126B, 172B
Nash:	409F
Pump APV:	228C, 288C
SIHI Ryaland:	174B, 297C
SPP:	345E
SSP:	125E
Stork:	408F
Torres:	410F

PRODUCTS

Carbon Syrup:	290C,294C, 416F
Caustic Solution:	137E,174B, 228C
Condensate:	091E, 297C
Corn Liquor:	139E, 413F, 414F, 417F, 419F
Effluent:	289C, 408F
Germ Slurry:	412F
Glucose:	125E, 126B
Gluten:	420F
Hot Water:	409F
Hydrochloric Acid:	138C
Intermediate Syrup:	421F, 422F
Lime Sludge:	172B
Liquid Detergent:	312D
Mud Effluent:	
Oil:	074B,076B, 134C
Starch:	176B, 411F, 415F, 418F
Steep Water:	
Syrup:	288C, 345E, 407F, 410F

Many of the seal types shown in the Case History Index are products which through practical application experience were improved and evolved into more modern seals, designed to enhance application performance.

There follows a list of the principal changes:

CSAI and CAPI seals have been updated to CURC™ design.

CAPO seals have been updated to CRCO™ design.

CMDS seals have been updated to CDSA™ design and subsequently DMSF™.

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Case No: 126B

In a Food Processing Plant, 45mm CURC™ seals with Solid Tungsten Carbide faces and Viton® 'O' Rings were installed in Mono Merlin SAC 12H IRS/H1421 pumps. These pumps rotate at 800 r.p.m. and supply Glucose to the process area to make batches of preserves. The product is at 35 degrees C. and 2 bar gauge pressure. Initially the pump was packed using an Asbestos/P.T.F.E. material. This caused constant leakage and shaft wear.

The installation of CURC™ seals in November 1988, with hard faces to stop the abrasive sugar content wearing the seal faces away and to prevent damage on start-up, has cured the problem.

The seal gland plate was reduced on the O.D. to suit the pump housing, and an electrical trace heater was wrapped around the stuffing box to keep the product temperature constant between batches.

Case No: 134C

In a Food Processing Plant, DMSF™ (originally CMDS) seals 35mm with Solid Tungsten Carbide faces and Kalrez® 'O' Rings inboard, were installed into Girdlestone pumps. These pumps rotate at 3,000 r.p.m., and transfer Hot Vegetable Oil with traces of a Nickel Catalyst through filters. The product is at 210 degrees C. and 8 bar gauge pressure in the stuffing box. The original sealing member was a metal bellows seal with a Silicon Carbide face running against a Ni-Resist stationary which lasted 2- 3 weeks before failure.

The DMSF™ seals, with barrier fluid of Vegetable Oil at 9 bar gauge, have been installed since November 1989 and give an 18 month seal life.

No modification was needed.

Case No: 137E

In a Food Processing Plant, DMSF™ seals 1.1/8" with Alloy 276 wetted parts, Silicon Carbide faces and FEP 'O' Rings were installed into Durco Group 1 pumps. These rotate at 3,000 r.p.m., and circulate 25% Caustic Solution through the pipe lines to clean them after batches are produced. Previously seals in Stainless Steel were used and were being attacked by the product. The temperature is 60-70 degrees C. and the pressure 2 bar gauge.

In August 1989, the Alloy 276 units were installed and all are working well.

No modifications were required.

Case No: 139E

In a Food Processing Plant, a DMSF™ seal 100mm with Solid Tungsten Carbide faces and Viton® 'O' Rings was installed to a KSB CPK 300/40 pump. This pump replaces three smaller KSB pumps on the same duty which were uneconomical in operation. The product is Corn Steep Liquor at 60-70 degrees C. and 6 bar gauge pressure and water is used as a barrier fluid.

The seal was fitted to the new installation in August 1989 and is still working well.

No modification was necessary.

Case No: 172B

In a Sugar Refinery, CURC™ seals 2,3/4" with Solid Tungsten Carbide faces and Viton® 'O' Rings were fitted to Mono D82 pumps. These pumps rotate at 400 r.p.m. They transfer Lime Sludge from the process machine and feed the settling lagoons where the product is diluted and sold to farms for re-introduction to the land. The product temperature is 30 degrees C. and the pressure 100 p.s.i. Previously the pumps were packed using G.F.O. packing and this leaked continuously causing a build-up of sludge in the pump bearing frame which forced its way into the bearings and caused rapid failure.

The CURC™ seals, with water flush via the seal, were installed in September 1989 and are still working well.

No modification was required.

Case No: 174B

In a Brewery, CURC™ seals 1.3/4" with Carbon/Silicon Carbide faces and Viton® 'O' Rings were installed to Ryaland Ryax F50/26 pumps. These units rotate at 2,900 r.p.m. and supply a Caustic Washing Solution to clean the fermentation vessels. The product temperature is ambient and the pressure 6 bar gauge. The pumps were previously packed using Graphite/Asbestos packing which soaked up the product and in-between washes hardened in the material. On start-up, this would then exert a braking force which snapped shafts.

The fitting of CURC™ seals in March 1986 has eliminated the problem and they are still working well.

No modification was required.

Case No: 176B

In a Food Processing Plant, DMSF™ seals 1.7/8" with Solid Tungsten Carbide faces and Viton® 'O' Rings were installed to Durco pumps. These pumps rotate at 2,900 r.p.m. and feed a Starch Solution to the Centrifuge. The product temperature is 50 degrees C. maximum at a viscosity of 20-30 centipoise and a pressure of 8 bar gauge.

This is a new application where the Company specified the seal to the Pump Manufacturer. The seals were installed in October 1989, with a water barrier fluid of 1 gallon/hour, running to drain. These are still working well.

No modification was required.

Case No: 288C

In a Food Processing Plant, 1.000" CAPOH APV seals with Solid Tungsten Carbide/Silicon Carbide faces and Viton® 'O' rings were installed in APV Puma 2"-3"-9" pumps. The pumps rotate at 2,950 r.p.m. and are used as Syrup Transfer pumps. The product is extremely abrasive, viscous and has carbonization problems on sealing components. The operating temperatures are 90 degrees C. with vacuum conditions in the pump. The units were previously sealed using single spring double seal arrangements which lasted days.

The seals, with a built-in auxiliary lip seal and water barrier fluid, were installed in October 1990 and are still working leak-free.

No modifications were required. The seal was designed to be installed specifically in the pump.

Case No: 289C

In a Food Processing Plant, 2.3/4" DMSF™ seals with Solid Tungsten Carbide faces and Viton® 'O' rings were installed to Allis Chalmer 8 x 6 x 17 pumps. The pumps rotate at 965 r.p.m. and are used to remove Syrup Effluent. The product is extremely abrasive and very viscous at its operating parameters of 70 degrees to 80 degrees C. and 2 to 2.1/2 bar gauge pressure. The units were previously sealed using external seals with hard faces. These seals gave three months service life, a large improvement on the original seal type.

The DMSF™ seals, with a Thermosyphon system to provide a water barrier fluid at 5 bar gauge pressure, were installed in January 1989 and are still working satisfactorily.

No modifications were required.

Case No: 290C

In a Food Processing Plant, 1.7/8" DMSF™ seals with inboard and outboard faces of Solid Tungsten Carbide and Viton® 'O' rings were installed to Durco 3 x 1.1/2 - 8/80 pumps. The pumps rotate at 2,950 r.p.m. and supply Carbon Syrup to the Purifying Plant. The product is extremely abrasive, viscous and crystal forming at its operating parameters of 85 degrees C. and 2 bar gauge pressure. These pumps were previously sealed using SAI™/USL™ seals with Solid Tungsten Carbide faces which gave a service life of one month.

The change to double seals with a 4 bar continuous feed barrier fluid of water increased the life of the seals to one year.

No modifications were required.

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Case No 294C

In a Food Factory, 2.3/4" CRCO™ seals with Carbon/Chrome Oxide faces and Viton® 'O' rings were installed to Alfa Laval Evaporators. The shafts rotate at 140 r.p.m. and are in contact with a viscous malt syrup mixture. The product temperature is 80 degrees to 120 degrees C. dependent on the stage of the process, and atmospheric pressure. The units were previously sealed with a single spring seal which gave installation problems due to the many parts of the seal and the long shaft length over which the seal had to be passed.

The CRCO™ seals were installed in May 1990 and are still working leak-free. The barrier fluid is Condensate, allowed to run to drain.

No modifications were required.

Case No: 297C

In a Brewery, 50mm CRCO™ seals with Carbon/Chrome Oxide faces and EPR 'O' rings were installed to SIHI Ryaland Ryax 80/40 pumps. The pumps rotate at 1,460 r.p.m. and act as the Condensate Recovery Transfer pumps back to the Boiler House. The product is at 96 degrees to 98 degrees C. and a pressure of 7 to 8 bar g. The pumps were previously sealed using single spring seals which gave an unsatisfactory service life of six months maximum.

The CRCO™ seals, with water barrier fluid running to drain, were installed in March 1990 and are still running leak-free.

AESSEAL® recommend the use of double seals in water services above 80°C.

No modifications were required.

Case No: 312D

In a Production Plant, 40mm CSWIB™ seals with Carbon/Silicon Carbide faces and Viton® 'O' rings were installed to Lightnin Mixers. The shafts rotate at 130 r.p.m. and mix the components of a liquid detergent. The liquid is at 25 degrees C. and 10m static head. The mixers were previously fitted with single spring cartridge seals with a stationary spring. These gave a service life from weeks to several months and the leakage had to be collected in drums and disposed of at great expense. The CSWIB™ seals have been installed since March 1989 and are working leak-free.

No modifications were required.

Case No: 345E

In a Food Product Plant, 1.5/8" CURC™ seals with Solid Tungsten Carbide faces and Viton® 'O' rings were installed in S.P.P. Horizontal Split Case pumps. The pumps rotate at 1,460 r.p.m. and transfer Sugar Syrup at 70 degrees C. and 3.5 bar gauge pressure. The pumps were previously fitted with locally made cartridge type seals which gave a three week seal life.

The seals were installed in January 1992 and give a minimum eleven months seal life.

No modifications to equipment were required.

Case No: 407F

In a Maize Processing Plant, 40mm CSWIB™ seals with Carbon/Solid Tungsten Carbide faces and Viton® 'O' rings were installed to Lightnin Mixers. The mixers rotate at 350 r.p.m. and are fitted to the Enzyme Tanks and agitate Unfiltered Syrup. The product is at 80 degrees C. and 40 ft/hd. The units were previously packed using Kevlar packing which needed constant attention and wore the shaft sleeves.

The CSWIB™ seals were installed in December 1992 and are still operating leak-free.

No modifications were required.

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Case No: 410F

In a Maize Processing Plant, 1.5/8" CRCO™ seals with Solid Tungsten Carbide faces and Viton® 'O' rings were installed into Torres pumps. The pumps rotate at 450 r.p.m. and are Tanker Loading pumps. The product is Finished Syrup at 70 degrees C and 2 bar pressure. The pumps were previously packed using Kevlar material and this needed constant attention.

The CRCO™ seals with Condensate quench and drain and a polyurethane lip seal were installed in June 1992 and still operate leak-free.

Two flats were machined on the seal gland plates.

Case No: 411F

In a Maize Processing Plant, 45mm DMSF™ seals with Solid Tungsten Carbide faces and Viton® 'O' rings were installed in KSB CPK 65200 pumps. The pumps rotate at 1435 r.p.m. and transfer Starch to the Refinery. The product is at 45 degrees C to 50 degrees C and 6 bar pressure. The pumps were sealed using single spring, stationary cartridge seals. This gave a life measured in weeks.

The DMSF™ seals were first installed in 1985 and give a two to two and a half year life. A barrier fluid of water is provided at 8 bar.

No modifications were required.

Case No: 412F

In a Maize Processing Plant, 3.000" DMSF™ seals with Solid Tungsten Carbide faces and Viton® 'O' rings were installed to KSB KWP 150500 pumps. The pumps rotate at 1,450 r.p.m. and transfer Germ Slurry. The product is at 45 degrees C and 10 bar pressure. The pumps were previously sealed using single spring seals with Carbon/Ceramic faces. These seals gave an estimated life of two to three months.

The DMSF™ seals were installed in March 1987 and have a barrier fluid of water at 10 bar pressure. The seals give a two to two and a half year life.

No modifications were required.

Case No: 413 F

In a Maize Processing Plant, 1.1/2" DMSF™ seals with Solid Tungsten Carbide faces and Viton® 'O' rings were installed in Girdlestone 5L33E pumps. The pumps rotate at 1,440 r.p.m. and transfer Corn Steep Liquor through the Evaporator. The product is at 70 degrees C. and 8 bar pressure. The pumps were supplied with the seals from new.

The DMSF™ seals were installed in 1987 and give one year life.

No modifications were required.

Case No: 414F

In a Maize Processing Plant, 3.000" or 70mm DMSF™ seals with Solid Tungsten Carbide faces and Viton® 'O' rings were installed to Allis Chalmer 12 x 10 x 17 pumps. The pumps rotate at 980 r.p.m. and supply Concentrated Corn Steep Liquor with approximately 55% dried solids through the final phase of the Evaporator. The product is at 62 degrees C and 8 bar pressure. The pumps were previously sealed using single spring, stationary cartridge seals which clogged up and gave a four to five month working life.

The DMSF™ seals were installed in October 1987 with a 10 bar gauge barrier fluid supply of water and give a one and a half to two year life.

No modifications were required.

Case No: 415F

In a Maize Processing Plant, 1.7/8" DMSF™ seals with Solid Tungsten Carbide faces and Viton® 'O' rings were installed into Durco 3 x 2 x 13/130 pumps. The pumps rotate at 3,000 r.p.m. and transfer Starch at 45% dried solids. The product is at 45°C. to 50°C. and 6 bar pressure. The pumps were installed with the seals from new.

The DMSF™ seals were installed in January 1989 and give a two year working life. The barrier fluid is water at 8 bar pressure.

The stuffing box bore was increased to increase product circulation (3mm).

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Case No: 416F

In a Maize Processing Plant 35mm DMSF™ seals with Solid Tungsten Carbide faces and Viton® 'O' rings were installed into KSB CPK 50200 pumps. The pumps rotate at 2,800 r.p.m. and circulate Intermediate Syrup and Carbon Fines through Filters. The product is at 70°C. and 6 bar pressure. The pumps were previously installed with multi-spring double seals which gave a two month average life. The seals were installed in May 1987 and give an average one and a half to two year working life.

No modifications were required.

Case No: 417F

In a Maize Processing Plant, 2.000" DMSF™ seals with Solid Tungsten Carbide faces and Viton® 'O' rings were installed to Girdlestone 6ZD68K pumps. The pumps rotate at 1,450 r.p.m. and circulate Corn Steep Liquor with 15% Dried Solids around the Evaporator. The product is at 58°C. and 2-3 bar pressure. The pumps were supplied with the seals from new.

The units were commissioned in October 1987 and are fed with a water barrier fluid at 3 bar. The seals give an estimated one and a half to two year life.

No modifications are required.

Case No: 418F

In a Maize Processing Plant, 45mm DMSF™ seals with Carbon/Chrome Oxide faces and Viton® 'O' rings were installed to KSB CPK 80200 pumps. The pumps rotate at 2,900 r.p.m. and transfer Starch Slurry through the Hydro-Cyclone. The product is at 52°C. and 9 bar pressure. The pumps were supplied with the seals from new.

The system was commissioned in November 1986 and the seals are fed with a water barrier fluid system at 10 bar pressure. An average seal life of one to one and a half years is in evidence.

No modifications were required.

Case No: 419F

In a Maize Processing Plant, 45mm DMSF™ seals with Solid Tungsten Carbide faces and Viton® 'O' rings were installed in KSB KWp 80250 pumps. The pumps rotate at 1,440 r.p.m. and transfer Mud to the Effluent Plant. The product is concentrated Corn Steep Liquor, Effluents and Carbon Fines and is at 70°C. and 6 bar pressure. The pumps were previously packed using single spring, stationary cartridge seals which gave a two week life.

The CURC™ seals gave a six month to one year life, but have now been up-graded to DMSF™ seals.

No modifications were required.

Case No: 420F

In a Maize Processing Plant, 35mm DMSF™ seals with Solid Tungsten Carbide faces and Viton® 'O' rings were installed to KSB 18400 pumps. The pumps rotate at 1,450 r.p.m. and transfer Finished Gluten to Storages. The product is at 50°C. and 8 bar pressure. The pumps were previously sealed using Carbon/Ceramic single seals which gave a two to three month life.

The DMSF™ seals were installed in May 1987 and give an approximate life of two years.

No modifications were required.

Case No: 422F

In a Maize Processing Plant, 45mm DMSF™ seals with Solid Tungsten Carbide faces and Viton® 'O' rings were installed to Worthington Simpson WS 50 CP 250 pumps. The pumps rotate at 1,450 r.p.m. and supply Intermediate Syrup to the Evaporator. The product has various viscosities depending on the percentage solids and is at 20°C. and 1 bar pressure to vacuum. The pumps were sealed using single spring, stationary cartridge seals which gave a life measured in weeks.

The DMSF™ seals were installed in January 1986 and give a one and a half to two year life.

The water barrier fluid is supplied via a Thermosyphon system.

No modifications were required.

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®.

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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AES / DOC / IN 4538 01/2002

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