ENVIRONMENTAL TECHNOLOGY

A Guide to sealing the BIO FUELS INDUSTRY

- **BIO ETHANOL PRODUCTION PROCESS**
- **BIO DIESEL PRODUCTION PROCESS**
- **SEALING APPLICATION**
- **MECHANICAL SELECTION**

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INTRODUCTION

Background

Automobile usage continues to grow in both the developed and under developed world. The escalation of road traffic puts increased demand on the supply of fuels derived from crude oils. Oil production around the world is under pressure from this increased demand. This and the fact that the oil industry is also faced with depleting reserves, have combined to dramatically increase oil prices across the globe.

The use of crude oil, which is a fossil fuel, is also coming under scrutiny from an environmental perspective. Carbon emissions from road traffic account for approximately 30% of all carbon emissions in the developed world. These emissions are a major contributor to greenhouse gasses and there is now a general acceptance that this is causing climate change.

With such a high requirement for oil, many nations are increasingly nervous of their dependence on potentially unstable oil producing areas.

BIO FUELS

Bio fuels offer a potential solution to many of the problems associated with conventional fuels. Bio fuels such as bio diesel and bio ethanol are liquid fuels that are made from plant material and recycled elements from the food chain. The notion of growing plants for road transport fuels is not new. One hundred years ago, agriculture was a major producer of oats and hay that were used for horses. There is now again the opportunity for farmers to become useful suppliers of transport fuels.

Unlike conventional fuels that are finite, Bio fuels, to a large extent, are renewable and sustainable. Crops can be domestically produced, negating the reliance on politically unstable producing regions. Bio fuels are derived from atmospheric carbon dioxide (as the plant grows, it absorbs carbon dioxide from the atmosphere) and thus does not amount to increase the net amount of carbon dioxide in the atmosphere. Bio fuels can therefore be termed as a carbon neutral.

This brochure examines the processes that are used for turning crops into usable road traffic fuels. The booklet also explains how the mechanical seals developed by AESSEAL® have been successfully used in the production of these fuels. The processes involved are very similar to those used in food production. The information outlines the various stages of the processes.

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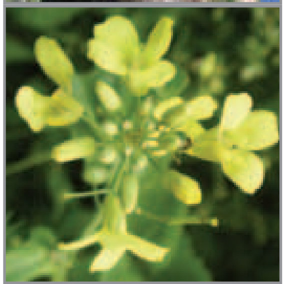


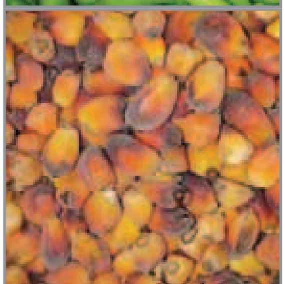


BIO ETHANOL

Bio Ethanol can be blended with conventional gasoline by up to 5% in Europe, 15% in the USA, without invalidating automobile manufacturers' warranties. With very minor modifications, significantly higher blends of Bio Ethanol can be used and in several countries, vehicles are equipped to burn these higher blends. Henry Ford designed the original Model T in 1908 to use Ethanol.

Bio Ethanol is predominately produced from corn, maize, sugar beet and sugar cane. The primary processes are different and are described in this booklet. The secondary fermentation and distillation process is virtually identical regardless of feed stock.

BIO DIESEL

Again, this can be blended with conventional diesel up to 5% without invalidating automobile manufacturers' warranties. Higher blend ratios are commonly found around the globe. Indeed, the very first compression ignition engine invented by Dr Rudolf Diesel in 1897, was demonstrated in 1898 at the Paris exhibition using peanut oil as a fuel.

Bio Diesel is predominately produced from seed. Various plants including Rape, Palm Soybean & Sunflower seed are used as feed stock and again, primary processes are similar to edible oil production. Waste vegetable oils sourced from restaurant chains and food producers is also a primary source of feed stock. The secondary process commonly found is the transesterification process, which would be common regardless of feed stock used.

BIO FUEL INDUSTRY

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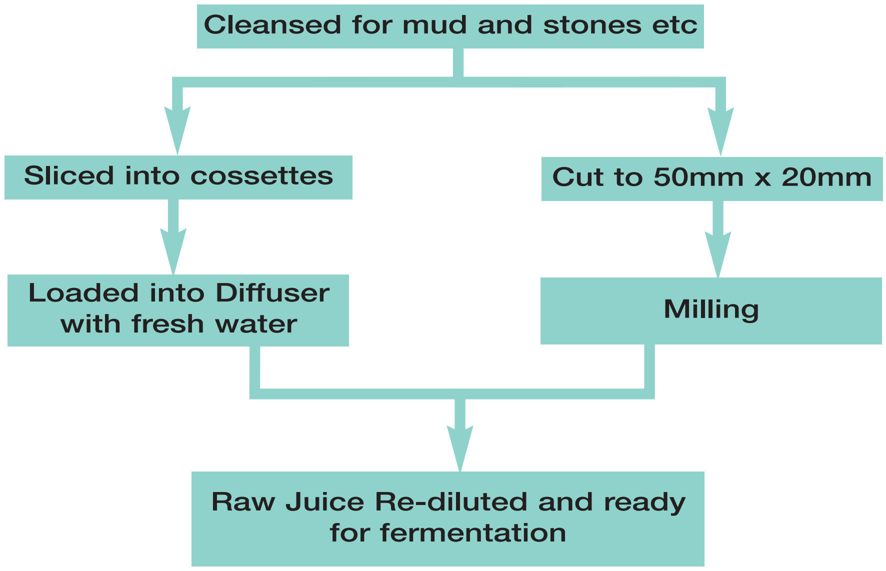
Ethanol Production - Primary Process: Sugar Beet/Cane Preparation & Extraction



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 0.800") and 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".

1

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".

2

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.

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Milling

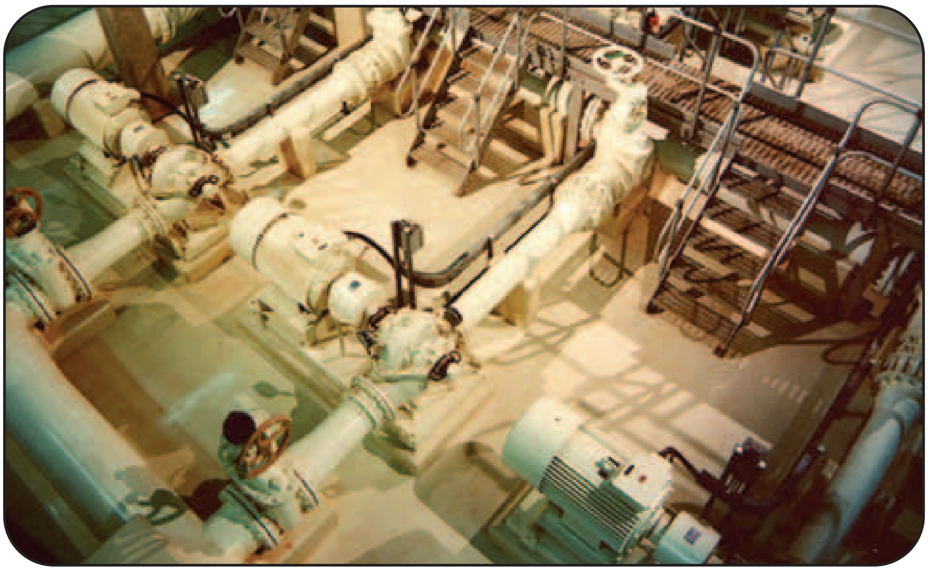
The prepared crop passes through heavy rollers, which squeeze out the juice. This process is repeated down a line of mills. The dry fibre (bagasse) can be used to fire the boilers or can be added to molasses to make animal feed, paper and industrial solvents. Particleboard can also be produced from this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

Mechanical Seal Selection for 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	70°C (160°)	Convertor II™ (C/SIC/AFLAS)	



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Clarification /Carbonization / 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 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.

Mechanical Seal Selection for 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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Ethanol Production- Primary Process: Corn Processing

- Cleansed for mud & stones etc
- Water added (steeping)
- Germ separation
- Grinding
- Gluten separation
- Starch created
- Diluted & ready for fermentation
- Liquefaction
- Saccharification

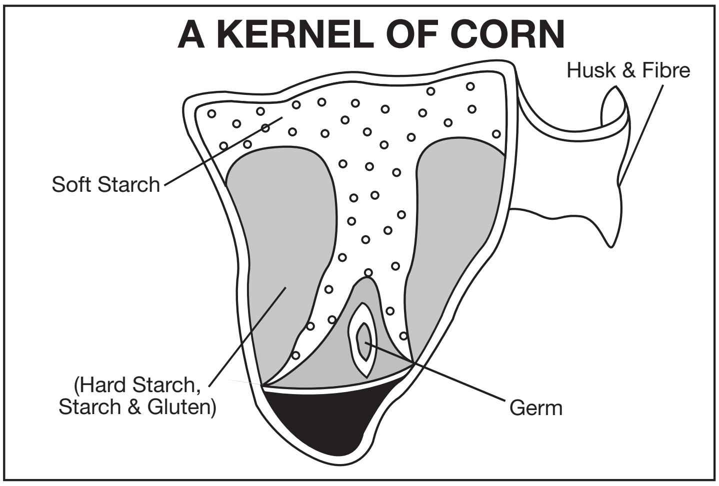
The basic component used in the production of starch is corn. European manufacturers refer to corn wet milling as maize processing. References to "maize" occur occasionally in the attached case history information.

Other raw products such as wheat, rice, barley, sago and potatoes can be used in the milling process. The scope of this booklet, however, 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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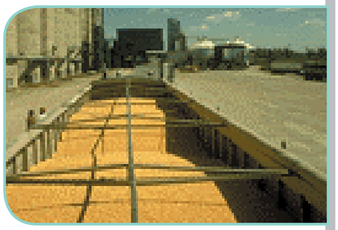
CORN WET MILLING - THE PRODUCTION PROCESS

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

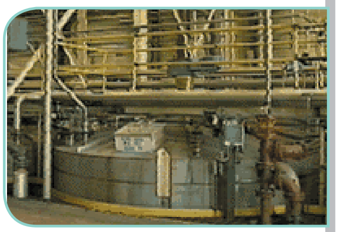
After delivery by truck, rail, or river barge, corn is held in large silos awaiting the start of the production process. Unwanted debris is removed as the product enters the next stages of production.



2

Steeping

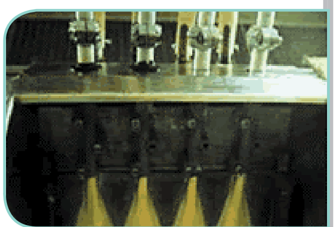
The purpose of steeping is to soften and condition the corn kernel for subsequent milling and to prevent germination and fermentation. Corn is soaked in water at a controlled temperature, normally 118°F. (47.8°C.), for approximately 30-50 hours. Sulphur dioxide (SO_2) is added to prevent bacterial growth 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 re-ground in a second mill as required.



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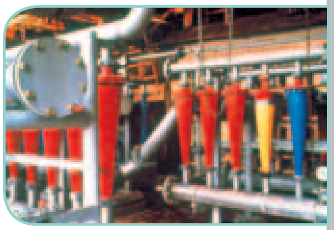
Germ Separation

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.



5

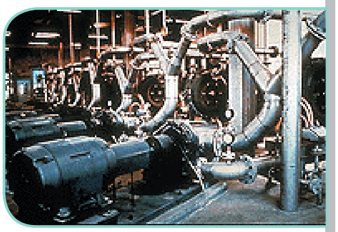
Germ Washing

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

Liquification

The corn starch is broken down even further in the Liquefaction and Saccharification processes to form fermentable sugars. This process takes place with the addition of steam and enzymes and requires 10-20 gallons of water at 12 pounds of steam per bushel of corn.

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Mechanical Seal Selection for Ethanol Production Plants

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
SUMP WASTE	<40C (104F)	AISI 316L	TC/TC	AFLAS®	SAI™	REFINERY

PRODUCT	TEMPERATURE	METALLURGY	MINIMUM REQUIRED	BEST AVAILABLE OPTION	PLANT LOCATION	SYSTEM
Refinery						
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	-
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
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
CAUSTIC MAIN FEED	<60 C (140F).	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
DEXTROSE CIRCULATING PUMP	50 C (122 F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
EFFLUENT WASTE	<60 C (140F).	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
GLUCOSE SHIFT PUMPS	<50C (122F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
LOADING TRANSFER	<40C (104F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
MAIN STARCH TRANSFER	<60 C (140F).	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
MUD AND FAT TRANSFER	<80 C (176F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS® OR SSE25™-W2	REFINERY	SSE10™-W3 SYSTEM
QUENCH TANK TRANSFER	<60 C (140F).	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM
REFINERY LIQUOR	<80 C (176F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS® OR SSE25™-W2	REFINERY	SSE10™-W3 SYSTEM
SIDE ARM TRANSFER	<110C (230F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS® OR SSE25™-W2	REFINERY	SSE10™-W3 SYSTEM
STARCH TRANSFER	<60 C (140F).	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	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® OR SSE25™-W2	REFINERY	SSE10™-W3 SYSTEM
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
CARBON SYRUP TRANSFER	<90C (194F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS® OR SSE25™-W2	REFINERY	SSE10™-W3 SYSTEM
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
SYRUP LOAD PUMPS	<40C (104F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	REFINERY	SSE10™-W2 SYSTEM

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PRODUCT	TEMPERATURE	METALLURGY	MINIMUM REQUIRED	BEST AVAILABLE OPTION	PLANT LOCATION	SYSTEM
Milling						
FIBRE WASH	<40C (104F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	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	-
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
CORN STEEP TANK LIQUOR	<70 C (158F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS® OR SSE25™-W2	MILLING	SSE10™-W3 SYSTEM
GERM CLONE STEEP LIQUOR TO EVAPORATORS	<70 C (158F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS® OR SSE25™-W2	MILLING	SSE10™-W3 SYSTEM
GERM CLONES	<40C (104F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W2 SYSTEM
GLUTEN TRANSFER	<60 C (140F).	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W2 SYSTEM
DRY MILL LIQUOR	<80 C (176F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS® OR SSE25™-W2	MILLING	SSE10™-W3 SYSTEM
SODIUM BISULPHITE CIRCULATING PUMP	60 C (140F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS®	MILLING	SSE10™-W2 SYSTEM
STARCH HYDROCYCLONE	<80 C (176F)	AISI 316L	CDSA™/TC/TC/CR02/C/AFLAS®	DMSF™/TC/TC/TC/C/AFLAS® OR SSE25™-W2	MILLING	SSE10™-W3 SYSTEM
Caramel						
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

Picture used courtesy of Sulzer Pumps

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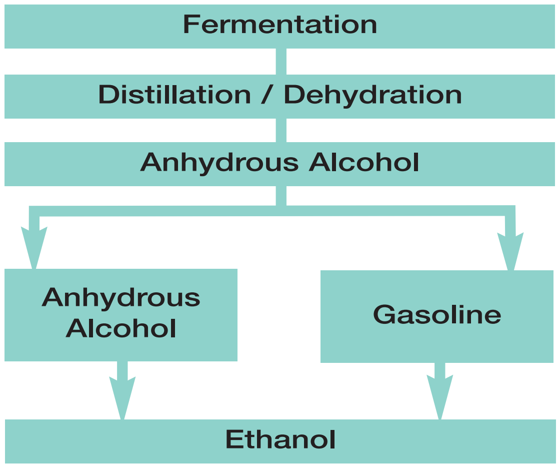
Ethanol Production - Secondary Process

Grain Ethanol Production



1 Fermentation

The fermentable sugars are then mixed with yeast to begin the fermentation process. The mash passes through several fermentation phases and is then cooled and mixed with more enzymes before proceeding with the fermentation process. CO_2 gas is a by product of this process and can be captured and sold or processed through a scrubber system to recover all residual alcohol and then released to the atmosphere.

2 Distillation

When the fermentation process is complete the mash alcohol content is between 10-13%. The beer mash is transferred to holding tanks called "beer wells". The mash is stored in the beer wells and is metered into the distillation columns (beer columns) where the solids and water are removed to form 95% purity (190 proof) alcohol. During the distillation process, the mash is passed through reboilers to separate the water from the Ethanol. The solids (stillage) fall to the bottom of the distillation column and are collected and processed and sold as Distillers Wet Grain (DWG) for use as animal feed.

3 Water Removal

In order to mix the alcohol with Gasoline the remaining 5% of the water must be removed. Modern plants pump the alcohol through molecular sieves, which remove the remaining water and bring the alcohol to 198.6-199.9 proof (Anhydrous Ethanol). Other processes used to remove the remaining water are Grits Dehydration and Azeotropic Dehydration.

4 Blending

The Anhydrous Ethanol is then mixed with a denaturing liquid such as Gasoline to provide the composition required by the government for the typical properties of fuel Ethanol. Usually the percentage of Anhydrous Ethanol to Gasoline is 95.3% Fuel Ethanol to 4.7% Gasoline.

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Mechanical Seal Selection for Ethanol Production Plants

Description	Fluid	Solids %	Temp (F)	Specific Gravity	AESSEAL® Seal Design	Metallurgy	Suggested Seal Faces and Elastomers	API Plan/Seal Support System
Fermentation								
Fermenter Feed Pump	Thin Stillage Mash	12-29%	95	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Fermenter Drain Pump	Thin Stillage Mash/Water	12-29%	95	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
CIP Fermenter Pump	5% NaOH	2.0%	170	1.10	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW02
CO2 Scrubber Pump	Water	0.0%	85	1.00	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
Fermenter Recirculation Pumps	Thin Stillage Mash	12-29%	95	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Beerwell Discharge pump	Thin Stillage Mash	12-29%	90	1.06	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE10 SW02
Distillation								
1st Effect Evaporation Pump	Beer Stillage / Thin Stillage Syrup	7-13%	212	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
2nd Effect Evaporation Pump	Beer Stillage / Thin Stillage Syrup	7-13%	212	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
3rd Effect Evaporation Pump	Beer Stillage / Thin Stillage Syrup	7-13%	212	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
Steam Condensate Receiver Pump	Water	0.0%	212	0.96	SMSS	AISI 316L	ANT CB/TC/AFLAS	Plan 11 + Finned Tubing
4th Effect Evaporation Pump	Beer Stillage / Thin Stillage Syrup	3.0%	212	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
5th Effect Evaporation Pump	Beer Stillage / Thin Stillage Syrup	7-38%	200	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
6th Effect Evaporation Pump	Beer Stillage / Thin Stillage Syrup	7-38%	200	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
7th Effect Evaporation Pump	Beer Stillage / Thin Stillage Syrup	7-38%	200	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
8th Effect Evaporation Pump	Beer Stillage / Thin Stillage Syrup	7-38%	200	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
Evap. Process Condensate Pump	Water	0.0%	200	0.97	SMSS	AISI 316L	ANT CB/TC/AFLAS	Plan 11 + Finned Tubing
Evaporator Drain Pump	Thin Stillage Syrup	0-38%	200	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
Evaporator Syrup Pump	Thin Stillage Syrup	1.0%	188	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
EtOH (Ethanol) Evaporation Pump	Syrup	1.0%	183	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
Beer Bottoms Pump	Ethanol/Water/Solids	12.0%	183	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
Side Stripper Bottoms Pump	Water	0.0%	183	0.97	SMSS	AISI 316L	ANT CB/TC/AFLAS	Plan 11 + Finned Tubing
Rectifier Bottoms Pump	Ethanol/Water/Solids	30.0%	183	0.80	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW03
Dehydration								
Reflux Pump (Distillation Pump)	95% Ethanol	0.0%	130	0.80	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
Molecular Sieve Regen Pump	199.9 Proof Ethanol	0.0%	77	0.90	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
200 Proof Product Pump	Anhydrous Ethanol	0.0%	200	0.80	CDSA/CDPN	AISI 316L	CB/TC//TC/CB/AFLAS/VITON	52/SSE 10 SW02
Separation								
Whole Stillage Discharge / Centrifuge Feed Pump	Thin Stillage Mash	15.0%	180	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Evaporator Transfer Pump	Syrup	4.5%	180	1.10	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Centrate Pump	Thin Stillage Mash	7.0%	180	1.10	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Syrup Pump	Thin Stillage Syrup	7.0%	180	1.10	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Evap Feed Pump	Thin Stillage Mash	7.0%	180	1.00	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Final Product								
Denaturant Pump	Gasoline	0.0%	80	0.67	CURC/CSSN	AISI 316L	CB/TC/VITON	11
Ethanol Loadout Pump	Denatured Ethanol / Gas	0.0%	80	0.80	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
Ethanol Transfer Pump	Anhydrous Ethanol	0.0%	80	0.80	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
Utilities								
CIP Make-up	5% NaOH	2.0%	70	1.53	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
CIPS Pump	5% NaOH	1.0%	140	1.10	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
CIPS Fermenter Pump	5% NaOH	1.0%	140	1.10	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Raw Water Pump	Water	0.0%	50	1.00	CURC/CSSN	AISI 316L	TC/TC/AFLAS	11
Chiller Pump	Water	0.0%	70	1.00	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
RO Product Pump	Water	0.0%	55	1.00	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
Process Water Pump	Water	0.0%	70	1.00	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
50% NaOH Pump	50% NaOH	1.0%	70	1.53	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
50% NaOH Unload Pump	50% NaOH	1.0%	70	1.53	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Waste NaOH Meter Pump	5% NaOH	1.0%	170	1.10	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Acid Wash Pump	Sodium Bisulphite	1.0%	170	1.10	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Cooling Tower Pump	Water	0.0%	90	1.00	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
Optional								
Methanator Product Pump	Water	0.0%	120	1.00	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
Methanator Recycle Pump	Water	0.0%	120	1.00	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11

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Bio Diesel Primary Process

Oil Seed Production

1. Seeds are harvested & conditioned in a steam heating process
2. Dry flakes are introduced to water & steam
3. Oil extracted with use of solvents
4. Solvents evaporated off and oil moved to processing

1 Dry End

The seeds are moved to the cleaning process via mechanical augers and conveyors where any field trash is removed. The seeds are dried to the desired moisture content of 12% and then tempered which causes the husk to pull away from the meat and prepares the product for cracking and dehulling. The objective of cracking is to break the seeds into suitable pieces for dehulling and flaking. The seeds now pass to either the vibratory screens, cyclone separators, or vacuum separators (Kice Separators). Cyclone Separators are utilized to remove the fine particles and trash from the hulls and collected in the bag house.

2 Conditioning

The beans or meat are then passed through a steam heating process. This is accomplished by either a vertical stack cooker or rotary horizontal cooker where the cracks are heated to approximately 72ºC (161ºF) and steam, or a water spray, is added to adjust moisture to approximately 11%, which makes the material plastic for flaking. On these types of cookers there are rotary steam joints (Johnson is typical) which require sealing.

3 Flaking

Flaking mills consist of a pair of smooth-surfaced rolls of approximately 20 to 32 inches (508mm to 812.8mm) in diameter which operate in opposing directions with minimum clearance and driven at different speeds.

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Expanding (optional)

The dry flake is then transferred to the Expanders (extruders) where water and steam is introduced into the product and mixed in the chambers of the extruder. These extruders require shaft sealing on the drive end where the shafts tend to operate at slow speeds but with high pressures and solids content in the extruder chamber.

5

Extraction

Solvent extraction of oil seeds is a diffusion operation in which the solvent (Hexane) selectively dissolves miscible components (oil) from other substances. The extractor unit provides the physical means of contact between the solvent and solids consisting of prepared oil seeds. Immersion and Percolation are the most common types of extraction though Percolation extraction is more common in modern process plants.

6

Solvent Removal and Recovery

The spent Hexane solvent must be recovered and recycled with a minimum of loss. Solvent leaves the extractor as full miscella and as solvent in the flakes, and is then transported to desolventizing. Solvent is removed from the Miscella by double-effect evaporation and steam stripping via a rising film evaporation process. In the first effect evaporator the mixture is 80% oil and the mixture is heated to approximately 38ºC (100ºF). In the second effect evaporator the mixture is heated with 182ºC (360ºF) steam to drive the Hexane out and leave a mixture of 98% oil at 110ºC (230ºF). The miscella is then contacted directly by steam in the primary stripping operation and the Hexane is again driven off leaving 99.5% oil. In the secondary stripping process, steam is again injected into the miscella and the final 99.9% pure oil product is produced. Producers strive for less than 100ppm of Hexane in their pure oil products.

7

Hexane Recovery

Hexane recovery is essential and mandated by the EPA. The remaining Hexane present in the non-condensable gases is removed via a mineral oil stripping process. Purchased mineral oil is mixed with the Hexane latent gases in the absorption column where the Hexane is absorbed by the cold mineral oil. The cold mineral oil latent with Hexane is then heated and pumped to the top of the stripping column. Steam from the stripper passes to a condenser for recovery of the solvent. Solvent free gases from the absorber are vented to the atmosphere through a steam ejector or fan. The recovered Hexane is recycled by the facility and mixed with fresh Hexane to be re-used in the extractor process.

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Solvent Extraction and Solvent Recovery

Application	Fluid	Temperature	AESSEAL®	Metallurgy	Faces	Elastomer	API Plan	Barrier
Extraction Condensate	Condensate	82°C (180°F)	CURC™	316L	CB/TC	Aflas®	11	
Water Stripper Feed	Water	Ambient	CURC™	316L	CB/TC	Aflas®	11	
Hexane	Hexane	Ambient	CURC™	316L	CB/TC	Viton®	11	
Skim Pit	Water	Ambient	CURC™	316L	CB/TC	Viton®	11	
Finished Oil	Raw Oil	Ambient	CDSA™	316L	TC/TC//TC/CB	Aflas®	SW02	Water
Condensate Condenser	Glycol	Ambient	CURC™	316L	CB/TC	Viton®	11	
1st to 2nd Stage Pump	Miscella	115°C (240°F)	CURC™	316L	CB/TC	Viton®	11	
2nd Stage to Stripper	Miscella	115°C (240°F)	CURC™	316L	CB/TC	Viton®	11	
Stripper Condenser	Hexane Vapour	115°C (240°F)	CURC™	316L	CB/TC	Viton®	11	
Vent Condenser	Hexane Vapour	115°C (240°F)	CURC™	316L	CB/TC	Viton®	11	
Cold Mineral Oil	Mineral Oil	Ambient	CURC™	316L	CB/TC	Viton®	11	
Hot Mineral OilMineral Oil/Hexane	115°C (240°F)	CURC™	316L	CB/TC	Viton®	11		
A Stage	Miscella	115°C (240°F)	CURC™	316L	CB/TC	Viton®	11	
B Stage	Miscella	115°C (240°F)	CURC™	316L	CB/TC	Viton®	11	
C Stage	Miscella	115°C (240°F)	CURC™	316L	CB/TC	Viton®	11	
Slurry PumpMiscella	115°C (240°F)	CURC™	316L	CB/TC	Viton®	11		
Full MiscellaMiscella	115°C (240°F)	CURC™	316L	CB/TC	Viton®	11		

Conditioning and Expanding

Application	Fluid	Temperature	AESSEAL®	Metallurgy	Faces	Elastomer	API Plan	Barrier
Steam Joints	Steam	177°C (350°F)	SNOZ™	316L	CB/TC	Aflas®		
Expander Extruder	Seed Flake	71°C (160°F)	CDSA™	316L	TC/TC//TC/CB	Aflas®	SW02	Water
Water	Water	Ambient	CURC™	316L	CB/TC	Aflas®	11	

BIO FUEL INDUSTRY

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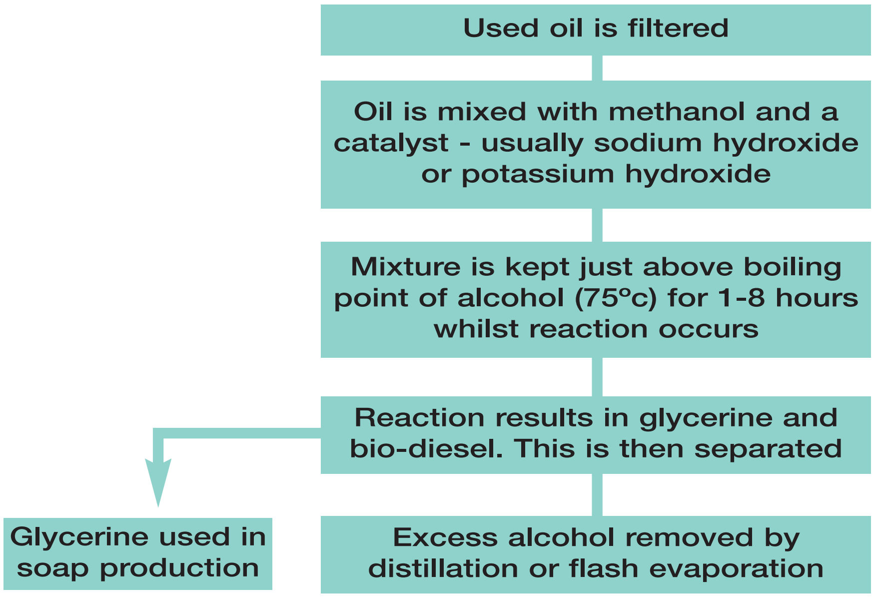
Bio Diesel Production



Straight vegetable oil (SVO) can be used directly as a fossil diesel substitute however using this fuel can lead to some fairly serious engine problems (The reason for this is that the viscosity is too high). The best method for solving these problems is the transesterification of the oil.

Almost all Bio Diesel is produced using base catalyzed transesterification as it is the most economical process The Transesterification process is the reaction of fat/oil with an alcohol to form esters and glycerol. During the esterification process, the fat/oil is reacted with alcohol in the presence of a catalyst, usually a strong alkaline. The alcohol reacts with the fatty acids to form the Methyl Esters, or Bio Diesel and crude glycerol. In most production methanol or ethanol is the alcohol used and is base catalysed by either potassium or sodium hydroxide.

A General Overview of the Process

1

Mixing

The catalyst is typically sodium hydroxide (caustic soda) or potassium hydroxide (potash). It is dissolved in the alcohol using a standard agitator or mixer.

2

Reaction

The alcohol/catalyst mix is then charged into a closed reaction vessel and the oil is added. The system from here on is totally closed to the atmosphere to prevent the loss of alcohol. The reaction mix is kept to around 160 °F. Reaction time varies from 1 to 8 hours. Excess alcohol is normally used to ensure total conversion of the oil to its esters.

3

Separation

Once the reaction is complete, two major products exist: glycerin and Bio Diesel. Each has a substantial amount of the excess methanol that was used in the reaction. The glycerin phase is much more dense than Bio Diesel phase and the two can be gravity separated with glycerin simply drawn off the bottom of the settling vessel or by use of a centrifuge. The heavier, co-product, glycerol may be sold as it is or it may be purified for use in other industries, e.g. the pharmaceutical, cosmetics etc.

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Alcohol Removal

Once the glycerin and Bio Diesel phases have been separated, the excess alcohol in each phase is removed with a flash evaporation process and is recovered using condensers.

5

Glycerin Neutralization

The glycerin by-product contains unused catalyst and soaps that are neutralized with an acid and sent to storage as crude glycerin. Water and alcohol are removed to produce 80-88% pure glycerin that is ready to be sold as crude glycerin. In more sophisticated operations, the glycerin is distilled to 99% or higher purity and sold into the cosmetic and pharmaceutical markets.

6

Methyl Ester Wash

Once separated from the glycerin, the Bio Diesel is purified by washing gently with warm water (to remove residual catalyst or soaps), dried, and sent to storage.

7

Product Quality

Prior to use as a commercial fuel, the finished Bio Diesel must be analyzed using sophisticated analytical equipment to ensure it meets any required specifications.The resulting liquid is a clear amber-yellow liquid with a viscosity similar to Petro-Diesel.

Mechanical Seal Selection for Bio Diesel

Product	S.G. g/cm3	Visc. Max CP	Vapour Pressure Bar (a)	Temperature Min °C	Temperature Norm °C	Temperature Max °C	Suction Pressure Bar(g)	Discharge Pressure Bar(g)	seal chamber Pressure Bar(g)	Equipment Mechanical Seal
Raw Product										
Used Frying Oil	0.93	60.00	Not Given	20	20	35	0.00	3.63	3.63	CURC C/SIC/V
Soya Oil	Not Given	Not Given	Not Given	25	25	25	0.00	15.00	0.00	CURC C/SIC/V
Palm Oil	Not Given	Not Given	Not Given	45	45	45	0.00	11.00	0.00	CURC C/SIC/V
Rape Seed Oil	Not Given	Not Given	Not Given	20	20	20	0.00	11.50	0.00	CURC C/SIC/V
Transesterification										
Methanol	Not Given	Not Given	Not Given	25	25	25	0.00	1.70	0.00	CURC C/SIC/K6375
Methyl Ester	0.90	4.50	Not Given	25	25	25	0.00	8.82	8.82	CURC C/SIC/K6375
Water + 30Wt% Sodium Hydroxide	1.33	24.00	0.02	25	25	25	0.00	2.79	2.79	CURE C/SIC/E //C/CHR/E
Sodium Methylate + 30% Methanol	0.94	15.00	Not Given	25	25	25	0.00	1.87	1.87	CURC C/SIC/K6375
Glycerine Removal										
Glycerin	Not Given	Not Given	Not Given	60	60	60	0.00	2.30	0.00	CURC C/SIC/E
Final Product										
Neutralized Oil	0.93	60.00	Not Given	20	20	30	0.00	3.63	3.63	CURC C/SIC/V

AESSEAL® ENVIRONMENTAL TECHNOLOGY

Bio Diesel Chemicals: Seal and Elastomer Selections

Application	Chemical(s)	Temp (F)	Stuffing Box Config.	Seal Style	Seal MTL	Suggested Seal Faces and Elastomers	Seal Support System Ordering Code
Sodium Methylate Process Pump	Methyl Ester/Methanol/Glycerine	140	Big Bore	BDFI+	316SS	SC/SC/AZ//SC/CB/V	MZM1258
Process Pump	Methyl Ester/Methanol/Glycerine	122	Big Bore	BDFI+	316SS	SC/SC/AZ//SC/CB/V	MZM1258
Process Pump	Glycerine/Methanol/Methyl Ester	122	Big Bore	CURC+	316SS	CB/TC/AZ	
Sodium Methylate Process Pump	Methyl Ester/Methanol/Glycerine	140	Big Bore	BDFI+	316SS	SC/SC/AZ//SC/CB/V	MZM1258
Methanol Feed Pump	Pure Methanol	104		Mag Drive			
Wash Water Supply/RO Make-up	Condensate	133	Big Bore	CURC+	316SS	TC/TC/AZ	
Process Pump	NaCL,HCL,Methanol, Methyl Ester	122	Big Bore	DSMN-FI	NM	SC/SC/KZ6375//SC/CB/V	MZM1258
Wash Column Bottoms Pump	PH 2	122	Big Bore	DSMN-FI	NM	SC/SC/KZ6375//SC/CB/V	MZM1258
Methanol Column Feed Pump	Methanol/Water	135	Big Bore	DSMN-FI	NM	SC/SC/KZ6375//SC/CB/V	MZM1258
Methanol Reflux Pump	Methanol/Water	104		Mag Drive			
Methanol (MeOH) Discharge Pump	Methanol/Water	220	Big Bore	DSMN-FI	NM	SC/SC/KZ6375//SC/CB/V	MZM1258
Scrubber Water Process Pump	Water/Methanol/Glycerine, NaCL	95	Standard	CURC	316SS	TC/TC/AZ	
BioDesiel Pump	BioDesiel/NaCL	122	Big Bore	BDFI+	316SS	CB/SC/AZ//SC/CB/V	MZM1258
Water Evaporation Pump	BioDesiel	230	Big Bore	BDFI+	316SS	SC/SC/AZ//SC/CB/V	MZM1258
Dryer Discharge Pump	BioDesiel	230	Big Bore	BDFI+	316SS	CB/SC/AZ//SC/CB/V	MZM1258
Glycerine Water Discharge Pump	Glycerine/Water	194	Big Bore	DSMN-FI	NM	SC/SC/KZ6375//SC/CB/V	MZM1258
Fatty Matter Pump	Methyl Ester/HCL	212	Big Bore	DSMN-FI	NM	SC/SC/KZ6375//SC/CB/V	MZM1258
Transfer Pump, Heated Oil	Edible Oil	194	Big Bore	BDFI+	316SS	SC/SC/AZ//SC/CB/V	MZM1258
Transfer Pump, Deacidification Oil	Edible Oil	482	Big Bore	BDFI+	316SS	SC/SC/AZ//SC/CB/V	MZM1259
Preheated Oil Pump	Edible Oil	428	Big Bore	BDFI+	316SS	SC/SC/AZ//SC/CB/V	MZM1259
Fatty Acid Pump	Fatty Acid	176	Big Bore	BDFI+	316SS	SC/SC/AZ//SC/CB/V	MZA1258
Chilled Water Pump	Clean Water		Big Bore	CURC+	316SS	CB/TC/AZ	
CIP Tank Pump	Caustic/Water	185	Big Bore	BDFI+	316SS	SC/SC/AZ//SC/CB/V	MZM1258
2nd Effect Circulation Pump	Glycerine and Water	203	Big Bore	CURC+	316SS	TC/TC/AZ	
Evaporator Condensate Pump	Glycerine and Water	203	Big Bore	CURC+	316SS	CB/TC/AZ	
Evaporator Condensate Pump	Glycerine and Water	140	Big Bore	CURC+	316SS	CB/TC/AZ	
Glycerine Circulation Pump	Glycerine	176	Big Bore	BDFI+	316SS	SC/SC/AZ//SC/CB/V	VSE/SP04-25-US
Glycerine Circulation Pump	Glycerine	311	Big Bore	BDFI+	316SS	SC/SC/AZ//SC/CB/V	VSE/SP04-25-US
Glycerine Circulation Pump	90% Glycerine, 10% Water	113	Big Bore	BDFI+	316SS	SC/SC/AZ//SC/CB/V	VSE/SP04-25-US
Cooling Destillant Pump	Glycerine	266	Big Bore	BDFI+	316SS	SC/SC/AZ//SC/CB/V	VSE/SP04-25-US
Product Glycerine Pump	Glycerine	194	Big Bore	BDFI+	316SS	SC/SC/AZ//SC/CB/V	VSE/SP04-25-US
Tempered Water Pump	Water	131	Big Bore	CURC+	316SS	CB/SC/AZ	
Demineralized Water	Demin Water	90	Big Bore	CURC+	316SS	TC/TC/AZ	
Carbon Slurry Pump		Amb	Big Bore	CURC+	316SS	TC/TC/AZ	
Cooling Tower Pump	Cooling Water	80	Big Bore	CURC+	316SS	TC/TC/AZ	
Cooling Tower Pump	Cooling Water	80	Big Bore	CURC+	316SS	TC/TC/AZ	
Saturated Condensate							
Deaerator Feed Pump	Water	212	Standard	SMSS	316SS	TC/TC/AZ	VFI/FINTUCN-04-E-FITKIT-CPT11B
Soybean Oil Feed Pump	Soybean Oil	120	Big Bore	BDFI+	316SS	SC/SC/AZ//SC/CB/V	MZA1258
Methanol Transfer Pump	Methanol/Water	105		Mag Drive			
Sodium Methylate	NaCL, Methane (Sodium Methylate)	90		Mag Drive			
Caustic Soda Pump	50% NaOH	86	Big Bore	TPOC+	316SS	TC/TC/AZ	
37% HCL Pump	37% HCL	86	Big Bore	SSNM	NM	SC/SC/KZ6375	
Glycerine Water Feed Pump	Glycerine/Water	203		Mag Drive			
Glycerin II Pump	100% Glycerine	176	Standard	SMSS	316SS	TC/TC/AZ	VFI/FINTUCN-04-E-FITKIT-CPT11B
Crude Glycerine Feed Pump	Glycerine	162	Standard	SMSS	316SS	TC/TC/AZ	VFI/FINTUCN-04-E-FITKIT-CPT11B
USP Glycerine	100% Glycerine	125	Big Bore	CURC+	316SS	CB/TC/AZ	
BioDesiel Pump	BioDesiel	104	Big Bore	CURC+	316SS	CB/SC/AZ	
BioDesiel Pump	BioDesiel	104	Big Bore	CURC+	316SS	CB/SC/AZ	
Neutral Oil Feed Pump	Soybean Oil	80	Big Bore	TPOC+	316SS	TC/TC/AZ	
Fatty Acid Distallate Loading Pump	Fatty Acid	130	Big Bore	CURC+	316SS	TC/TC/AZ	
Vent Scrubber Circulatioin Pump	HCL/Water/Salt/Caustic	200	Big Bore	SSNM	NM	SC/SC/KZ6375	
Hot Well Pump	Water	200	Standard	SMSS	316SS	CB/TC/AZ	VFI/FINTUCN-04-E-FITKIT-CPT11B
Salt Wash Tank Pump		70	Big Bore	TPOC+	316SS	TC/TC/AZ	
Boiler Room Sump			Big Bore	CURC+	316SS	TC/TC/AZ	
Catalyst Tank Sump Pump	Storm Water	70	Big Bore	CURC+	316SS	TC/TC/AZ	
Methanol Tank Sump Pump	Storm Water	70	Big Bore	CURC+	316SS	TC/TC/AZ	
HCL Tank Farm Sump Pump	Storm Water	70	Big Bore	CURC+	316SS	TC/TC/AZ	
Main Tank Farm Sump Pump	Storm Water	70	Big Bore	CURC+	316SS	TC/TC/AZ	
BioDesiel Building Sump Pump	Storm Water	70	Big Bore	CURC+	316SS	TC/TC/AZ	
Methanol Unloading Pump	Pure Methanol	105		Mag Drive			
Catalyst Unloading Pump	Sodium Methylate	90	Big Bore	BDFI+	316SS	SC/SC/AZ//SC/CB/V	MZM1258
Caustic Unloading Pump	NaOH		Big Bore	TPOC+	316SS	TC/TC/AZ	
Anti-Oxidant Unloading Pump	BioDesiel		Big Bore	TPOC+	316SS	TC/TC/AZ	
Winter Additive Pump	Winter Additive		Big Bore	TPOC+	316SS	TC/TC/AZ	
Glycerin Building Sump Pump	Storm Water	70	Big Bore	CURC+	316SS	TC/TC/AZ	
Fatty Acid Distillant Tanks Loadout	Fatty Acid	150	Big Bore	CURC+	316SS	TC/TC/AZ	
Fatty Matter Loadout Pump	Methyl Ester	212	Big Bore	BDFI+	316SS	SC/SC/AZ//SC/CB/V	MZM1258

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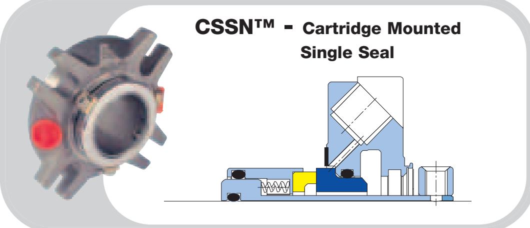
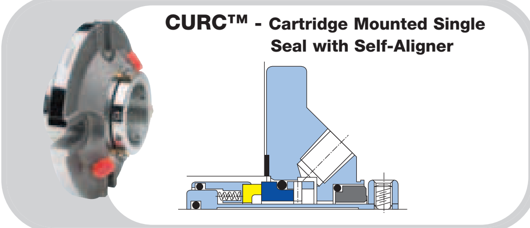
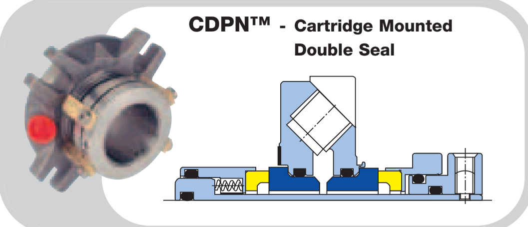
BioDiesel Pilot Plant Seal Selections

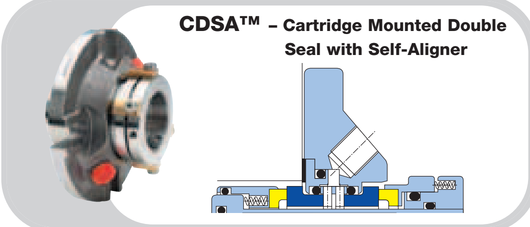
Application	Chemical(s)	Temp (F)	Flow Rate (gpm)	Stuffing	Seal Style	Seal MTL	Inboard Faces	Inboard Elastomer
Waste Oil Transfer Pump	Waste Oil	104	400	Big Bore	CURC+	316SS	TC/TC	Aflas
Glycerin Transfer Pump	95% Glycerin	74	10	Big Bore	CURC+	316SS	CB/TC	Aflas
Glycerin Transfer to Distillation Column Pump	95% Glycerin	74	10	Big Bore	CURC+	316SS	CB/TC	Aflas
Mix Transfer Pump	Glycerin Oil Mixture	104	100	Big Bore	CURC+	316SS	TC/TC	Aflas
Methanol Transfer Pump	Methanol	74	85	Big Bore	CURC+	316SS	CB/TC	Aflas
Curde Fuel Transfer Pump	BioDiesel	Amb	28	Big Bore	CURC+	316SS	CB/TC	Aflas
Neutralized Fuel Transfer Pump	BioDiesel	Amb	65	NA	P05U	316SS	CB/TC	Viton
Fuel Transfer Pump	BioDiesel	Amb	26	NA	P05U	316SS	CB/TC	Viton
BioDiesel Transfer Pump	BioDiesel	Amb	100	Big Bore	CURC+	316SS	CB/TC	Aflas

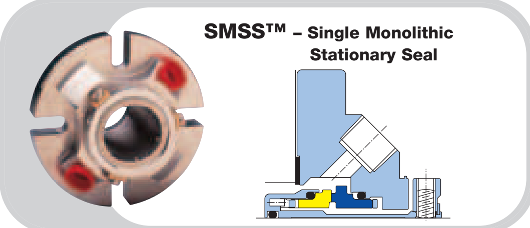
Products used in the Ethanol Industry

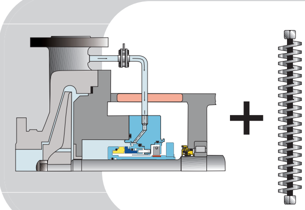

CSSN™ - Cartridge Mounted Single Seal


CURC™ - Cartridge Mounted Single Seal with Self-Aligner


CDPN™ - Cartridge Mounted Double Seal


CDSA™ – Cartridge Mounted Double Seal with Self-Aligner


SMSS™ – Single Monolithic Stationary Seal


API Plan 11 and Finned Tubing

API Plan No.11
Product Recirculation
from Pump Discharge
to Seal using
Finned Tubing

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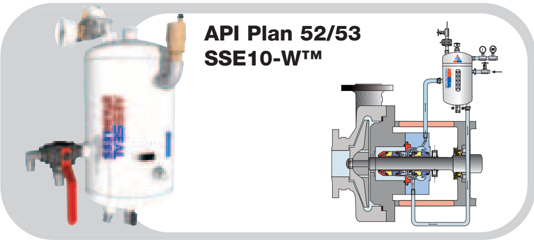

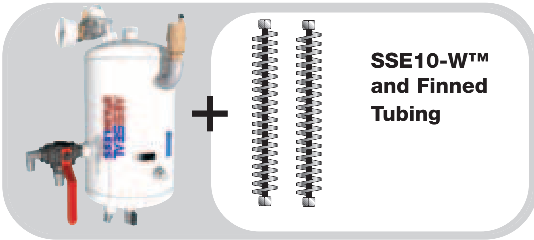

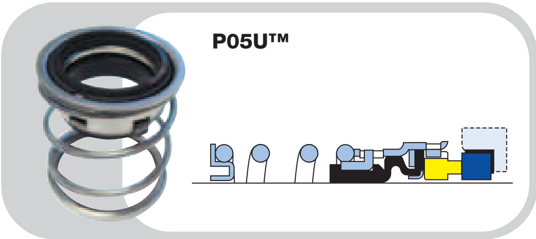

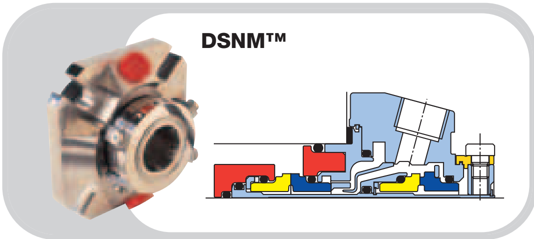

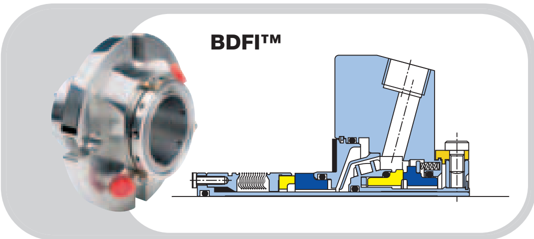

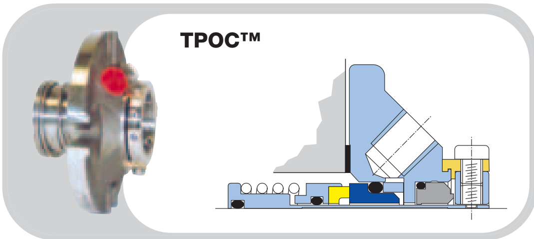

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INVESTOR IN PEOPLE

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

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

WARNING

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