CHOCOLATE MANUFACTURING

Best True Costs Decisions for Air, Water, Energy Products Used in Chocolate Manufacturing

Introduction

Chocolate manufacture creates a number of challenges for air, water, energy product suppliers and the purchasers.
To help purchasers make the best true cost decisions this topic is now included in the Productivity Hub.
This power presentation in the Discussions section includes the value propositions also found individually in the Hub.

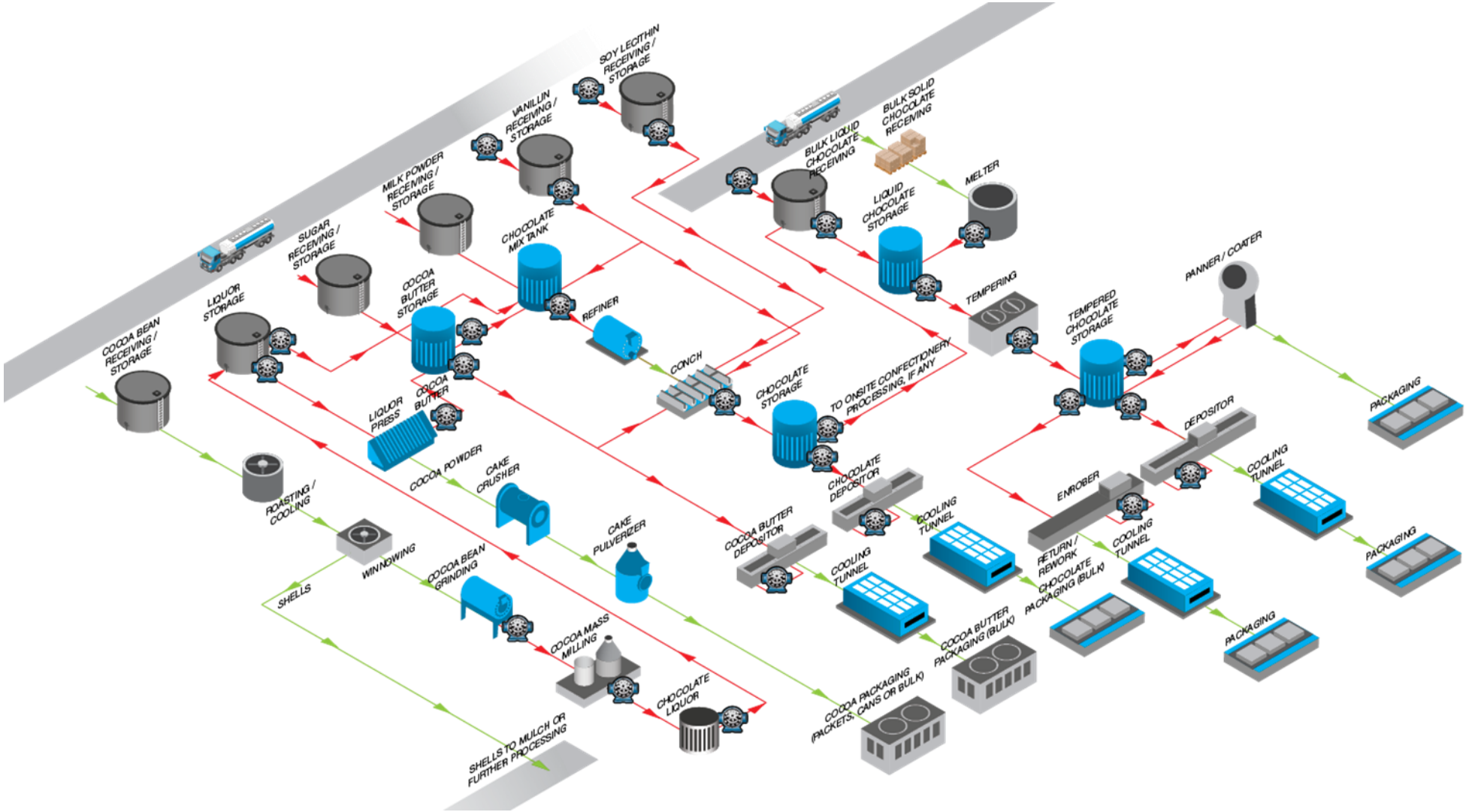
There are two types of Value Propositions included.

- Brief: These include short product analyses of companies with direct experience
- Participant: This includes companies who are supporting this initiative and are providing continuing input

This is an ongoing effort and input from end users and consultants is invited
The first participating supplier to the Chocolate Decisions is Viking Pump, a company with a long history as part of IDEX and previously an even longer history as an independent company
The analyses appearing here are being reported in feature articles in the following magazines.

- Pump Engineer
- Valve World Americas
- Stainless Steel World Americas
- Hose & Coupling World

An interactive process diagram prepared by Viking Pump shows the various processes and products used in chocolate manufacturing



https://www.vikingpump.com/chocolate

Click on interactive process diagram

Case History: Mars NE

Mars Wrigley Confectionery, the world's leading manufacturer of chocolate, chewing gum, mints and fruity confections, has achieved energy and CO2 reduction with GEA's heat pump solution at its facility in Veghel, the Netherlands - one of the largest chocolate factories in the world. The heat pump installation reduces the chocolate factory's carbon footprint and contributes to the achievement of Mars' stated sustainability goals.

At Mars' Veghel site, GEA's innovative heat pump solution has reduced total energy consumption across the site by 6% and contributes to a reduction of 1,000,000 m3 of natural gas per year, equivalent to a reduction of more than 1,000 t CO2 per year, or more than 1,800 t CO2 per year if green electricity is applied.

Mars says that is equivalent to the combined annual energy consumption of about 625 households. The firm estimates that over the course of just one year, the amount of heat recycled using the heat pump technology allows Mars' Veghel site to save about 26 terajoules in gas.

Case History: Nestle CZ

Nestlé Česko s.r.o. operates a production site in Olomouc, Czech Republic, and manufactures different kinds of confectionery products.

Measurement requirements:
The plant operator stores different kinds of liquefied chocolate in storage tanks located outside of the production facility. In order to make them available for production, the different types of chocolate are transported to six smaller tanks inside the plant, where they are temporarily stored and kept at around +45 °C / +113 °F. These double bottom tanks (1.8 m / 5.9 ft in height) are heated with liquid water. The liquid chocolates are continually stirred by a slowly rotating agitator.

In order to guarantee consistent chocolate supply to the production line, these tanks need continuous level monitoring. In order to automate replenishment of the tanks, the customer decided to equip them with non-contact level transmitters.

Chocolate Industry AWE Facts and Factors

BASIC FACTS AND FACTORS

The chocolate-making process is a delicate craft perfected over thousands of years. Cacao trees are harvested for their beans which are then roasted, ground up, and mixed with oils to create a semi-liquid, which is the beginning point in the making of finished chocolate. If the chocolate has been liquified by heating, it is known as chocolate liquor (liquid chocolate).

Early-stage chocolate is called bitter chocolate named after its bitter taste. Add sugar, and it is known as sweet chocolate. Add milk for milk chocolate.

Despite the name, white chocolate does not contain any chocolate liquor or cocoa solids. It is a mixture of cocoa butter, sugar, and milk. Chocolate can be further diluted with fats like palm oil, coconut oil, or lecithin.

JACKETED VALVES AND PIPING

For applications where temperature-induced solidification is a concern – such as liquid chocolate and confectionery products -- jacketed valves and piping play a crucial role in preventing in-line clogging. A precisely formed, open jacket that encloses the body of the valve receives a flow of steam or hot water to maintain the desired viscosity or product composition as the product runs through the valve area.

When exploring valve jacket options, don't be tempted by cheap methods of applying heat to a conventional valve, such as heat tape or bolt-on jackets. For best performance, manufacturers should look for direct-welded jackets, which transfer heat much more efficiently and reliably.
f particular importance to chocolate and candy producers is the ease with which valves come apart for hassle-free inspections and thorough cleanings. Manufacturers can gain a significant boost in maintenance and cleaning efficiency by deploying a two-piece valve design that disassembles by hand instead of a conventional three-piece valve that requires tools to disassemble and clean.

As chocolate and confectionery manufacturers respond to growing demand by adding capacity and/or efficiency to their operations, processing valves should be part of the consideration. Their impact on food safety and operational metrics can be surprisingly significant.

FILTERING FACTS AND FACTORS

Chocolate is filtered to ensure a high-quality finished product free of contaminants. Additionally, because of different global consistency standards, there is a need for filtration systems capable of handling diverse raw materials. These are just a few ways 3A certified strainers are used in chocolate processing.

- Filtering virgin chocolate after conching
- Tanker loading and unloading
- Filtering reclaimed chocolate after it drips off of candies with centers
- Filtering reworked chocolate to remove contaminations like foil wrappers, nuts and almonds

Filtering chocolate not only creates a mouth-watering treat, but it also ensures product safety and quality and reduces the potential for product recalls.

MIXING FACTS AND FACTORS

major raw chocolate producer needed to develop their mass standardization process.
To achieve high homogenization of the cocoa mass concentration, the operating temperature had to be very close to the critical point that would have destroyed the quality of the product.
This set extra high requirements for efficient heat transfer from the vessel wall into the bulk mass in order to avoid temperature gradients destroying the chocolate.

Customers in the chocolate processing industry usually use top entry agitators or even more often horizontal blenders consisting of plough impellers or a combination with helical ribbon impellers.
The installed mixers/blenders have several disadvantages. In particular, the extremely high-power consumption of the blenders has a negative impact on the overall energy balance of the process.
Furthermore, these units have an enormous space requirement that leaves no space in the halls for expansions.

The top entry units installed in some chocolate processes mainly consist of anchor or complex frame-type impellers with additional elements in the center.
All of these constructions are complicated to clean.

PUMP FACTS AND FACTORS

Here are some of the facts which need to be addressed.

- Slow and complicated pump startups
- Abrasive products wearing away at the pump internals
- Product buildup within the pump
- Leaky pumps leave product all over the floor leading to slip hazards and costly clean up

Positive displacement pumps have been the reliable solution to the challenges that the chocolate industry faces.

Viking is an example of a pump company which has worked closely with processors to overcome the many difficulties of pumping chocolate and developed solutions for each unique chocolate liquid.

- Hardened parts to minimize wear by abrasive cocoa liquor
- Extra clearances and drilled idler gears to prevent caramelization of white chocolate
- Grooves to promote flow behind the rotor to prevent solids buildup on sugar-free chocolate
- Special seals for cocoa butter and fats
- Jacketed for smoother startups
- Cast iron and stainless-steel material options

FILTERS

Russell Finex

Industry: Chocolate

Product: self cleaning filter

Value Proposition: Options allow the right particle separation with no use of consumables

1201

We understand the importance of protecting the quality of your chocolate products. Whether you are producing cocoa liquor, cocoa butter, or manufacturing and processing liquid chocolate, Russell Finex will safeguard your reputation. We have different screening solutions suited for all the places you may need them including incoming ingredients, post conch, post enrober, rework or tanker loading and unloading.

Our Self-Cleaning Russell Eco Filters offer totally enclosed, automatic, high-capacity screening to keep your operators and environment safe. We also offer vibratory sieve solutions for more difficult or heavily contaminated batches.

With its versatile range the automatic filtration equipment improves product quality by removing oversize contamination from 15 microns or above. The self-cleaning industrial filter does not require filter bags or cartridges, which offers significant reductions in wasted product.

SaniClean

Industry: Chocolate

Product: strainer

Value Proposition: Strainers for a range of particle and pipe sizes

1202

Chocolate is filtered to ensure a high-quality finished product free of contaminants. Additionally, because of different global consistency standards, there is a need for filtration systems capable of handling diverse raw materials. These are just a few ways 3A certified strainers are used in chocolate processing.

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Filtering chocolate not only creates a mouth-watering treat, but it also ensures product safety and quality and reduces the potential for product recalls.

SaniClean Strainers are suitable for a wide range of applications, from small batch runs to 24/7 continuous production cycles. Our strainers are available in varying capacities from creeping flow rates to high volume production outputs. They are easily integrated into new or existing piping configurations. Standard material of construction is 316L; other corrosion resistant alloys are available for handling highly corrosive fluids.

MEASUREMENT

Krohne

Industry: Chocolate

Product: Flow and Level instruments

Value Proposition: Precises flow, temperature and pressure measurement despite varying conditions

1203

KROHNE recommended using the **OPTIWAVE 7500 C**. Six units of the 80 GHz FMCW radar level transmitter with PEEK Lens antenna were supplied. The 80 GHz technology allows the antenna (DN 25) and the process connection to be small. Upon customer request, the radar level devices were provided with G1 thread and subsequently installed via hygienic Tri-Clamp connection manufactured by the food company itself. If it had been required for this application, KROHNE would have been able to deliver radar level devices already equipped with any hygienic connections.

The OPTIWAVE 7500 enables reliable measurement independent of process conditions like temperature, pressure, density or viscosity. It is particularly suitable for liquid applications in small tanks with agitators. Due to its empty spectrum function, false reflections caused by those tank internals are eliminated right away, preventing failed measurements.
The level of each tank is monitored continuously. The readings are transferred to the control room of the plant. Whenever the chocolate level falls below a certain threshold, the tanks are replenished by the storage tanks.

A high-quality product often means a challenging production process. Manufacturers of chocolate and cocoa products have special requirements, starting with the input logistics through to the measurement accurate to the gram.

KROHNE has a dedicated Global Industry Division which accepts these challenges and offers individual measurement solutions.

In the chocolate manufacturing process, achieving high quality, safety and efficiency is the priority: this sets highly challenging demands on the measurement technologies used. Please accept our invitation to meet in person, or online, to discuss your process improvement potential. Let us help you enable the evolution of your manufacturing process with our industry and application know-how and high-quality products.

One of the biggest challenges in the manufacture of chocolate, ice cream and other sweets and cocoa products is to increase efficiency and to lower costs without compromising the texture of the final product. Besides precise flow, pressure, temperature and analytical instruments, KROHNE can supply units with direct heat tracing of the measurement tube.

Liquids with a solids content or entrained gas can be measured precisely, even despite high viscosity, for example with cacao butter, changes in viscosity, or where there are sensitive temperature conditions. Modern technologies face challenges like the deficits of two-phase flow conditions, revealing big potential for process optimization and reduction of losses. Coriolis flowmeters with EGM™ entrained gas management maintain operation and high repeatability of measurements – despite the presence of fibers, solids or air entrainment in the slurry, dough or any other kind of mash. Mass flow and direct density measurement of aerated products is already possible in the mixed stage.

MIXERS

North American Process Inc.

Industry: Chocolate

Product: Mixer

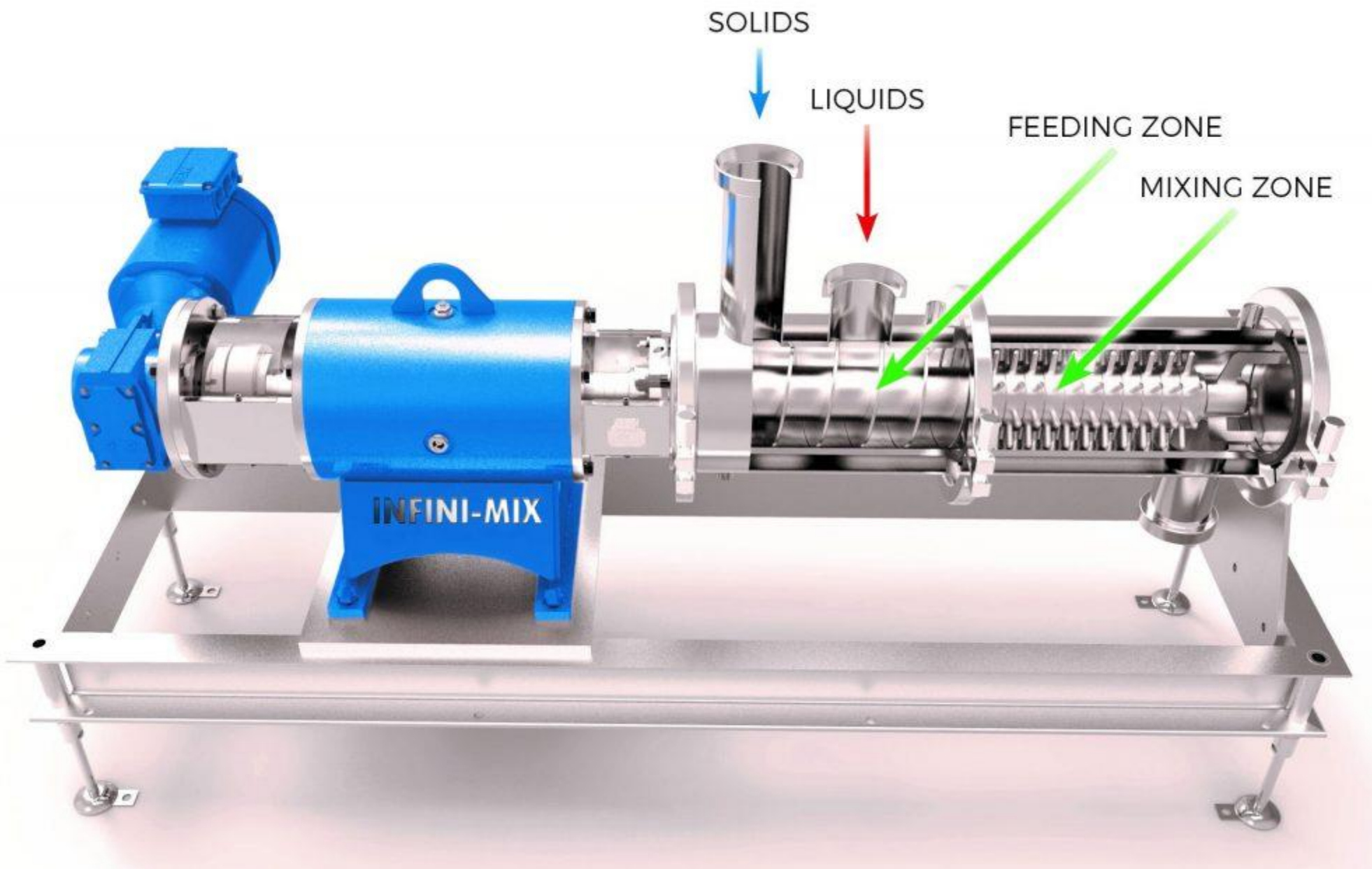
Value Proposition: Unique design eliminates tank cleaning as ingredients change

1204

The Infini-Mixer™ is ideal for blending inclusions into the finished chocolate. Inclusions can be various nuts, “crispies”, coconut, sea salt or just about anything. Many manufacturers will use a batching vessel to mix the inclusions into the chocolate. When the recipe changes to a different inclusion, the batching vessel and all of the transfer piping and equipment must be cleaned.

Instead, install the Infini-Mixer™ at the end of the process, just prior to the depositor. Meter the chocolate into the liquid port on the feed zone while using a gravimetric solids feeders to meter the inclusions directly into the solids port. While delicately blending the solids the jacketed housing and temperature-controlled rotor is tempering the product.

When production calls for a new inclusion, simply clean the Infini-Mixer™ and then you are on to the next product. This saves time in changeovers and the cost in cleaning. The Infini-Mixer™ with the optional slide base makes it easy to disassemble to clean by hand or to inspect.


SOLIDS
LIQUIDS
FEEDING ZONE
MIXING ZONE
INFINI-MIX

SPX

Industry: Chocolate

Product: Mixer

Value Proposition: Superior vertical blending

#1205

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The installed mixers/blenders have several disadvantages. In particular, the extremely high-power consumption of the blenders has a negative impact on the overall energy balance of the process. Furthermore, these units have an enormous space requirement that leaves no space in the halls for expansions.

The top entry units installed in some chocolate processes mainly consist of anchor or complex frame-type impellers with additional elements in the center.
All of these constructions are complicated to clean.

UTG Mixing Group has applied its patented Sigma impeller series widely in the chemical industry and for special food industry applications for decades already. In 2015, this patented technology was introduced successfully also to the chocolate industry.

UTG Mixing Group's experts designed with the customer a special modification of Sigma technology that allowed a vertical tank mixing solution. The solution was tested with the customer's product and quality control methods at the UTG Mixing Technology R&D Center in Germany.

- Sigma technology generates forced counterflow circulation with good wall velocity.
- Sigma offers superior vertical blending compared to an anchor blade; the equivalent blending time can be achieved with less power due to more efficient circulation.
- Forces impacting on the agitator and drive are smaller than with an anchor impeller, allowing a lighter construction.

VALVES

Lee Industries

Industry: chocolate

Product: Valves

Value Proposition: 316L Stainless valves are providing sanitary protection along with high performance

1206

Lee Sanitary Valves are precision made of Type 316-L stainless steel and are designed for corrosion resistant, highly sanitary conditions in the food, drug, cosmetic, pharmaceutical, beverage, chemical and metal-detection industries worldwide. They are 3A Sanitary and USDA-M&P accepted and certified.

Our 3A Sanitary Valves are used for a variety of food and beverage products including meats, condiments, juices, flavors, oils, sauces, syrups, soups, bouillons, jams and jellies, chocolate and confectionery and milk products. Lee sanitary valves also are used for many cosmetic, chemical and pharmaceutical formulas. All Lee valves are available with various optional connection fittings such as sanitary clamp, sanitary thread, I-line, flanged, butt-weld and NPT.

PUMPS

IDEX Viking Pump # 1209

- Industry: Chocolate
- Product: Internal Gear Pump
- Value Proposition: the unique variations of the pumps and seals have been created over many decades to ensure that chocolate product quality is maintained during transfer while at the same time creating the lowest true cost of this process
- *Viking Pump is a Hub Participant joining in the effort to help purchasers make the best True Cost Decisions*

Value Proposition

Based on many decades of experience Viking addresses each of the cost factors affecting chocolate pumping and has developed special pumps to provide the best value proposition for each process variation. The CHC1 models are especially suitable for chocolate, cocoa masses and creams.

The CHC2 models are used for low-viscosity media such as cocoa butter, oils and lecithins. Both models are characterized by freedom from leaks with a double O-ring seal, integrated heating jacket, flushing lines and holes on the follower to ensure better flushing and to prevent heat build-up and caramelization on the bearings.

Viking is the leader in pumping chocolate and has achieved this position by continuing development to meet the industry challenges.

THE VIKING PUMP ADVANTAGE

- EC1935 Compliant constructions
- Internal O-rings create a sealed lubrication chamber for the bracket bushing, increasing bushing life
- Trusted and proven with world leading chocolate manufacturers
- Pre-defined chocolate pump constructions to make business easy
- Low shear design protects delicate chocolate suspensions
- Hardened materials provide long life on abrasive liquors and chocolates
- Internal gear principle handles viscosities ranging from thin cocoa butter to thick peanut butter
- Simple, in-house maintenance
- Vertically integrated manufacturing process, from raw materials to finished product, meets ISO 9001:2015 quality standards

Viking Pump has been a trusted partner in reliability with chocolate and confectionery processors around the world for more than a century. As the world's leading positive displacement process pump manufacturer, solving difficult liquid transfer problems is what we do. And it doesn't get more difficult than chocolate, so you can rely on Viking's experience and expertise.

Viking has worked closely with processors to overcome the many difficulties of pumping chocolate and developed hundreds of different, unique pump designs for each different chocolate liquid. For example:

- Hardened parts to minimize wear by abrasive cocoa liquor
- Extra clearances and drilled idler gears to prevent caramelization of white chocolate
- Grooves to promote flow behind the rotor to prevent solids buildup on sugar-free chocolate
- Special seals for cocoa butter and fats

Viking Pump identifies the cost factors:
•Slow and complicated pump startups
•Abrasive products wearing away at the pump internals
•Product buildup within the pump
•Leaky pumps leave product all over the floor leading to slip hazards and costly clean up

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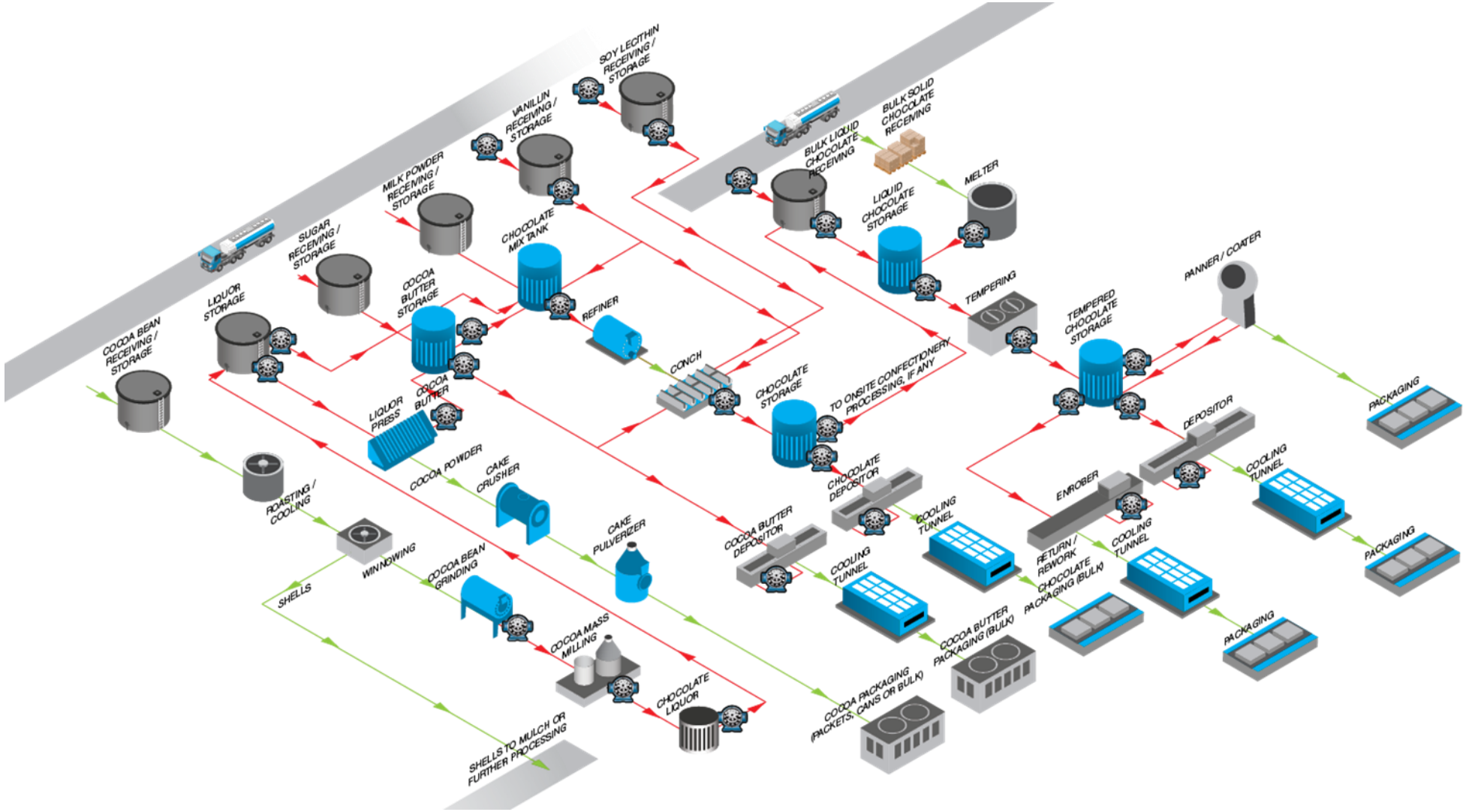
•Special seals for cocoa butter and fats
•Jacketed for smoother startups
•Cast iron and stainless-steel material options

Whether the task is to transfer cocoa mass from a ball mill across the plant to a blending tank, or to recirculate yogurt coating in a closed loop to feed a series of panners, or to continuously recirculate tempered milk chocolate from an enrobing machine's sump to the feed trough, or a hundred other possibilities, Viking's gentle, reliable pumps will improve your operational efficiency

The many process and variables addressed by Viking Pumps are shown in the following interactive process diagram



https://www.vikingpump.com/chocolate

To view interactive process diagram

One superiority factor is the immunization of leakage

Packing was designed to leak

But it doesn't have to be that -
With Viking Pump's patented **O-Pro® Sealing Technology**, you keep your product where it belongs; Inside the pump and off your floors. We listened to our customers and engineered a seal that reduces loss of product due to leakage.

Each O-Pro® Seal design option replaces packing or a mechanical seal by occupying the internal bracket cavity with a machined seal gland. Utilizing O-rings to seal externally on the bracket and internally on the shaft, a combination of O-rings and lubricating grease provide a **robust seal.** This prevents process fluids from leaking out of the pump.

The O-Pro® Cartridge seal allows for an easy retrofit while addressing any need for stainless steel seal construction.

Viking's internal gear pumps can be used in almost all areas of chocolate production.
To further increase the service life of the pumps and to ensure that the chocolate is conveyed even more gently, Viking has developed two special types of pumps. The CHC1 models are especially suitable for chocolate, cocoa masses and creams.

The CHC2 models are used for low-viscosity media such as cocoa butter, oils and lecithins. Both models are characterized by freedom from leaks with a double O-ring seal, integrated heating jacket, flushing lines and holes on the follower to ensure better flushing and to prevent heat build-up and caramelization on the bearings.

RELIABILITY

1224A-CHC1 models for chocolate liquids minimize frictional heat at bushings and prevent solids buildup that can cause seizing. The O-Pro™ Barrier Seal is lubricated with clean food-grade grease instead of chocolate and keeps chocolate out of the bracket while providing superior shaft support; the extra-clearance idler gear and bushing are drilled to ensure flow between the bushing and pin to reduce heat; and flush and suckback grooves on the casing create flow behind the rotor to eliminate buildup. High-strength steel or ductile iron rotors handle high viscosities, and hardened iron bushings and hardened steel shafts minimize wear. There's no packing to adjust, which eliminates common overtightening problems.

LESS PUMP & PART VARIATION The 1224A-CHC2 models for non-chocolate liquids are identical to CHC1, except the casing does not have flush and suckback grooves, for higher efficiency on thin liquids like cocoa butter. This reduces pump and spare part variation and enables easy conversion from CHC1 to CHC2 and vice versa. Seal kits enable low-cost conversion of existing Viking Universal Seal pumps to the O-Pro™ Barrier Seal.

SIMPLE MAINTENANCE

O-rings are replaceable with the pump in-place, when configured with spacer couplings allow space to remove the O-Pro™ Barrier Seal. Jack screws in seal kits allow easy O-Pro™ Barrier Seal removal. Proven O-ring sealing technology means low-cost seal replacement. Recommended re-greasing interval is every 500 hours of operation.

FOOD SAFETY - EC1935 COMPLIANT

The pumps are constructed of food grade materials and carry the EC1935 mark to limit leaching of harmful substances into food and are suitable for use on low hazard foods like chocolate, according to your HACCP plan.

IDEX Pulsafeeder

Industry: Chocolate

Product: Sliding vane pump

Value Proposition: Superior durability and flexibility along with constant flow with varying viscosity.

1207

Foster Sliding Vane Pumps have been an essential component of many industries since its inception in 1845. Heavily relied upon for its durability, Foster outlasts its competitors in some of the harshest pumping environments imaginable. Available in both four vane and a six vane options, Foster's capacity for fluid handling is incomparable. From water to tar, Foster has the stamina to power through any job and be ready for your next application.

Extensive material availability provides versatility for pumping a variety of chemicals

- Four or six vane Pumps provide ample space for efficient fluid transfer
- Viscosities from 1600 cPS to 45,200 cPS
- Jackets help to regulate a temperature of a pumped fluid. In high viscosity liquids, a jacketed pump assists in keeping the liquid fluid enough to pass through the pump. In food production this can be especially important. On the low viscosity end, jackets provide the added assurance that highly flammable liquids such as petroleum and biodiesel products are kept at a constant temperature during the transfer process

PSG-Blackmer

Industry: Chocolate

Product: Sliding vane pump

Value Proposition: Superior for early-stage Cocoa bean processing

1208

The main challenge in the production of chocolate – which begins during a process where cocoa beans are refined into a “chocolate liquor” – is handling a liquid that can be highly viscous, from 50,000 to 75,000 SSU (10,994.73 to 16,494.73 cP), and somewhat abrasive, while also being extremely shear sensitive. Too much shear can lead to the separation of the oils and butter in the chocolate liquor, resulting in a substandard product. Additionally, so that the chocolate is kept in the proper liquid state, it must be heated to and maintained at a temperature between 150°F (65.6°C) and 200°F (93.3°C) during production.

Sliding Vane Pumps

The Blackmer solution for chocolate handling, especially during early-stage cocoa bean processing, is the positive displacement (PD) NP Series Sliding Vane Pumps, which is part of its Iron Line.

Blackmer arguments for sliding vane pumps vs alternatives

- Lobe Pumps are typically mechanically sealed and even when utilizing two mechanical seals, they will eventually fail – usually quite quickly – so they will need to be replaced frequently.
- Air-Operated Double-Diaphragm (AODD) Pumps The pump's diaphragms have temperature limitations that can limit their operational window and service life.
- Gear Pumps Are not self-adjusting, so they will not maintain volumetric consistency when pumping fluids with higher viscosities.