New Sugarcane Mill Drive Concept

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Over the last century the sugarcane mill drives are constantly reducing their size while increasing the torque capacity. From the first generation: through hardened open gears, the second generation: carburized helical gearboxes and the third generation: compact split torque gearboxes, today the fourth generation: planetary gearboxes are achieving very high torque density per unit weight which is advantageously putting planetary gearboxes on the top of cost effective solutions. If there are evident price advantages using compact planetary gearboxes less evident is how their smaller rotating parts, compared with the previous bull gear large mass-moment of inertia, can cope with dynamic behavior of the milling process which is characterized by torque variations induced by continuous short accelerations and decelerations of mill rollers. The present paper describes the innovative sugarcane mill planetary gearbox concept designed to absorb torque variations coming from the milling process, can dump sudden shocks caused by tramp metal and finally can measure torque directly at output. The on-site measurements revealed the expected torque variation behavior of the mill. The gearbox operating results, based on safety factor >2 (AGMA 2001 or ISO6336) and bearing selected for L10h>100,000h (ISO281), are more than comfortable. The concept is validated in more than 50 installations and now the next research step will be to understand how much this type of planetary gearboxes can be upgraded for further torque density factor (Nm/kg) increase - without jeopardizing the gearbox safety.

Preliminary Study on Sodium Permanganate as a Biocontrol Agent and a Processing Aid for Louisiana Factories

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Microbial contamination of sugarcane causes an estimated 93% of sucrose losses and is the origin of most sugarcane deterioration (Eggleston 2002). The compounds currently used by the mills for sugarcane juice disinfection are either ineffective under mill processing time constraints, or toxic to people and the environment, or both. Sodium permanganate is a nontoxic eco-friendly oxidizing agent that has been historically used safely to disinfect drinking water. Permanganate’s antimicrobial and coagulation activity make it an effective benign compound for use in sugarcane juice as a disinfectant, it targets Leuconostoc sp. bacteria and yeast which both
form exopolysaccharides that negatively impact sugar quality and factory processing. During the 2016 and 2017 harvesting season two sugarcane factories were asked to apply sodium permanganate to sugarcane juice or its byproducts in the following locations; last tandem mill, cuch – cuch, cane storage yard and clarification tank. Brix, turbidity, pH, ATP (adenosine triphosphate) and CFU (colony forming units) were evaluated in crusher juice, mixed juice, flash heated lime juice, clarified juice, clarification mud, bagacillo, and juice from eight inch cane billets. Results of both lab evaluation and onsite mill tests indicated a reduction in microbial growth, and sample turbidity with a slight increase in pH. Further investigation is needed to assess the long term impact of permanganate on clarification and turbidity. The impact of temperature on cane billet degradation and sugarcane juice disinfection also needs further evaluation.

**Results of Implemented Rotary Screens in US Factories**

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In a US mill that grinds around x tons of cane per harvest (Per campaign or per crop) and that normally used 1 mm cush cushion strainers with a continuous dredge opening, with an inefficient result, a rotary sieve balance of 0.5 mm mesh opening was installed. The first year the sieve was used in series with the cush cushion and an improvement of X% was achieved in the reduction of the insoluble solids of the diluted juice. As a consequence of this reduction of solids, a lower amount of non-sugars generated in the filtered juice and a lower amount of mud, the amount of final molasses could be minimized. During the wet season of the harvest using the new sieve, the quality of the VHP was easily maintained and afterwards the return on investment was calculated.

**Size Dependent Quality of Louisiana Bagasse**

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In Louisiana, bagasse is the renewable, green fuel which powers the raw sugar factory. In recent years it has become common to experience excess bagasse at the end of the season, with significant disposal cost and challenges. Due to the short processing season and low energy prices in the US the world-wide common use of excess bagasse for thermal conversion to electricity is currently limited in Louisiana. Alternative uses such as chemical conversion typically require a high-quality bagasse, i.e. consistent low ash level and low moisture. During the 2017 season, stored and fresh bagasse was collected from every mill in Louisiana. These samples were screened and analyzed for the moisture and ash content of the individual size fraction. The results indicate that the ash level is inversely proportional to the particle size, i.e. the highest ash level is found with the smallest particles. As such, a significant improvement in bagasse quality can be achieved by screening out the fines. This improved bagasse quality could enable alternative uses and allow a better management of excess bagasse.
Effect of Feed Source and Pyrolysis Conditions on Sugarcane Bagasse Biochar

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Processing of sugarcane in sugar mills yields approximately 30% bagasse, a fibrous waste material composed mostly of crushed cane stalks. While 80-90% of the bagasse used on site as fuel, the remaining portion can be converted into a value-added product. One such option is thermal conversion of bagasse into biochar, a solid, stable, carbon-rich product. Fresh and field-aged sugarcane bagasse and detrasher output material were used in a slow-pyrolysis system to produce biochar. The effect of feed source material and pyrolysis conditions (peak-temperature [350 – 800 °C], steam activation [at 800 °C]) on biochar properties and efficiency as sorbent for heavy metals were determined. Biochar properties were feedstock and pyrolysis conditions dependent. Biochar of fresh bagasse had the highest fixed carbon and surface area, while detrasher and field-aged bagasse biochars had the highest ash content. While the field aged biochars showed the highest affinity and capacity for metal sorption, the biochars showed limited ability to remove copper, cadmium, and lead from water. Detrasher output material and resulting biochars had the highest nitrogen content compared to the other feed sources and biochars. Ash content seemed to play a decisive role in metal sorption capacity of sugarcane bagasse biochars. Overall, old sugarcane bagasse feedstock demonstrated best performance in producing biochars of higher metal sorption capacity compared to fresh cane-trash or fresh bagasse.

Reasons for Using Platular® Exchangers in Cane Sugar Mills

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Reducing energy consumption in cane sugar mills is now essential in light of the global energy situation and the ongoing need to reduce operating costs in the face of volatile sugar prices. The recovery of the energy available in condensates, low-pressure vapor and flash vapor is possible thanks to Platular® welded plate heat exchangers, invented by Barriquand, which optimize consumption and reduce maintenance costs. These Platular® exchangers can be utilized in the same manner for new processes involving cane sugar (bioethanol produced from hydrolyzed cane, green chemistry, etc).
Performance Optimization of Mud Processing through Floculant Selection and Application

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US Sugar’s Clewiston Mill processes approximately 36,000 tons of cane per day on average. For maximum sugar recovery, the mud that is produced from the juice clarification process is further processed via a combination of traditional rotary vacuum mud filters and non-traditional high speed decanters. The high rotating speeds of the decanters presented performance challenges for traditional anionic flocculants. A program was developed via extensive bench and plant trial evaluations of unique ultra high molecular weight anionic flocculants. Objectives were to evaluate charge density, molecular weight, shear resistance and process application point’s modifications to obtain the needed performance. The combination of extensive knowledge of flocculent chemistry and field experience with high speed centrifuge dewatering applications in other industries were used in optimizing throughput and sugar recovery.

Proper Sizing and Selection of Valves as a Means to Increase Plant Reliability

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Reliability of a plant process is determined by the control of the variables within the process. With valves often being the final control element, proper valve performance is critical to the reliability of the process. Valve performance is determined by design, function, application and operation. Poorly performing valves have been identified as a leading culprit for driving plant operating costs higher and plant profitability lower. This presentation will include a case study involving a valve problem at US Sugar, followed by a detailed review of the design, sizing and selection of the proposed solution.

KemTalo Scale 207 as Antiscalant for Sugarcane Juice Evaporation System

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Raw sugar juice is a complex mixture of organic and inorganic compounds. A number of processes such as liming, sulphitation/bleaching, phosphatation, and carbonation may be used to remove non-sugar and colored impurities during clarification and sedimentation processes. After these steps, the juice is then heated and concentrated - in multiple effect evaporator (MEE) systems -increasing the sucrose concentration as measured from 15% to 65% on the Brix scale.
During the evaporation process, sucrose becomes supersaturated in solution. At the same time, sparingly soluble calcium salts such as: organic fatty acids (e.g. calcium oleate), silicate (Ca$_2$SiO$_3$), and hydroxyapatite (Ca$_5$(PO$_4$)$_3$(OH)) reach and exceed their solubility limits. It is not surprising therefore, that one of the major problems cited by the industry literature, is the occurrence of strong/resilient scale deposits in MEE in white sugar and VHP sugar production. Scale deposition and fouling is generally defined as the accumulation of unwanted materials on the surfaces of process equipment, that seriously degrade the capacity of the surface to transfer heat at the designed rate. Fouling of heat transfer surfaces is one of the most important problems in heat transfer equipment. Almost all sugar plants experience scaling of pre-heaters, distillers and evaporators, but the extent of scaling varies from plant to plant. The deposits formed depend on a combination of factors related to the chemical composition of the feedstock, and the mill process applied. Thus complex interactions develop between organic and inorganic ions, leading to insoluble salt formation. Scale facilitates the corrosion of surfaces, restricts fluid flow and, because it has low thermal conductivity, its accumulation on metal surfaces hinders heat transfer across the tube walls. Consequently, sucrose losses develop due to the extra time need to achieve the same targeted brix. The management and control of scale deposition thru chemical washing and/or mechanical treatment has become a widespread practice among the major sugar producers. The application of antiscalant chemicals as process additives is an alternative approach that prevents scale deposits. Last year, Kemira participated in a successful mill trial at a Viralcool site with the antiscalant KemTalo Scale 207. The application of antiscalant avoided scale formation in the 1st and 2nd and even the 5th effect of the multiple evaporator system using a fixed dosage of 30 g/m$^3$ during 7 days of operation. This industrial trial demonstrated that KemTalo Scale 207, applied before each multiple evaporator system at the Viralcool site, postponed at least one shut down for chemical washing and mechanical cleaning during 7 days of operation. Therefore, less OPEX (related to labor and chemical cleaning products) is expected in addition to increased evaporative capacity offering a potential gain of throughput. It is likely that the decreased scaling problems will result in less corrosion due to reduced chemical cleaning requirements and the elimination of corrosive under-deposit environments. Additionally, improved thermal performance in the evaporators should lower steam consumption, and sucrose loses. The benefits mentioned above are the main advantages of preventing scale formation with antiscalant products, such as KemTalo Scale 207.

A New Approach to Control Spray Water Addition and Spinning Time in Batch Centrifuges

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The sugar quality delivered by batch centrifuges depends a lot on the massecuite quality and the operation of the centrifuges. The massecuite quality is mainly influenced by the crystallisation. The amount of sugar crystals, the crystal size and crystal size distribution contribute to the purgeability of the massecuite. The operation of the discontinuous centrifugal has to be adapted to the massecuite quality in order to receive sugar of good and stable quality. One key issue in the process of centrifugation is the addition of spray water. It is not only important how much water is added but also the number of sprays and the proper timing of the
sprays have a major influence on the sugar quality. Usually each spraying interval is defined by timers that will give the start point and the end point of the spraying interval. Neltec has developed a method that allows monitoring of the syrup purging. The signal of the syrup purging from the centrifugal can be used to control each spraying interval at the technical correct time instead of using fixed timers. Another important set point on batch centrifuges is the correct time to stop the spinning. If the spinning is stopped too early the final moisture of the sugar crystals will be too high. If the spinning is stopped too late the sugar will be too dry and it may be difficult to fully discharge. The new Neltec ColourQ 1700 BC will allow the factory to stop spinning at the right time to obtain a more uniform sugar moisture. The presentation of the results collected in different sugar factories shows how the Neltec control system for batch centrifuges can help the factories to optimize the centrifugation process by avoiding pre set timers for water addition and spinning control.

Evaluation of a Neltec ColourQ 1700 CC Colorimeter in Continuous Centrifugals at U.S. Sugar

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The Neltec ColourQ 1700 CC colorimeter is a device which can be installed on a continuous centrifugal and give a real time color reading of the sugar product as it is made. This device was installed on a B and a C centrifugal at the U.S. Sugar factory during the 2017-2018 crop. A series of tests were performed to determine under which conditions the results from the device were reproducible and if it could help finding an optimum operating point, given by sugar and molasses purity, and maintaining it during operation. Samples of sugar and molasses were taken at different conditions of load and conditioning water. Sugar was analyzed in the lab for Brix, pol and color while molasses were analyzed for Brix and pol. Color measured in the lab was compared against the color given by the ColourQ device. Purities of sugar and molasses were used to look for a target operating point. This paper presents some results and experiences during such tests.

Pilot Plant Studies on the Removal of Residual Amylase and Other Impurities by Powdered Activated Carbons in a Sugar Refinery Stream

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Pilot plant studies were carried out to scale up laboratory results reporting on the ability of powder activated carbon (PAC) in removing multiple impurities from sugar refinery streams. Prior studies identified a set of ideal laboratory conditions and treatment conditions to remove colorant compounds, soluble starch, insoluble starch as well as residual amylase. The pilot plant
includes a pre-coat tank, a filter unit with a filter bag insert, an insulated feed tank and an insulated product tank, all having stirrers. Flow is controlled by a centrifugal pump sized to deliver approximately 10 L.min⁻¹. Feed tank handles up to 350 liters of liquor and temperature is maintained via steam supply through indirect heat exchanging coils. Pressure across filtration system, flow rate and temperature are monitored over time for overall performance. Sugarcane liquor was collected from a local sugar refinery and transported to be processed at the pilot plant. Prior to testing, liquor was spiked with known amounts of amylase similar to what is typically found in industry. Liquor was then treated with PAC at various dosages (ranging from 250 to 1,000 ppm on Brix basis), processing temperature (75°C, 80°C) and amylase concentration (0.5 and 1 ppm). Its ability to remove various impurities was monitored over residence time in order to determine best performance conditions and confirm prior laboratory results.

Development of Factory Performance Curves Using Sugars™ for Windows

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Sugar mills and refineries involve a series of complex, interconnected processes. Feed material properties and process parameters in one part of the factory have cascading effects throughout the rest of the facility. It is necessary to gain a full understanding of these relationships between process inputs and process outputs in order to optimize the process as a whole and maximize profitability. This can be a very difficult and time-consuming task, especially considering the non-linearity of many process relationships. A novel approach to this task has been developed using the Sugars™ for Windows mass and energy balance simulation software. “Performance Curves” can be generated by running a series of balances on an established factory model, varying one input parameter over a range of possible values. Two examples are presented: varying cane sugar content, and varying cane diffuser draft. Comparisons are made between responses of parameters such as overall extraction, steam demand, molasses purity, etc. The applications of this technique to production planning, financial forecasting, and capital improvement planning are also discussed.

Sealing Viscous Fluids in Rotating Equipment

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Fluid Sealing Technologies have improved during the last decade. Production facilities can now use methods that are easy to implement, require very little to maintain, and do not leak product externally for many years. These options are extremely reliable and do not dilute product as it moves through the processes. Many solutions combine different technologies such as mechanical seals, square packing, and engineered polymers. These solutions can be engineered for general service, or food service approved products when required in the processes. Product loss and elimination of product contamination can now be achieved in all parts of the facility. This presentation will review specific examples that can be implemented in Sugar Mills.
Water Treatment in Sugar Mills

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This presentation reviews the fundamentals of water treatment specific to Cane Sugar Mills. Sugar Mills have many unique water treatment requirements and applications that necessitates specific technological solutions and engineering skill sets. Unlike typical heavy industry sites, Sugar Mills combine many different systems requiring water treatment. These systems can include boilers, process steam generation, potable water plants, open cooling, closed loop cooling, evaporators, sugar clarification, milling, dust control and mud ponds. To further complicate the treatment requirements, many Sugar Mills require that chemical additives meet FDA, Kosher and Non-GMO standards. Due to the multitude and complexity of the systems found at a Sugar Mill, some applications can be left untreated while the site accepts the consequences of reduced asset protection, inefficiency and increased maintenance, leading to elevated costs. The presentation will cover the core water treatment applications in a sugar plant with a focus on water treatment principals that govern the treatment philosophies. This presentation is designed to review the basics of water treatment as it relates to Cane Sugar Mills as they strive to optimize operations and maintenance.

Air Seals as a Sealing Option for Sugar Refineries

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There are a number of sealing options for the equipment in a sugar refinery. The air seal can handle many of the parameters, such as shaft movement / misalignment and sticky or abrasive products that cause packing or traditional mechanicals seals to fail. They require no routine maintenance and will not damage the equipment they are installed on. Although not suited to every piece of equipment, air seals should be considered where appropriate.

The Clewiston Sugar Mill – 10 Years after Breakthrough

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In November 2004, the United States Sugar Corporation (USSC) embarked on a project (“Breakthrough”) to consolidate its milling operations at the Clewiston Sugar Mill where its refining operations are located. The project involved expanding and modernizing the Clewiston Sugar Mill (whilst it was in operation) over a three year period. Groundbreaking took place on April 14th 2005 and construction was executed in three phases with the commissioning of the associated equipment in each phase as it was completed. The expanded and modernized
Clewiston Sugar Mill commenced milling operation in October 2007. All of the sugar cane for the 2007-08 crop was processed at the Clewiston Sugar Mill with the Bryant Sugar Mill ceasing operations at the end of the previous crop. This presentation reviews the performance of the Clewiston Sugar Mill since October 2007 as compared to the goals of that project from a factory operations perspective.

Selecting the Correct Motor for Your Application

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The presentation reviews the information needed to accomplish a proper motor and driven equipment installation. These include the key mechanical considerations for both Horizontal and Vertical Motors including bearing types for radial, axial and thrusting loads as well as the associated lubrication requirements for application types and operating speeds. The electrical design parameters applicable to NEMA standards including speed/torque performance curves operating across the line and with VFD operation will be reviewed along with system specifications operating motors on VFD’s to include Thermal, Non-Sinusoidal Wave Forms, Service Factor and Bearing System Protection.

Payback of Process Control Investment

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Pay back of new investments are often just valued by the amount of savings in regards of energy, sugar losses, labour costs etc. But these calculations often only give a small part of the real pay back of the process control. In the structure of a sugar factory you can find many areas where a simple addition in process control can lead to a more stabilized process that will increase the efficiency of the operators, the process and the overall performance of a sugar factory. This efficiency contributes significantly to the pay back of an investment although it cannot be calculated in numbers. During the last 30 years Neltec has supported sugar factories world wide not only by selling and commissioning of inline colour measurement for sugar crystals, but also by helping the sugar factories to use the equipment in the correct way to achieve a more efficient process. Based on this experience this paper will try to show that pay back of investment is much more than only comparing money that has been spent with money that has been saved.
Seven Years of Molasses Survey Data in Louisiana: What It Has Told Us

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The loss of sugar in molasses is generally the largest loss suffered by a sugarcane factory. It is important that reliable data on molasses exhaustion be obtained. The Audubon Sugar Institute (ASI) performs the analyses of molasses samples for the factories in Louisiana Sugar Industry. A composite weekly final molasses sample is sent to the Audubon Sugar Institute for analysis. From the results, the molasses survey report is generated by the analytical laboratory and distributed to the Louisiana sugar factories during the grinding season. This poster is an overview of the key components of the molasses survey from 2010-2016.

Positive Aspects of Cane Sugar and Sugarcane Derived Products in Food and Nutrition

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Recently, like previously for fat and protein, there has been negative discussion about carbohydrate, including blaming it for the rise of obesity and related metabolic conditions, even though overconsumption and sedentary lifestyles are more definitive contributors. In many parts of the world, natural sugar (sucrose) from sugarcane is the main dietary source of carbohydrate. Considerable misinformation about sugar is in the public domain with the average consumer being unaware of (i) the critical need of body cells for sugar to function, (ii) the multitude of functionalities other than sweetening that sugar imparts, and (iii) micronutrients delivered with many sugar products. Micronutrients such as antioxidant phenolics from other sugarcane products are also discussed.

Descaling Evaporators with a Reusable Chelating Agent

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AkzoNobel has developed a novel chelating agent called Dissolvine® SR that readily descales Ca sulfate, oxalate and carbonates scales – that is readily regenerated for reuse by simple pH adjustment with minimal equipment. A plant trial at U.S. Sugar showed SR to be effective at descaling the 5th effect, and subsequent laboratory testing using the spent SR solution indicated that this chelate can be used at least 3 times (possibly more). This would potentially allow 1 lb of SR chelate to dissolve at least half its weight of Ca scale at virtually pennies per regeneration cycle. Besides a significant cost benefit in being able to recover and reuse SR, the amount of
waste generated vs. EDTA is significantly reduced. An overview of this developing technology will be presented. (Dissolvine® is a registered trademark of AkzoNobel)