The Use of Decanters for processing Juice Clarifier Muds at US Sugar

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In 2004, U.S. Sugar began a three-year project to expand and modernize its operations at the Clewiston Mill. This project, termed “Breakthrough”, was intended to facilitate the consolidation of its cane sugar milling operations at Clewiston allowing the closure of the Bryant Mill.

U.S. Sugar initially investigated the use of Decanters in place of Rotary Vacuum Filters to process all of the clarifier underflow in the new Clewiston Mill. Decanters were attractive since they lend themselves to automation and do not require the addition of bagacillo for mud conditioning. US Sugar’s Refinery operates year round and enough bagasse has to be accumulated during the crop to support summer operations.

Two Decanters were acquired and installed at the Bryant Mill for testing and evaluation. After the evaluation was completed, it was decided to use a combination of the traditional Rotary Vacuum Filters along with Decanters in the new Clewiston Mill. After optimizing the operations of the two Decanters, a third was added and these units are now an integral part of the Clewiston Mill’s mud processing installation. This presentation tells of this journey and what has been learnt along the way.

Effect of Purity Changes and C Massecuite Crystal Size on Molasses Exhaustion and Centrifugal Performance

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Molasses exhaustion is one of the most important steps for sugar recovery. The complete assessment of the performance of the boiling house requires the careful monitoring of purity drops, crystal content, retention time in crystallizers and crystal size, especially in the C-Strike including pans, crystallizers, rehetaters and centrifugals. The information given by these measurements can be used by engineers in seeking better exhaustion.

Purity and crystal size of massecuites and molasses along the C-strike (pan, crystallizers and reheatert), and crystal size of C sugar from the centrifugal machines were measured for the Louisiana sugar factories during the 2015 grinding season. The effect of these indexes on the purity of final molasses and crystal losses in the centrifugals was evaluated. Results indicate that reducing purity drop in pan or crystallizers by 1 point, may reduce the final molasses purity by 0.47-0.49 points. Increasing the crystal size of C massecuites by 10 microns, may reduce the purity rise across centrifugals by 0.1 points, while increasing the crystal content of C massecuites by 1% may reduce the final molasses purity by 0.58 points. While these results are a good indication of the expected effects of crystal size and purity drops on the final molasses purity, individual factories may have particular impacts. Measurements for each individual factory are necessary to
determine specific values and to determine the optimal crystal size that minimizes losses to molasses.

The Role of Mill Sanitation in Sugarcane Processing

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Sugarcane sugar deterioration begins post-harvest causing significant problems for the sugar processor. The majority of sugar destruction in sugarcane occurs shortly after harvest during storage in truck loads and in mill yards. During sugarcane processing favorable conditions in temperature, juice pH, water activity, sugar and nutrient content promote microbial growth, resulting in sugar loss. Raw sugarcane factories apply biocides to last expressed juice, and during mill sanitation to reduce sucrose loss caused by microbial contamination. This study will look at several factors in sugar mills that effect the microbial growth and contamination. Biocide efficacy, conditions of use, chemical detection methods and sanitation practices will also be discussed. More research is needed in the area to determine if biocide application is practical and effective for use sugarcane mills.

Increasing Productivity with the Use of a Pressurized Rotating Sieve as a Second Stage Filter for Diluted Juice

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In a Brazilian Mill, whose milling output in the harvest of 2013 was or 3,250,000.00 metric tons of cane, equipped with a 0.50 mm mesh size rotary sieve, decided to install a secondary rotary pressure sieve with a 0.15 mm mesh (100 mesh) opening for the 2014 harvest. This secondary sieve was to work as a second stage screening of diluted juice. This paper presents comparative results of the screened juice through a 0.50 mm mesh with the use of an additional filter in series done for the 2013 harvest, with the results obtained in the 2014 harvest using a pressurized rotating sieve as a second stage filter with a 0.15 mm screen. Relative parameters of the 2014 harvest to the 2013 basic harvest were applied, with special emphasis on the insoluble solids separation percentage, mud reduction percentage and recoverable sugar losses via mud reduction yield. It was established that the percentage of separation of insoluble solids with double screening is around 92%, this value being a constant throughout the whole harvest season.

The investment return for a sieve capable of handling the juice generated by 13,000 MT/Day to 1 Million MT/Day of sugarcane and the return produced by that application in a typical USA Sugar Mill are analyzed in this paper.
Purification of Energy Cane Syrup

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Energy cane is a high-fiber sugar cane bred and grown for its high biomass yield. Due to its robustness it can be grown in a wider area than regular sugar cane and might aide in extending processing seasons or be the basis for dedicated energy production. To be suitable for thermal or lignocellulosic conversion it is processed like sugar cane with bagasse being the main product. A byproduct from milling; the syrups obtained from energy cane have a very high ash content (> 7%) and are not suitable for high-value fermentations or thermochemical conversion. In order to compete with the de-facto gold standard of high-value fermentation feed stocks, corn-based dextrose, the ash level needs to be reduced to below 0.05% and the fermentable sugar content raised to greater than 99%. This paper presents a three-step purification process based on membrane and ion exchange technologies, which successfully reduced the ash level to below 0.05 %/Bx.

Production of Multiple Agricultural Feedstocks for Processing into Biofuels and Bio-Based Chemicals

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This project consists of an array of experts in crop production, protection and processing to develop complete guidelines for cultivation and harvest of energycane and sweet sorghum, the biomass crops targeted for the Southern United States. A third source of biomass that compliments these crops is the surplus bagasse produced by the 11 raw sugar factories operating in Louisiana. Economists and other logisticians have identified optimal locations in the southern United States for bio-refineries, based on the availability of marginal lands. Life cycle analyses, C sequestration efforts, and wildlife ecological efforts are defining the environmental impact of production of these crops compared to more traditional crops. Research in-house and at facilities of private sector partners have identified a group of high-value products that can serve as suitable feedstocks for selected polymers, bulk chemical and high-value liquid sectors. Researchers have produced, clarified and de-ashed syrups derived from energycane and sweet sorghum to meet standard industry specifications for the production of biofuels and bio-based chemicals. Research has led to the development of processes to produce and concentrate butanol and isopropanol through fermentation of biomass feedstocks. Two private ventures, NFR Bioenergy and Virdia Inc, a subsidiary of Stora Enso of Helsinki, Finland, have started construction of plants in Louisiana at two sugarcane factories, Cora Texas Manufacturing Company and Raceland Raw Sugar to produce fuel pellets and cellulosic sugars, conventional sugars and starch for the production of gasoline, jet fuel, diesel and bio-based chemicals, respectively, from surplus bagasse at these two factories. The companies indicated that, if successful, negotiations with the remaining nine factories could be initiated to install additional facilities.
Automatic Backwash Filter for Thick Juice Filtration

Stefan Schöpf and Stefan Strasser

Conventionally, there have been two systems for the filtration of thick juice in the sugar production process, namely candle type precoat filters and suction nozzle backwash filters. In one known case, even disposable filter bags are used for thick juice filtration. This paper shows an efficient alternative to the conventional systems with regards to a process and cost efficiency perspective.

The Lenzing OptiFil® allows for continuous, automatic filtration with very fine filter material at lowest losses due to the patented backwash device. Furthermore, it is a space-saving system of low complexity, requiring only one automatic valve per filter. Compared to the above mentioned filtration systems, the solution explained in this paper does not need any filter aid which results in low operating costs. By using the 10μm stainless steel weave, filtrate is clear from the first second of filtration. The backwash losses are significantly below 1% of the feed flow with 2.5 litres every 5 minutes per unit.

In order to make an objective comparison, the filtration technologies where rated by 9 selective parameters, which are not only about CAPEX, but also based on important OPEX factors. The values for the Lenzing OptiFil® have been collected in two years of intensive pilot testing, whilst the values for the competing technologies have been compiled by experiences of operators.

In terms of filtrate quality, the study has shown that the labour-intensive bag filter system also shows poor particle separation and therefore ended up with the lowest value for this parameter.

The comparison resulted in a clear ranking for the various methods: the Lenzing OptiFil® ranked first with a total of 22 points compared to 18, 13, and 9 points for suction nozzle, bag, and candle or plate filter.

The Importance of Correct Pump Selection and Sizing in Sugar Mills

Yuri Tarafa

It is very important to select the correct pump for the various applications that are found in sugar mills – maceration, juice (mixed, limed, clear), syrups, massecuites, magma, injection water, etc. The use of incorrect pump types often lead to poor performance and other operational problems. It is also critical to correctly size pumps so that they do not run off the curve.

This paper will point out the guidelines for selecting the appropriate type of pump for each application as well discuss the effects of running pumps off the curve.
The First Use of a HPLC System at a Louisiana Sugarcane Factory: What it Can Do For You

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Alma Plantation sugarcane factory established and operated the first High Performance Liquid Chromatography (HPLC) system in Louisiana in 2015. Although many HPLC systems exist, the factory opted for a ThermoFisher™ ion chromatography (anion exchange) system with integrated pulsed amperometric detection. With the help of USDA-ARS and LSU scientists, a method was established to measure mannitol, glucose, fructose, and sucrose in 10 min. For the best accuracy, separate and higher dilutions are needed to quantitate sucrose due to its relatively high amount in sugar products (except molasses). Training was essential for operations and analyses. No technique is worth anything if the results cannot be interpreted properly, thus, training was also critical in basic sugar chemistry, *Leuconostoc* sugarcane deterioration reactions, and color formation in the factory. A simplified chart was provided to the factory staff to help interpret the results. The HPLC system allowed the factory to: (i) monitor sucrose losses in “real time”, (ii) rapidly identify dextran via mannitol, (iii) rapidly monitor molasses exhaustion and enzyme applications, and (iv) explain difficult samples more easily. The pros and cons of using a HPLC system at a sugarcane factory are described.

Optimisation of Massecuite Production through the Utilisation of On-Line HD Video Pan Cameras

Catherine Bouché

Ensuring a factory can produce good massecuite quality is a key focus for any sugar factory operation. Managing the crystallization to produce homogeneous crystals while limiting the number of fines or the creation of false grains whoever the operator in charge is always challenging.

The paper describes the implementation of an ITECA high resolution camera on a batch pan. It shows how an accurate characterization of the pan operation helps establishing the best possible sequences to increase the overall pan floor extraction, whilst still guaranteeing the final massecuite quality remains stable. This is achieved by analyzing on-line or a posteriori the HD videos displaying crystal growth and by comparing different strikes between them at different stages of the process:

- Before seeding, the camera automatically detects any non-conformity that may appear in the syrup, such as super coarse crystals, contaminants or air bubbles that will limit the production of high quality crystals
- At the seeding stage, the software counts and measures the crystals sizes from 4 µm, to make sure the good volume and crystal size have entered the pan as requested
• During the graining phase, the crystal growth is monitored in real-time and valuable statistical information are calculated (CV, MA, number of fines) to check normal crystal crop and trigger alarms on non-conformity.

The measurements made by the on-line camera are compared to the results obtained by a laboratory method in a German refinery, on crystals ranged from 100 µm to 500 µm. The various benefits brought by the camera are reported. This new technology already marks a big step forward in improving the sugar pan yield. It lays the foundations for even more significant advances in the future when full automation will be achieved.

POSTER PRESENTATION

Offseason Evaporator Cleaning with EDTA
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Off-season cleaning of evaporator tubes and plates is conducted mechanically and very labor intensive. EDTA (ethylenediaminetetraacetate tetra sodium salt) can support the cleaning effort as its mode of action is less temperature dependent than traditional agents such as caustic or hydrochloric acids. EDTA is a promising chelating agent, which provides a complimentary dissolving action to caustic and acidic scale removal. In order to utilize EDTA successfully a suitable method to monitor the chelating strength was developed. Laboratory test showed good scale dissolution and a full scale test was conducted during the offseason at the Westfield and Lula sugar factories in Louisiana.

Production of Sugarcane Starch and Particulate Matter Reference Material
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Sugarcane starch is a natural impurity found in sugarcane, which has substantial negative impacts on viscosity, heat transfer and crystallization in the factory and the refinery. There is quite a gap of knowledge in the behavior of starch during the raw sugar and refining process and this gap has prompted active research during the last few years. Corn and potato starch have been commonly used to simulate sugarcane starch for laboratory testing and amylase activity evaluation. While this practice leads to usable results, an uncertainty about the adequacy of the sugarcane starch substitute still remains. Tests on actual sugarcane streams from a factory are the best approach for relevant results. Nonetheless, a common reference material for testing is desirable especially as fresh material from the factories is only available during a limited time of the year. We report on the technique and production of said reference material. Two types of reference
material were generated: pure sugarcane starch, which allows fundamental research and particulate matter samples from clarified juice for each mill in Louisiana; which can serve as realistic reference sample for enzyme and starch separation evaluations.

Bagacillo in Sugar Processing

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In the raw sugar factory insoluble material is inadvertently separated along with the raw sugar in the centrifugals. The insoluble particles can be fine bagasse fibers, metallic particles, or scale. This insoluble material consists of carryover from the clarification process, extraneous matter from evaporators, vacuum pans, piping, and holding tanks in the process. The insoluble matter can plug the screens in the centrifugals and reduce sugar filterability. Bagacillo levels were assessed in raw sugar samples directly from the factory as well as ware houses in Louisiana. Typical bagacillo levels ranged from 16 to 116 ppm/°Bx in raw sugar. Filters and screens can reduce bagacillo levels; however, low levels of bagacillo are achievable without these measures.

Mechanism of Removal of Undesirable Residual Amylase, Insoluble Starch, and Select Colorants from Refinery Streams by Powdered Activated Carbons

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There is a need in the world-wide sugar industry to find a practical and economical solution to remove or inactivate residual α-amylases that are high temperature stable from factory or refinery streams. A survey of refineries that used amylase and had activated carbon systems for decolorization, revealed they did not have any customer complaints for residual amylase. Five commercial, high performance powdered activated carbons (PAC) were investigated for their ability to remove residual amylase as well as other impurities. Removal of the residual amylase protein by PAC was dependent on its surface area as well as mixing (retention) time. A select, high performance PAC (RFM-JHT™) with high surface area (1764 m2/g) performed the best and, because this PAC also had the largest particle size characteristics (mean particle size ~274 μm), it was also the easiest to filter after use. Activated carbon also had the additional benefit of removing color, and RFM-JHT™ preferentially removed cane derived flavonoid and phenolic colorants at pH 9 over process formed color at pH 4, which is opposite of color removal by the refinery phosphatation-clarification process and thus complementary. The dose of RFM-JHT™ was more critical than retention time with respect to color removal. RFM-JHT™ also consistently removed undesirable insoluble starch from raw sugar syrups and refinery liquors. A tentative mechanism for the removal of impurities is provided.
Further studies are now warranted to investigate the use of high performance PAC as a tool to remove residual amylase, select colorants, and insoluble starch at the large-scale.

**Evaluation of Changes in C Massecuite Crystal Size after Sampling**

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It is very important to monitor the crystallization process in the C massecuite in order to achieve maximum exhaustion and minimize sugar and energy losses at the sugar factory. Monitoring the crystal size distribution could become a very important tool in the evaluation of the massecuite crystallization.

Massecuite temperature at the point of sampling is 60-70°C (140-160 °F). Temperature falls and viscosity increases after sampling. At room temperature massecuite caramelizes and becomes hard, which makes crystal size analysis challenging if not impossible.

Because of the high importance of C massecuite crystal size data for the sugar factories, the main purpose this study was to evaluate changes in the massecuite crystal size after sampling. Different types of containers and temperature for transportation were considered. This preliminary study allowed us to make some recommendations about massecuite sample transportation and possibility – or rather impossibility - of long sample storage for crystal size analysis. Maximum time allowed before analysis would be 2 hours at the temperatures tested. Additional experiments including massecuite of different properties and a wider temperature range for storage are necessary to give final recommendations.

**Effect of Trash Separation on Sweet Sorghum Sugar Yield**

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High biomass sweet sorghum is an energy crop that can be used for production of syrup, biofuels and other value-added products. Processing in a sugar cane mill is challenged by the high content of leafy matter and the excessive starch content (>1%) due to the grain holding panicles. Both challenges can be addressed by adjusted mill settings and application of amylase; however, it seems sensible to separate the high-value starch as byproduct and reduce the trash level prior to milling. The separation of seed heads and leaves from stalks could therefore increase sugar yield and facilitate utilization of sweet sorghum. This paper presents some efficiency results for the separation of seed heads and leaves from billets, for sorghum harvested with a sugar cane combine.