

ISSCT FACTORY ENGINEERING & PROCESSING WORKSHOPS

Processing and Engineering options towards more competitive factory operations

Book of abstracts

October 1-3, 2018. Cali, Colombia



Colombian Sugar Industry

Sugarcane industry in Colombia is located around the Cauca river Valley. The industry has 14 sugar mills, 12 power cogenerators and 6 fuel ethanol distilleries. The sugarcane cultivated area is 240.000 hectares. The cane growers (which are approximated 2750) own 75% of the cultivated land, while the sugar mills own the other 25%. Average property size is 63 hectares and 69% farms are below the average in size.

Crushed cane in 2017 was 24.200.000 tons, the production was 2.100.000 t of sugar and 365 .000 m3 of ethanol. Field productivity was 133 t/ha and crushing days/year was 322. Currently in Colombia, 66% of power generation is hydroelectric while Cogeneration represents only 0.5%. In 2017, the sugarcane mills generated 1487 GWh and 41 % of this was sold to the grid. An advantage of cogeneration from sugar cane is that it is available during dry season while in the same period the water is at a critical factor for hydroelectric power.

SECTOR AGROINDUSTRIAL DE LA CAÑA
asocaña

tecnicaña

cenicaña



International Society of Sugar Cane Technologists (ISSCT)

The ISSCT is an association of scientists, technologists, managers, institutions and companies/corporations concerned with the technical advancement of the cane sugar industry and its co-products.

The ISSCT is governed by an Executive of 10 members elected every three-years by the Council which consists of representatives of the different Affiliated Societies (24) who meet during congresses. The Executive appoints a Technical Program Committee (TPC) which is responsible for monitoring the technical activities.

PROGRAM

JOINT SESSION

ISSCT FACTORY ENGINEERING & PROCESSING WORKSHOPS

Day 1 - *October 1, 2018*

7:30 - 8:30	Registration
8:30 - 10:30	**Joint session**
	Opening Ceremony and ISSCT presentation about Congress 2019.
	Invited paper: A review of sucrose losses in sugarcane factories. **Author: G. Eggleston**
	Reduction of determined sugar losses to increase sugar production. **Authors: B. Morgenroth and H. Singh Bola**
10:30 - 10:50	Coffee Break

Day 2 - *October 2, 2018*

17:00 - 17:50	**Joint Session**
	Increased inhomogeneities in the field parameters of industrial vacuum pans - the role of steam bubbles and their nucleation. **Authors: F. Geisendörfer and E. Flöter**
	General discussion / Conclusions
18:00 - 20:00	Farewell Dinner

Day 3 - *October 3, 2018*

7:30	Buses depart from Intercontinental Hotel
8:30 - 11:45	Visit to the Mayagüez sugar cane mill
12:00 - 13:00	Lunch at Cenicaña
14:00 - 16:00	Visit to the Providencia sugar cane mill
17:00	Arrive to Intercontinental Hotel

PROGRAMS

ENGINEERING AND PROCESSING



ISSCT FACTORY ENGINEERING WORKSHOPS

Day 1 - *October 1, 2018*

10:50 - 12:00	**Process design and equipment selection for optimized steam and power concepts**
	Process design and equipment selection for optimized steam and power concepts. **Authors: B. Morgenroth and H. Singh Bola**
	An innovative approach towards crystallization: ISGEC design vertical continuous vacuum pan (VCP). **Authors: S. Awasthi, A. Goyal, D. Kumar and D. Mishra**
	Performance of welded plate heaters in mixed and clear juice in INCAUCA S.A.S. **Authors: A. C. Rodriguez, F. Perez and P. N. Lopez**
12:00 - 13:00	Lunch
13:00 - 13:30	Poster Session
13:30 - 16:30	Strategies applied to increase power generation and reduce steam consumption at some sugar cane mills from Colombia. **Authors: D. F. Cobo, V. Erazo and J. J. Ortiz**
	Configuration and operation of evaporation stations in an environment of energy integration and production of sugar and ethanol in Colombian Sugar Industry. **Authors: J. G. Rodriguez and J. D. Tascón**
	Impact of condenser performance on sugar crystallization and power requirement of a sugar factory. **Authors: B. Morgenroth and H. Singh Bola**
15:10 - 15:30	Coffee Break - Exhibition stands
15:30 - 17:00	Increasing bagasse combustion efficiency in the Colombian sugarcane industry. **Authors: A. F. Ospina, J. E. Lucuara, J. A. Calpa, A. L. Gómez, N. J. Gil**
	Energy integration sugarmill - ethanol distillery - unicelular protein plant. **Presented by: M. Toledo** **Authors: I. Perez, J. M. Valdivieso-Piloto, O. Almazán del Olmo**

Day 2 - *October 2, 2018*

8:30 - 12:00	**Optimized asset and maintenance management with examples of long season operations**
	Illovo Asset Management Programme (iAMP) – An approach towards sustainable and improved factory reliability. **Author: R. Talanda**
	Increasing throughput using Lost Opportunity Reporting. **Author: D. Gent**
	Failure prevention using RCM and RAMS tools. **Authors: J. S. Saltarén, J. D. Montes and A. Gómez**
10:00 - 10:20	Coffee Break - Exhibition stands
	Evaluation of different procedures and materials for sugar mill roll arcing to maintain and improve juice extraction performance in long crushing season. **Authors: J. S. Saltarén, J. D. Montes and A. Gómez**
	OEE as a global index to improve Factory performance. **Authors: J. Marulanda, C. Martinez, J. Correa and C. Lopez**
	Reliability improvement of a critical asset: main cane carrier. **Authors: J. D. Montes, J. S.Saltarén and A. Gómez**
	An objective approach to prioritising capital replacement. **Authors: G. Kent, H. YU, R. Wang, M. Cholette, P. Borghesani and L. Ma**
12:00 - 13:00	Lunch
13:00 - 13:30	Poster Session
13:30 - 15:30	**Designs to reduce capital cost**
	The LLT Clarifier: Design features. **Author: S. Grimaldo**
	Experiences with the use of filtering nozzles in the rolls with internal drainage type XM. **Authors: J. Sanchez and. S. Chavarro**
	Sugar cane mill drive systems - evolution and efficiency. **Author: N. Gouez**
15:30 - 15:50	Coffee Break - Exhibition stands
15:50 - 17:00	**Equipment solutions for automated control of factory processes**
	Greater reliability with vacuum tight EPDMH valves **Authors: C. Castro and M. Erol**
	Air control strategy in boilers with limited instrumentation **Authors: S.Orduz, A. Montoya, F. Carvajal and C. Marin**
	Cyclonic flow correction in a boiler chimney with a Venturi gas scrubber using CFD models **Authors: S. Orduz, C. Jimenez, F. Carvajal and C. Marin**



ISSCT FACTORY PROCESSING WORKSHOPS

Day 1 - *October 1, 2018*

10:50 - 12:00	**Sugar losses: Chemical, microbial and physical losses in harvesting, transport and processing of cane**
	The impact of operating conditions on degradation reactions in Australian sugar factory evaporators. **Authors: D. Moller and D. Rackemann**
	A new approach to control spray water addition and spinning time in batch centrifuges. **Authors: B. Ch. Nielsen and T. Diringer**
	Optimizing the performance of continuous centrifugals by online monitoring of the sugar colour. **Authors: T. Diringer and B. C. Nielsen**
12:00 - 13:00	Lunch
13:00 - 13:30	Poster Session
	Comparison of sugar losses in milling and diffusion. **Author: P. Rein**
	Minimising sucrose losses by optimised crystallisation and conditioning of C-product massecuite. **Author: A. Lehnberger**
	The process capability analysis: a technique to minimize sucrose losses by increasing process stability. **Authors: J. G. Rodriguez and J. D. Tascón**
15:10 - 15:30	Coffee Break - Exhibition stands
	Reducing the sugar losses in clarification. **Author: P. Rein**
	The LLT clarifier: factory performance. **Author: S. Grimaldo**
	Strategy implementation of limed juice flow control in a trayless rapid clarifier. **Authors: A. Montoya, S. Imbachí and S. Orduz**

Day 2 - *October 2, 2018*

8:30 - 12:00	**Sucrose and reducing sugars losses: Use of enzymes and other processing aids**
	Unlocking challenges and developing enzyme products for the sugarcane industry: Enhancing Crystalization. **Authors: E. A. Borges da Silva, J. G. Rodenbusch Destro, B. Vanelli and V. G. Medina**
	Addressing the dextran problem: applications of dextran rapid detection kit and dextranase in China cane sugar factories. **Authors: Ying Liu, Guo-wei Chang, Rong-zhen Lin, Gui-yun Liu, Bu Ma and Da-feng Liang**
	α-Amylase and glucoamylase use in sugar cane processing. **Authors: M. Saska, S. Zossi, C. Gusils and M. Ruiz**
10:00 - 10:20	Coffee Break - Exhibition stands
	Importance of reliable determinations of undetermined pol losses in factory control. **Authors: R. Broadfoot and D. Moller**
	Microwave measuring technology for sugar industry. **Author: D. Mubarak**
12:00 - 13:00	Lunch
13:00 - 13:30	Poster Session
13:30 - 15:30	**Chemical control, NIRS analyses and factory balances**
	Using near infrared spectroscopy and excel spreadsheets to improve sucrose recoveries. **Authors: S. Davis, S.Walford and S. Madho**
	The use of the conductivity method to estimate the true purity of factory process streams. **Authors: D. Moller and J. Snoad**
	Application of probabilistic analysis to identify sources of variations in undetermined losses. **Authors: S. Peredo, N. Arbelaez, C. A. Moreno and J. V. Realpe**
	Laboratory control of dextran and starch in sugar and juice. **Authors: S. Zossi, M. Sastre, N. Sorol and M. Saska**
15:30 - 15:50	Coffee Break - Exhibition stands
15:50 - 17:00	**Cane quality and its effects on processing and sugar losses**
	Physicochemical effects of microbial action and indicators of microbial sugar losses. **Authors: T. Daza, J. Sierra, C. Prieto and N. Gil**
	Sucrose content and purity drop from field to mill in commercial cane. **Authors: O. Sanchez, L. P. and D. Luzuriaga**
	Cane sugar loss between harvesting and processing **Authors: N. Gil and T. Sanchez**

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ABSTRACTS

ENGINEERING

A review of sucrose losses in sugarcane factories

G. Eggleston

Audubon Sugar Institute, LSU AgCenter, 3845 Highway 75, St. Gabriel, LA 70776, USA.

geggleston@agcenter.lsu.edu

Abstract

Sugarcane processors must consider all costs to make sound economic decisions on how to reduce expensive sucrose losses. Total sucrose losses in a sugarcane factory can be split into two components: (i) physical, and (ii) chemical losses. Physical losses occur in bagasse, filter cake or mud, molasses, and spillages. Chemical losses are often referred to as undetermined losses (UDL), i.e., sucrose that is unaccounted for after completing a mass balance across a factory. Chemical losses can be further grouped into microbial, enzymatic, and acid degradation (inversion) losses, with the latter being more applicable downstream where heat is applied. Thermal acid degradation inversion) of sucrose is affected by factory operational pHs, temperature, Brix, flow rates and retention times, concentrations of invert sugars and salts, with temperature having the greatest effect. Acid degradation of sucrose is a misnomer because it can occur up to a pH of 8.3. Most acid degradation of sucrose in a factory occurs during clarification settling and in pre- or early evaporators due to high temperatures and low Brix,and are known to vary dramatically across a processing season due to variations in cane quality. For example, in Louisiana, the greatest losses occur in early season when the highest and most varied glucose and fructose concentrations occur and when the cane is more immature and leafy trash is highest. The measurement of acid degradation sucrose losses are notoriously difficult to measure and are often measured by gas chromatography or high performance liquid chromatography using two formulas (1) an increase in glucose/Brix across processing or a (2) as a decrease in sucrose/Brix. However, when actual losses are less than <0.5%, a sucrose decrease (formula 2) often does not detect losses. On the other hand, when high sucrose losses occur, i.e., >0.5%, sucrose losses based on a glucose increase (formula 1) are often lower than those based on formula 2. This is because industrial conditions where high sucrose losses occur also cause glucose degradation. These discrepancies may explain previous differences in measuring predicted acid degradation sucrose losses via the Vukov equation (a function of juice pH, juice Brix, temperature, and residence time) with measured sucrose degradation by a glucose increase. A full review of evaluating sucrose losses across sugarcane factories will be discussed.

Reduction of determined sugar losses to increase sugar production

B. Morgenroth[1] and H. Singh Bola[2]

[1]*IPRO Industrieprojekt GmbH, Celler Straße 67, 38114 Braunschweig, Germany.*
Morgenroth@ipro-bs.de

[2]*IPRO INDIA Private Limited, SCO 236, 1st & 2nd Floor, Sec- 40 D, Chandigarh, India.*
Harjeet.Singh@ipro-india.com

Abstract

During the last decade, a lot of work has been carried out to improve the performance of sugar mills. However, the overall sugar recovery improvement is still a neglected topic in the majority of the sugar mills.

The authors have carried out various studies in the recent years and observed determined sugar losses in the range of 1.6 – 2.5 % on cane. The overall sugar recovery ranges between 78 – 86 % against the benchmark value of 88 - 90 % depending on juice purity levels. Therefore, the reduction of determined sugar losses offers a potential to increase the sugar production by 2 – 12 % which can contribute improving the factory revenues. The factors impacting the sugar recovery, process challenges and approach to reduce the determined sugar losses are described.

Process design and equipment selection for optimized steam and power concepts

B. Morgenroth and H. Singh Bola

IPRO Industrieprojekt GmbH, Celler Straße 67, 38114 Braunschweig, Germany.

Morgenroth@ipro-bs.de

Abstract

Optimization of sugar factories in order to minimise process steam requirement, maximize sugar recovery and power export along with man power optimization is a must for sugar factories to survive under difficult conditions and to earn additional revenues.

In the last decade, the authors have been involved in the design of highly efficient green field projects and various plant revamps for process optimization and implementation of new technologies especially in Brazil, India and Pakistan. The process steam demand in the revamped plants has come down to 32 – 38 % from originally more than 50% steam requirement on cane. Also, significant improvement in the power requirement of the plant has been observed as well.

In order to set up an optimized highly efficient plant or to optimize an existing plant to achieve the benchmarks, process design and right equipment selection is very important. Important aspects concerning the process design and equipment selection are described in the presentation.

Keywords

Minimization of process steam requirement, energy saving, optimized process schemes.

An innovative approach towards crystallization: ISGEC design vertical continuous vacuum pan (VCP)

S. Awasthi, A. Goyal, D. Kumar and D. Mishra

Isgec, A-4, Sector -24, Noida 201301, India.

sanjayawathi@isgec.co.in

Abstract

Following the trend of continuous vacuum pan development; the horizontal type design became most popular but it has few flaws viz. i) high no. of shells for large capacity sugar plants that occupy larger area & demands heavy structure; ii) no by-pass provision of compartments which requires a standby pan of same capacity during cleaning; iii) no graining compartment which demands separate graining batch pan; iv) reduction in output capacity due to tube fouling after a period of use and v) inconvenient for mechanical circulator installation although recent developed horizontal CVP's have top mounted mechanical circulator in thickening zone only.

All these flaws were overcome by introducing a vertically designed continuous pan (VCP); typically with a number of batch pans placed one upon another, in series. Compared to the original and very efficient BMA VKT design, the local Indian designs of VCP have some limitations (e.g. Spray Engineering design, SCP), e.g. low vapor space height leading to more entrainment chances, honeycomb calandria with low ligament which restricts not only the uniform vapor distribution but also poor maintainability, lower man space for maintenance, bottom mounted circulator; causing leakage and poor exhaustion in low grade massecuite etc. Isgec designed a vertical continuous pan named as i-VCP, which is not only free of above flaws but also more efficient in terms of power consumption, steam consumption, and ease of operation than other VCPs' designs.

Till now, two installations of Isgec designed VCP have been in operation. As compared to the horizontal design where average vapor load on massecuite is 36% the i-VCP is achieving 28%. A 25 t/h capacity horizontal design occupies 47 m2 area with average structure requirement of 70 t; whereas the i-VCP occupies only 22 m2 with average structure requirement of 40 t. The foundation cost for horizontal CVP is four times higher than for the i-VCP.

Other design VCP's (e.g. SCP) where honeycomb calandria have 12 mm ligament the i-VCP calandria is designed on 18 mm ligament which leads to excellent vapor distribution even on vapor temperature less than 90 °C.

Unlike other VCP's, the i-VCP have a partitioned shell in the top compartments. Especially for low grade massecuite which hinders short circuiting and maintains constant flow of massecuite and hence helps to keep 25-30% coefficient of variation as compared to 32-35%coefficient of variation in

other design VCP. An efficient hydrofoil impeller design mechanical circulator with VFD, installed in the un-partitioned compartment makes it possible to handle high flow rates with 30% lower power

consumption than other VCP design. A poly baffle type inbuilt catchall and higher vapour space height repels the entrainment. The operation is DCS based and fully automatic.

One 100 t/h capacity VCP was installed at Dalmia Bharat Sugar Ltd., India and has completed one crop with operating on 4th& 3rd vapor of a quintuple evaporator set. A 25 t/h capacity VCP was installed at Shree Chhatrapati Shahu SSKL, India and has also completed one crop with operating on 2nd& 3rd vapor of quintuple evaporator setwithout any stoppages.

Keywords

Energy consumption, i-VCP, horizontal CVP, coefficient of variation, calandria, automation, DCS.

Performance of welded plate heaters in mixed and clear juice in INCAUCA S.A.S.

A. C. Rodriguez, F. Perez and P. N. Lopez

Incauca S.A.S, vía El Ortigal - Cauca, Colombia.

acrodriguez@incauca.com, fperez@incauca.com

Abstract

In order to reduce the consumption of steam during mixed juice heating and in the evaporation station, INCAUCA S.A.S. decided to incorporate welded plate heaters (platulaire heaters). The decision was made based on the low approach temperature offered by this type of heat exchanger (3 to 5 °C)

In 2016 six heaters were installed (two per heating step) to modify the mixed juice heating from three to six steps, of which two are operated with condensates, three with vapor 3 and the last one with vapor 2 and vapor 1. The use of vapor 1 is only done as final adjustment with automatic valve control in order to achieve the required clarification temperature.

For the heating of clear juice two 800 m2 multistream plate heaters were purchased operated with vapor 2 and vapor 1. The objective is raising the clear juice temperature to 113 ° C before entering the evaporators. However, there have been problems that have not allowed to achieve this goal, like the difficulty to remove incrustations and breakages of plates that give discontinuity to the process.

It is estimated that with the new mixed juice heating system, a specific steam reduction of 1.8 % on cane was achieved reducing from a specific steam consumption of 54.9 % before the system was implemented to 53.1 % with the new scheme (consumption for an average milling of 13,000 ton of cane per day- including refinery and distillery). Regarding the benefits obtained with the heating of clear juice, there is no consolidated data due to the intermittence in the operation of the heaters.

Keywords

energy efficiency, steam integration, evaporation, design, vapor bleeding.

Strategies applied to increase power generation and reduce steam consumption at some sugar cane mills from Colombia

D. F. Cobo, V. Erazo and J. J. Ortiz

Ingenio Mayagüez S.A, Candelaria - Valle del cauca, Colombia.

dicobo@ingeniomayaguez.com

Abstract

Using energy resources in an efficient way to produce sugar is a topic that has gained more importance in the Colombian sugar mills. Projects to increase surplus power have required more investment to reduce steam consumption. Power sold to the public network increased from 53 MWh in 2011 to 575.3 MWh in 2017, according to last Annual Report of Asocaña (2017). Five boilers that produce steam at 65 bar and 510 °C, have been commissioned in the last ten years.

In the Colombian sugarcane mills, the specific steam consumption decreased from 580 kg/t of cane to 520 kg/t of cane, according to Cenicaña (2017). Energy integration strategies to use condensates and low-pressure steam accompany these projects. Alongside several strategies followed by our sucroenergy industries to increase the surplus power will be shown: Increasing the thermal quality of the steam generated in boilers from 18 bar @ 280 ° C to 65bar @ 505 ° C increases also the possibility of recovering the cycle energy by 1.7 times; employ condensing turbogenerators can increase isentropic efficiency from 60% to 80%; take advantage of vegetable vapors from the third to the last effect for heating the juice, using a 3% more area in heating of the juice could reduce the requirement of exhaust steam by 1.8%.

Finally, a study case is discussed that reduces steam consumption from 53% to 45% steam on cane to sell 20 MWh. In this Colombian sugar mill, progressive steps of integration were followed looking for a lower consumption of steam; preheating of juice using steam from the fourth and last effect and condensates, were applied. The vapor of the third effect was used for a new continuous pan. The installed evaporation area was also increased to achieve a higher cane crushing rate.

Keywords

cogeneration, steam consumption, energy integration.

Configuration and operation of evaporation stations in an environment of energy integration and production of sugar and ethanol in the Colombian Sugar Industry

J. G. Rodriguez and J. D. Tascón

Colombian Sugarcane Research Center, Cenicaña, Calle 58 norte No. 3BN-110 Cali, Colombia.

jgrodriguez@cenicana.org

Abstract

Steam integration is an important issue for Colombian Sugar Industry nowadays. The improvements and modifications in cogeneration systems as well as changes in Colombian regulations for the energy sector encouraged the investment in energy generation systems from renewable sources. The evaporation stations plays an important role in the sugar process to satisfy the heat demands. Adequate sizing, operation and configuration of this station is fundamental to satisfy the steam requirements in the factory with efficiency and stability. This work presents the experiences in some evaporation stations of the Colombian sugar industry in recent years.

In the first case, the sugar mill performed modifications in one of the series of the evaporation station to improve second effect bleedings for heating. These modifications allowed to increase the processing rate (increase of 48 % of the flow processed in one of the evaporator series) and syrup brix (increase from 59 ± 2 to 68 ± 6) and using more vapor from the second effect to replace partially first effect bleedings for juice heating. In the second case, the effect of a distillery with clear juice as feed and first effect vapor bleeding for heating is evaluated. The operation strategy for this kind of configuration in the evaporation station is presented. Finally, in another sugar mill the transition from manual to automatic control increased the processing rate (7 %) and reduced sucrose losses (0.04 %).

Keywords

Energy efficiency, steam integration, evaporation, design, vapor bleeding.

Impact of condenser performance on sugar crystallization and power requirement of a sugar factory

B. Morgenroth and H. Singh Bola

IPRO Industrieprojekt GmbH, Celler Straße 67, 38114 Braunschweig, Germany.

Morgenroth@ipro-bs.de

Abstract

Condensers have substantial impact on the performance of the pan station. Stable and low vacuum for optimum pan boiling as well as low water and power consumption are main aspects concerning condenser design. In many cane sugar factories, the condenser & water cooling system is the section with the highest power consumption.

The performance of direct contact condensers is determined by the approach temperature (vapour temperature – tail water pipe temperature). Condenser performance improves as the approach temperature becomes smaller. In the European beet sugar industry, mostly high efficiency central curtain condensers are employed operating at approach temperatures of 2–4 K whereas, condensers in many cane sugar factories operate at an approach temperature of 10–18 K.

A survey of different design and operation of condensers, space requirement, difference in water and power consumption, pre-requisites for efficient condenser operation, non-condensable gas removal system and their power consumption are given. Further, factors impacting the condenser performance, sugar crystallization issues due to poor condenser performance and potentials to add additional revenues with condenser optimization are also described.

Keywords

Condensers, condenser performance, power demand.

Increasing bagasse combustion efficiency in the Colombian sugarcane industry

A. F. Ospina, J. E. Lucuara, J. A. Calpa, A. L. Gómez and N. J. Gil

Colombian Sugarcane Research Center, Cenicaña, Calle 58 norte No. 3BN-110 Cali, Colombia.

afospina@cenicana.org

Abstract

Colombian sugar mills have increased their cogeneration capacity up to 284 MW, positioning themselves as the second largest power generator in the region. This process is mainly performed by the combustion of bagasse in steam boilers. It was identified that, due to technical or operational conditions, the main efficiency losses are related to the presence of unburned fuel in the ashes, high temperature in flue gases and instabilities in steam generation. By means of tools such as boiler operational data analysis, Computational Fluid Dynamics (CFD) simulations, analysis of control strategies in commercial software and efficiency evaluations carried out on the sugar mill´s boilers, some alternatives for the reduction of the losses were identified. Three case studies are presented in which the application of the identified alternatives contributed in the improvement of the combustion efficiency on the evaluated boilers. In the first case, a reduction of 6 °C was observed in the temperature of the flue gases as a result of the redistribution between primary and secondary air injection. In the second case, a reduction of 4 percentage points in the unburned fuel losses was observed and a reduction of the CO concentration on the flue gases, as a result to increase in the secondary air temperature. In the third case, the unburned fuel grate ashes were reduced from 17% to 2% as a consequence of the improvement of the primary air distribution by using CFD as a tool for the redesign of the forced air duct.

Keywords

Combustion system, CFD, efficiency, reduction losses.

Energy integration sugarmill - ethanol distillery - unicelular protein plant

I. Perez, J. M. Valdivieso-Piloto and O. Almazán del Olmo

Cuban Research Institute of Sugar Cane By-Products (ICIDCA), Vía Blanca 804 esquina Carretera Central. San Miguel del Padrón. La Habana, Cuba. indira.

perez@icidca.azcuba.cu, julio.martinez@icidca.azcuba.cu, oscar.almazan@icidca.azcuba.cu

Abstract

This paper deals with a concept for the energy integration of a sugar mill with a capacity of 6.900 t/d cane, an alcohol distillery of 500 Hl/d and a single cell protein plant of 10 t/d capacity becoming a biorefinery complex. The concept considers that the sugar mill supplies steam and electricity to satisfy the needs of each plant during the season and providing enough surplus bagasse and trash to cogenerate and satisfy the steam and electricity demands of the annexed plants during the off-season period. It is proven that the sugar mill can satisfy the energy demands of the annexed plants and can also deliver 6,85 MWh to the national grid during the milling season. In addition, 1054 t/d of surplus bagasse is obtained, that, together with collected trash from cane harvesting, does ensure the energy demand, for operating 100 days in the off-season delivering a surplus of 14,18 MWh to the national grid during this period. With energy integration, the Sugar Mill-Distillery-Single Cell Protein (SCP) plant production costs are reduced because of reducing energy consumption. A total cost saving of US $ 3,065,385 has been calculated. In addition to this an additional income is added by selling electric energy to the national grid.

Keywords

Surplus bagasse, cogeneration, energy integration, biorefinery, ecofriendly operation.

Illovo Asset Management Programme (iAMP) - An approach towards sustainable and improved factory reliability

R. Talanda

Illovo Sugar Africa, 1 Nokwe Avenue, Ridgeside, Umhlanga Rocks, Durban.

rtalanda@illovo.co.za

Abstract

Polices and systems that support Asset Reliability are key to enhance both Factory Reliability and the Cost Effectiveness of this factory performance indicator.

The Illovo Asset Management Programme embarks on a journey to build capability and sustainability in Factory Reliability through process, people and technology aspects of this performance indicator.

The programme underpins Group strategy, is systemic in approach and delivers by focussing on situational relevance, making it applicable to a broad base of influence.

The programme aims to develop a standardised way of working across six countries of operation, is built on foundational maintenance engineering best practices and has yielded significant early successes.

The presentation explains the approach and showcases outputs of the programme.

Keywords

Asset reliability, maintenance programme, foundational maintenance engineering practices.

Increasing throughput using lost opportunity reporting

D. Gent

AB Sugar, Sugar Way, Peterborough, PE2 9AY, England.

david.gent@absugar.com

Abstract

A good level of Asset Utilisation is important in determining a sugar mill's financial performance. Season length is one factor affecting utilisation, whilst the second factor is the hour by hour factory throughput within the season.

Ideally a sugar mill would operate at 100% of its capacity from the first to the last day of the season, but there is a long list of reasons why this is not the case. These reasons range from scheduled events, such as evaporator cleaning through to unscheduled breakdowns or unexpected interruptions to cane supply. Many sugar businesses separate these two reasons when accounting for asset availability, but in reality both have a significant impact on processing throughput.

Lost Opportunity Reporting is a formal technique which records every hour of throughput where processing capacity fails to reach 100%. The lost throughput, measured in terms the lost sugar production or cane crushed is allocated to a root cause, termed a 'bad actor'. A list of bad actors, with its associated total lost opportunity is therefore developed, hour by hour, during the season enabling prioritised resolution plans to be made both in and out of season. This practice has now been adopted throughout AB Sugar and the presentation will explain the technique in detail and how it has enabled AB Sugar's sites to become more focussed on throughput constraints with improved targeting of capital, maintenance and improvement resources.

Keywords

Asset Utilisation, Lost Opportunity Reporting, bad actor.

Failure prevention using RCM and RAMS tools

J. S. Saltarén, J. D. Montes and A. Gómez

Colombian Sugarcane Research Center, Cenicaña, Calle 58 norte No. 3BN-110 Cali, Colombia.

jsaltaren@cenicana.org

Abstract

The Colombian sugarcane agroindustry has continuously increased its productions requirements to satisfy the higher competitiveness of international markets. The industry standard is set to crush for long seasons. In order to achieve such availability, sugarcane mills had taken several approaches of different maintenance techniques.

Traditionally, engineers and managers achieve availability through redundant equipment and enough labor experience to reduce Mean Time to Repair (MTTR). This means, performing equipment repair applying fast corrective and condition maintenance.

In this work, with the use of RAMS (Reliability, Availability, Maintainability and Safety) tools and engineering techniques is possible to identify and quantify equipment and system failures in different sugarcane mills. Reliability diagrams and Root-cause analysis led to identify that one pilot mill achieves world class availability (> 96 %) indexes with low reliability indexes (< 65 %) due to several standby equipment. This led to a proposal to improve reliability indexes by identifying the failure causes, reducing corrective maintenance and hidden maintenance costs.

In other mill, RAMS tools led to identify maintenance and productive practices that affect rotodynamic machines. In these cases, it was possible to reduce failures by specific proposals of improved maintenance practices and safety operation/production procedures.

Keywords

Mean time to repair, MTTR, RAMS, root-cause analysis.

Evaluation of different procedures and materials for sugarcane crushing parts to maintain and improve juice extraction performance in long crushing seasons

J. S. Saltarén, J. D. Montes and A. Gómez

Colombian Sugarcane Research Center, Cenicaña, Calle 58 norte No. 3BN-110 Cali, Colombia.

jsaltaren@cenicana.org

Abstract

Wear on sugarcane crushing parts represents one of the highest costs of maintenance for Colombia's sugarcane industry. Engineers work continuously evaluating new technologies which include different alloys, evaluation of arcing/hard-facing operations and consumables designed to improve productivity, extend life of components (MTBF), protect the assets and reduce the costs of continuous repairs.

In Colombia, sugarcane mills have schedules to crush for long seasons, frequently having available time targets of 330 days per year. This high standard requires efforts to reduce wear in order to maintain extraction performance indexes through the whole season. Different evaluations on sugarcane mills have shown the behavior of sucrose losses along the milling train increased during the service period of rolls. This is proportionally related to wear of the rolls.

This works presents the wear performance evaluation at laboratory scale, of two types of roll alloys commonly used in Colombia's industry. Mill setting practices, arcing procedures and consumables were assessed to determine how these influence the wear behavior of the rolls in local industry. Arcing procedures were evaluated for grey cast iron and ductile iron (nodular cast iron) using the G65 tribometer. Adhesive wear between the tips of the trash plate teeth and the bottom of the mill roll groove was explored using a G77 tribometer.

Keywords

Mean-time between failure; wear; milling.

OEE as a global index to improve factory performance

J. Marulanda, C. Martinez, J. Correa and C. Lopez

Ingenio Carmelita S.A. Riofrio, Valle del Cauca. Colombia.

jmarulanda@ingeniocarmelita.com

Abstract

Some sugar mills in the Colombian sugar industry are beginning to work with more comprehensive performance indexes, such as Overall Equipment Efficiency (OEE) oriented to a more competitive profile. Crushing around the year, including periods of high precipitation, is a challenge for both factory and harvesting groups. In this work, general performance indexes including Overall Recovery, Extraction Efficiency and Lost time are reported and applied to OEE calculations for a small sugar mill (2700 tons/day). Typical lost time distributions due to cane supply and different factory process are presented in addition to normalized cost distribution for each process. In these, cane preparation and milling were identified as having high potential for improvement. Furthermore, a cane preparation and milling detailed diagnostic is presented. The diagnostic was performed together with CENICAÑA, prior to the development of a short-term improvement plan including control strategies. Invest projects for the near future have been formulated in order to increase extraction efficiency and availability. They are also reported in this work.

Keywords

OEE, extraction, overall recovery.

Reliability improvement of a critical asset: the main cane carrier

J. D.Montes, J. S. Saltarén and A. Gómez

Colombian Sugarcane Research Center, Cenicaña, Calle 58 norte No. 3BN-110 Cali, Colombia.

jdmontes@cenicana.org

Abstract

A reliability and availability analysis made by Cenicaña revealed that Cane Carriers (or Slat conveyors) are the most critical equipment for the cane preparation area. This equipment can generate significant production losses.

Reliability values have been determined for the cane carrier and values have been found as low as 83%, calculated as the probability of not having a failure event in a time gap of 24 hours. This analysis unveiled an opportunity to generate a team effort between the academy, Cenicaña and Sugarcane Mills in order to solve a repetitive failure.

This work presents a root-cause analysis of the tail shaft of a cane carrier which suffered cracks and its main bearings (babbit) together with the bronze bearing idle sprocket suffered premature wear. These events led to failures and production outages due to derailment of the chains. Also, the tensioning screws showed episodes of catastrophic failures.

As part of an RCA analysis, the determination of the fatigue safety factors of the head-shaft and tail-shaft of the horizontal cane carrier was carried out and the selection of the bearings of both shafts was verified. A metallographic study of the base material of the tail-shaft was also carried out.

It was found that the fatigue safety factors for the most critical points of the head-shaft were adequate (FS = 1.53) but the same did not happen with the tail-shaft (FS = 0.47).

Finally, recommendations for the redesign of the tail-shaft and the tension system were generated in order to increase the reliability of the equipment and the MTBF reducing failure episodes by extending the life of the components through reliability centered design (RCD) modifications.

Keywords

Slat conveyor; Reliability; Cane Carrier; Fatigue; RCD.

An objective approach to prioritising capital replacement

GA. Kent, H. YU, R. Wang, ME. Cholette, P. Borghesani and L. Ma

Queensland University of Technology, 2 George Street, Brisbane, Queensland, 4000, Australia.

g.kent@qut.edu.au

Abstract

To maintain factory throughput and factory performance, it is necessary to maintain assets. As assets age beyond their useful life, asset replacement is required. The challenge is to select the right time to replace assets so that capital is not spent earlier than required and that excessive maintenance, degradation and risk costs are not incurred.

This presentation provides an overview of an objective procedure that has been developed to determine priorities for capital replacement. The procedure involves the construction of an asset heat map that provides an assessment of the condition of assets in terms of need for capital replacement and an optimisation strategy for determining priorities for replacement given a finite capital budget. The objective of the optimisation strategy is to minimise the cost of asset care, with cost being the sum of capital, maintenance, degradation and risk components.

Keywords

Asset management, capital replacement, heat map, maintenance, risk.

The LLT clarifier: design features

S. Grimaldo

Crompion International; 341 Third St, Baton Rouge, LA, 70801, USA.

santiagogrimaldo@outlook.com

Abstract

The LLT Clarifier is a new short retention time trayless clarifier developed at Audubon Sugar Institute in Louisiana. Since 2009, many sugar mills in different parts of the world have implemented the technology with excellent results. The main differences of the LLT, compared to other clarifiers, are that it comes with an integrated flash trough and juice turbulence reduction devices (TRDs). The built-in flash trough eliminates the necessity of an external flash tank; provides more degassing area compared to the latter; occupies less space; requires less steel, and avoids the need of foundations and support structures. The juice distribution system of the LLT Clarifier comprises a number of feed pipes uniformly distributed over the cross-sectional area. The exit points of the pipes come installed with the TRDs that effectively reduce flow momentum and eddies. As a result, the LLT Clarifier is capable of providing shorter retention times, lowers sucrose losses and provide juice of high quality compared to other clarifiers available in the industry. The purpose of this presentation is to explain in more detail the technical aspects of the LLT Clarifier.

Experiences with the use of filtering nozzles in the mill rolls with internal drainage type XM

J. Sanchez and. S. Chavarro

Fundiciones Universo S.A, Cali – Colombia.

jsanchez@fundicionesuniverso.com

Abstract

At the moment, the majority of Sugar Mills use "XM ROLLS" (Rolls with internal drainage) in order to reduce juice reabsorption during the milling process. Nevertheless, it is almost unavoidable that both nozzles and the internal drainage get clogged with solids as the milling season advances. The sugar cane fiber represents the higher percentage of those solids and its tendency to intertwine is mostly responsible for clogging. To minimize this problem, different kinds of nozzles have been designed, always keeping the basic principle of being conical and divergent. The best results were obtained with the new design that consists of nozzles with multiple holes that together maintain the same area of the original design of the one-hole nozzles. Back in 2015 tests started to take place, initially over the length of one drainage tube, to be followed by several tests in different Sugar Mills until the XM Rolls started to be used with all the nozzles of the new type and in all mill positions in the tandem. In the first 5 months of 2018, one Colombian Sugar Mill reached an average 46.2% bagasse humidity, bagasse POL of 1.42% and reduced extraction of 97.4% at an imbibition rate of 175% on fibre. Besides avoiding the clogging with bagasse, better and more stable milling indicators were obtained during the milling season. At present, XM Rolls with all their nozzles of the new type and of different diameters are being fabricated, depending on each roll's geometry and with nozzles having 3 to 8 holes. At the same time, different materials for the nozzle are also being tested, looking forward to obtaining an optimal lifespan, according to the XM roll's life. In addition, the bagasse rolls that were removed from the mill due to clogging of the one-hole nozzles (older design) can now be reinstalled.

Keywords

Filter nozzles, lotus roll, XM roll, extraction, bagasse moisture.

Sugar cane mill drive systems - evolution and efficiency

N. Gouez

CMD Engrenages et Réducteurs, 59400 Cambrai, France.

Nicolas.GOUEZ@cmdgears.com

Abstract

Over the last century, the technology of the sugar mill drives has evolved considerably and their economic and technical performance has improved drastically.

The efficiency of the gear drive system is a key factor when it comes to consumption of steam or power required to run the mills.

In this presentation, we will therefore introduce the design or manufacturing factors that influence the mechanical efficiency and explain how to supply an efficient drive system.

We will then compare the different generations of drive systems in terms of efficiency, and consequently quantify the advantage of converting an old generation drive into a state of the art compact drive.

Keywords

Gearbox, reducer, efficiency, power consumption.

Greater reliability with vacuum tight EPDMH valves

C. Castro and M. Erol

MCI Ingenieria y Aplicaciones S.A. de C.V. Kepler 72, Anzures, CDMX, 11590, Mexico, Airpower Europe GmbH, Maarweg 30, 53619 Rheinbreitbach, Germany.

ccastro@mci-i.com

Abstract

Sugar manufacturing poses a challenge to valve makers. The characteristics of the material to be handled, fluctuating pressures and high temperatures and viscosities present great demands to valve engineering. In addition, limits on the period of operation make a high degree of service flexibility desirable. While in the past many system components such as pumps and valves were simply replaced after the campaign, they now require much higher durability.

A sugar factory of 13,000 t/day requires approximately 3,000 installed valves. The most suitable valve type must be selected based on the expected temperatures, pressure conditions, viscosities, permissible pressure drops but also space constraints. Although valves are not the most expensive components in sugar production, their failure would lead to critical interruptions of the operational sequence. Operationally reliable and robust valves with high reliability must therefore be selected. Special attention must be given to:

- Valve design and materials
- Process specifications
- Seat design and materials
- Price constraints

On the basis of the experience of installing valves in the sugar industry, this presentation discusses the criteria for the selection of valves and the advantages of using vacuum-tight EPDMH butterfly valves in several key applications when compared to other more typical valve technologies available in the market.

Keywords

Valves, valve installation.

Air control strategy in boilers with limited instrumentation

S. Orduz, A. Montoya, F. Carvajal and C. Marin

Ingenio Riopaila- Castila Planta Castilla Florida, Valle del Cauca. Colombia

santiago.orduz@riopaila-castilla.com

Abstract

This work presents the design, implementation and assessment of a simple control strategy for the forced draft air of the two operating boilers at Castilla Factory (Riopaila Castilla Group, Colombia).

The control strategy consists of associating the damper opening of the boiler's Forced Draft (FD) fan, with the average opening value of the bagasse feeders by means of a ratio that is determined by the operator of the boiler, in a range between 0.7 and 1.3 depending to the bagasse quality supplied to the equipment.

The range of the ratio was determined experimentally for the minimum and maximum typical opening values of the bagasse feeders of each boiler, for its average steam generation rate. The minimum damper opening value of the FD fan in each scenario was identified to avoid fuel accumulation in the boiler grates.

Once the ratio that allows the minimum use of forced air for each boiler was determined, tests were performed at different damper openings of the Over-Fire Air (OFA) fan, with oxygen content in the combustion gases, furnace temperature and gases combustion temperature after the last heat exchange as an output variable.

With the FD fan set on automatic and controlled by the bagasse feed signal, an objective range of static pressure was determined at the exit of the OFA fan. A satisfactory performance of the operating variables of the boiler was observed.

After the implementation, it has been possible to keep the ratio value and a stable regime of the OFA fans, only requiring intervention in cases of considerable changes in the quality of the bagasse or when the steam generation of the boiler is greatly reduced, for instance, in the event of a factory startup or a factory liquidation.

Keywords

boiler efficiency, control strategy, air distribution.

Cyclonic flow correction in a boiler chimney with a Venturi gas scrubber using CFD models

S. Orduz, C. Jimenez, F. Carvajal, C. Marin

Ingenio Riopaila- Castila Planta Castilla Florida, Valle del Cauca. Colombia

santiago.orduz@riopaila-castilla.com

Abstract

This work presents the flow of combustion gases modeling inside the chimney of boiler No. 5 at Castilla Factory, (Riopaila Castilla Group, Colombia). The boiler gas cleaning system is composed by precipitator bottles and Venturi gas scrubber; it operates 100% with sugarcane bagasse.

This type of Venturi scrubber implies a tangential inlet of the combustion gases to the chimney, resulting in a turbulent behavior of the flow inside it. The Colombian standards specify that the inclination angle of flow lines measured on the boiler chimney cross sections has to be maximum 20° with a standard deviation maximum of 10°. The measurements made for the legal environmental report diagnosed gases cyclonic flow at sampling points, getting: 64.1° ± 11.7° and 48.1° ± 10.4°.

A fluid mechanics study using CFD models (Ansys CFX) determined that the chimney height and low velocity of gases inside, favored the cyclonic flow behavior. Different alternatives were evaluated to correct this situation, the best technical-economic alternative was to assembly a grid covering the entire diameter of the chimney installed after the last section change of it.

After the modification, the new measurements yielded the followings results: 8.6° ± 3.7° and 14.2° ± 4.1°. Therefore, the grid installed in the chimney allowed to correct the cyclonic flow and perform the measurement of emissions to continue with the environmental legal permission to the boiler operation.

Keywords

Cyclonic flow, combustion gases, CFD, venturi gas scrubber.

Increased inhomogeneities in the field parameters of industrial vacuum pans - the role of steam bubbles and their nucleation

F. Geisendörfer and E. Flöter

Technical University Berlin, Department of Food Process Engineering, the Berlin Sugar Institute, Seestrasse 13, 13353 Berlin, Germany.

Felix.Geisendoerfer@tu-berlin.de

Abstract

In the course of optimizing the energy consumption in industrial vacuum pans reduced surface temperatures cause less obvious boiling phenomena. This induces inhomogeneous distributions of temperature and concentration within the vacuum pans. This is to be avoided in order to reduce variability of crystals and the undesired generation of fines.

The ongoing study aims at both the evaluation how steam bubbles contribute to the mixing inside pans and how they are generated. Homogeneous nucleation of steam bubbles necessitates high over heating and is practically impossible. Four possible origins of steam bubbles have been identified: Circulating microbubbles (steam or inert gases); cavitation effects at the impeller tips; nucleation at crystal surfaces; microbubbles generated in the calandria. Since the observations at industrial scale do not allow to draw conclusions the problem is downscaled. Nucleation of steam bubbles is studied within droplets dispersed in a temperature-controlled oil, for synthetic and real sugar solutions as well as massecuite of both types. While monitoring the process parameters the actual occurrence of the steam bubbles is also observed using a high-speed digital camera.

For the solutions studied bubble nucleation occurs at overheating of approx. 30 K. Sucrose crystals within the test droplets reduced the maximum overheating to approx. 5 K and displace the source of nucleation from the droplet surface to the interior. Bubble nucleation at the crystal surface is clearly observed. Further experiments to be carried out will focus on surface properties, the presence of inert gases and the effect of reduced system pressures.

Bubble formation at crystal surfaces might degrade the sugar quality, causing irregularities and secondary crystal nucleation. Additionally, heavy flash evaporation as observed above the calandria promotes secondary nucleation. Consequently, improved understanding of the bubble formation process is needed to manipulate it deliberately in order to avoid sugar quality issues and inhomogeneities of temperature and concentration.

Keywords

Steam bubble nucleation, bubble formation on crystal surfaces.

POSTERS

ENGINEERING

Scale removal in evaporators with a reusable chelating agent

James LePage and Baltazar Ramirez[1]
Bruce McManus and Albert Katryan[2]
Carlos Acevedo and Alejandro Mejia[3]

[1]*AkzoNobel, Chicago, IL U.S.A.*
[2]*U.S. Sugar Corporation, Clewiston, FL U.S.A.*
[3]*Reciend S.A.S., Bogota, Colombia.*

Abstract

Chelates such as EDTA are now more frequently used in descaling cane sugar juice evaporators (see H. Chen, ISSCT XXIX Congress, Thailand, 2016). Unlike caustic and acids, EDTA is well suited to dissolve calcium sulfate and oxalate scales that are commonly present in later evaporators. While there have been sporadic literature reports on recycling / recovering EDTA to allow it to be reused – the recovery process for EDTA requires significant equipment, skill in processing and generates low yields.

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 vrs. EDTA is significantly reduced. An overview of this developing technology will be presented.

Dissolvine® is a registered trademark of AkzoNobel.

ABSTRACTS

PROCESSING

A review of sucrose losses in sugarcane factories

G. Eggleston

Audubon Sugar Institute, LSU AgCenter, 3845 Highway 75, St. Gabriel, LA 70776, USA.

geggleston@agcenter.lsu.edu

Abstract

Sugarcane processors must consider all costs to make sound economic decisions on how to reduce expensive sucrose losses. Total sucrose losses in a sugarcane factory can be split into two components: (i) physical, and (ii) chemical losses. Physical losses occur in bagasse, filter cake or mud, molasses, and spillages. Chemical losses are often referred to as undetermined losses (UDL), i.e., sucrose that is unaccounted for after completing a mass balance across a factory. Chemical losses can be further grouped into microbial, enzymatic, and acid degradation (inversion) losses, with the latter being more applicable downstream where heat is applied. Thermal acid degradation inversion) of sucrose is affected by factory operational pHs, temperature, Brix, flow rates and retention times, concentrations of invert sugars and salts, with temperature having the greatest effect. Acid degradation of sucrose is a misnomer because it can occur up to a pH of 8.3. Most acid degradation of sucrose in a factory occurs during clarification settling and in pre- or early evaporators due to high temperatures and low Brix,and are known to vary dramatically across a processing season due to variations in cane quality. For example, in Louisiana, the greatest losses occur in early season when the highest and most varied glucose and fructose concentrations occur and when the cane is more immature and leafy trash is highest. The measurement of acid degradation sucrose losses are notoriously difficult to measure and are often measured by gas chromatography or high performance liquid chromatography using two formulas (1) an increase in glucose/Brix across processing or a (2) as a decrease in sucrose/Brix. However, when actual losses are less than <0.5%, a sucrose decrease (formula 2) often does not detect losses. On the other hand, when high sucrose losses occur, i.e., >0.5%, sucrose losses based on a glucose increase (formula 1) are often lower than those based on formula 2. This is because industrial conditions where high sucrose losses occur also cause glucose degradation. These discrepancies may explain previous differences in measuring predicted acid degradation sucrose losses via the Vukov equation (a function of juice pH, juice Brix, temperature, and residence time) with measured sucrose degradation by a glucose increase. A full review of evaluating sucrose losses across sugarcane factories will be discussed.

Reduction of determined sugar losses to increase sugar production

B. Morgenroth[1] and H. Singh Bola[2]

[1]IPRO Industrieprojekt GmbH, Celler Straße 67, 38114 Braunschweig, Germany.

Morgenroth@ipro-bs.de

[2]IPRO INDIA Private Limited, SCO 236, 1st & 2nd Floor, Sec- 40 D, Chandigarh, India.

Harjeet.Singh@ipro-india.com

Abstract

During the last decade, a lot of work has been carried out to improve the performance of sugar mills. However, the overall sugar recovery improvement is still a neglected topic in the majority of the sugar mills.

The authors have carried out various studies in the recent years and observed determined sugar losses in the range of 1.6 – 2.5 % on cane. The overall sugar recovery ranges between 78 – 86 % against the benchmark value of 88 - 90 % depending on juice purity levels. Therefore, the reduction of determined sugar losses offers a potential to increase the sugar production by 2 – 12 % which can contribute improving the factory revenues. The factors impacting the sugar recovery, process challenges and approach to reduce the determined sugar losses are described.

The impact of operating conditions on degradation reactions in Australian sugar factory evaporators

D.Moller and D. Rackemann

Queensland University of Technology, 2 George Street, Brisbane, Australia.
david.moller@qut.edu.au

Abstract

The magnitude of sucrose degradation and the consequences of those degradation reactions, such as reduced pH of condensate in the evaporator station was investigated at five Australian sugar factories. These factories were chosen as their configurations allowed investigation of the impact on sucrose degradation caused indirectly by steam economy measures. The test program also examined the impacts of clarified juice pH and the presence of scale on the magnitude of the sucrose losses. Sucrose degradation results were compared with predictions using the Vukov expression (a function of juice pH, juice brix, temperature and residence time). Significant sucrose losses of over 0.5% were both measured and predicted in factories that incorporate extensive vapour bleeding and higher exhaust steam temperatures.

This presentation will discuss the results of the factory program and operational strategies and equipment options modelled that can be implemented to reduce the large sucrose losses that can occur during juice evaporation. Details of current research plans being undertaken towards developing alternative mitigation strategies will also be presented.

A new approach to control spray water addition and spinning time in batch centrifuges

B. Ch. Nielsen and T. Diringer

Neltec Denmark A/S.

tdi@neltec.dk

Abstract

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.

Keywords

Colour measurement, sugar quality, batch centrifugals.

Optimizing the performance of continuous centrifugals by online monitoring of the sugar colour

T. Diringer and B. C. Nielsen

Neltec Denmark A/S, Vestergade 35, 6500 Vojens, Denmark.

tdi@neltec.dk

Abstract

Transfer of colorants within the sugar end of a sugar factory has a major influence on the sugar quality. The colour components are not only transported downstream from the A-product pans towards the molasses, they are also transported upstream by returning the run-off from the batch centrifugals and by returning dissolved B sugar and C sugar. If both the B and C sugar crystals are dissolved and returned to the standard liquor, the colorants in these sugar crystals will contribute significantly to the quality of the standard liquor.

In the sugar factory La Gloria in Mexico and in several other factories the work of the continuous centrifugals has been monitored and optimized by installing an online colour measurement to indicate the colour of the sugar crystals in the continuous centrifugals. The influence of various parameters such as centrifugal load, water addition and steam addition on the colour of the crystals flowing up the screen has been tested.

This presentation gives a summary of the results achieved during these tests.

Comparison of sugar losses in milling and diffusion

P. Rein

2 Trent Court, Stone, ST15 0GZ, United Kingdom.

peterein@gmail.com

Abstract

The extent of losses in the extraction plant due to inversion and microbiological causes is discussed. The conditions under which these reactions occur are known, but losses are difficult to measure. It is shown that the most satisfactory option is to measure the breakdown products of the degradation reactions, which vary depending on the conditions. Measurement of lactic acid is a good indicator of the extent of microbiological losses, particularly in diffusers. Losses in diffusers are low if the operating temperatures are kept above 80 °C. In milling tandems careful attention has to be given to regular cleaning. Overall losses are shown to be lower in a diffusion system than in conventional milling tandems. The products of the breakdown reactions have a seriously adverse effect on boiling house recovery.

Minimising sucrose losses by optimised crystallisation and conditioning of C-product massecuite

A. Lehnberger

BMA Braunschweigische Maschinenbauanstalt AG, Am Alten Bahnhof 5, 38122 Braunschweig, Germany.

andreas.lehnberger@bma-de.com

Abstract

One of the primary objectives of almost every sugar factory is to ensure that the molasses is desugarised as much as possible. Since any sugar that is additionally centrifuged from the C-product massecuite can be sold as extra crystalline sugar, all efforts aimed at increasing the C-product yield can count as additional sugar production. Based on the mass of dry substance, any additional output of crystalline sugar will reduce the amount of molasses produced.

Cooling of C-product to raise the crystal yield is a measure that has been known for some time and is widely used. The yield improvement obtained by continuous cooling crystallisation of C product directly depends on the outlet temperature reached. As a rule of thumb, lowering the temperature by 4 to 5 K will reduce the purity of the mother liquor by one purity point. The oscillating vertical cooling crystalliser system (OVC) achieves low molasses purities thanks to a final temperature of 40 °C and the low percentage of fine crystals.

At these low temperatures, the viscosity of C-massecuite is very high. By means of a molasses-magma-mingler (MMM), heated molasses is added to the high-viscosity massecuite after the crystallizer without remelting crystals. To maintain a constant viscosity in the massecuite delivered to the centrifugals, the current of the MMM motor is used as a reference value for the molasses flow rate.

Controlled crystallisation, the prevention of the formation of fine crystals while cooling the C-product massecuite, and effective conditioning are distinctive features of the OVC and the molasses-massecuite mingler. The resulting improvement in molasses purity has been demonstrated in real production on long term views.

Keywords

Crystallisation, molasses purity, sucrose yield, crystalliser, molasses-magma-mingler.

The process capability analysis: a technique to minimize sucrose losses by increasing process stability

J. G. Rodriguez and J. D. Tascón

Colombian Sugarcane Research Center, Cenicaña, Calle 58 norte No. 3BN-110 Cali, Colombia.

jgrodriguez@cenicana.org

Abstract

Process capability analysis is a technique used to determine when a variable in a process meets the statistical specifications between some given limits. For controlling continuous variables, a set point is specified, and the standard deviation should be within the limits defined by process engineers. In the sugar processing some variables are highly important for reducing sugar losses and energy consumption, such as pH of mixed juice, brix of syrup and purities of molasses. These variables were analyzed in some Colombian sugar mills to detect if the evaluated process is under control for the specified limits (stability and capability). The histogram and the statistical information of each variable over periods of time (days, weeks, etc.) is used as a diagnostic tool to evaluate the process. Depending on the severity of deviation in operating variables, some recommendations are made to the sugar mills in order to improve and achieve their specification limits. The statistical data analysis itself could also be used to determine sugar losses due to values out of specification.

In this presentation, we demonstrate how to apply this technique to improve process control. We show three case studies related to control of pH, syrup brix and final molasses purity. In all three cases, process changes were recommended to the sugar mills. After the sugar mills applied these changes, improvements were evaluated again with the process capability analysis. Finally, the benefits were estimated in terms of the reduction of sugar losses.

Keywords

Process control, capability analysis, sugar losses reduction.

Reducing the sugar losses in clarification

P. Rein

2 Trent Court, Stone, ST15 0GZ, United Kingdom.

peterein@gmail.com

Abstract

Sugar losses which can occur in juice and syrup clarification are considered. The effects of temperature, time and pH on losses are considered, and data available to illustrate the effect of these variables on losses are presented. Losses due to inversion may be calculated, but the magnitude due to other causes is difficult to estimate. In particular the losses due to residence time are considered. In this respect, lamella type clarifiers have a substantial advantage, since they are capable of better clarification performance at residence times which may be up to an order of magnitude lower. Success with syrup clarification has also been translated to using lamella clarifiers for phosphatation in sugar refining, with accompanying benefits.

The LLT clarifier: factory performance

S. Grimaldo

Crompion International; 341 Third St, Baton Rouge, LA, 70801, USA.

santiagogrimaldo@outlook.com

Abstract

The LLT Clarifier is a new short retention time trayless clarifier developed at Audubon Sugar Institute in Louisiana. Since 2009, many sugar mills in different parts of the world have implemented the technology with excellent results. The LLT Clarifier has been tested successfully in both mixed juice and mud filtrate clarification applications. Since its introduction, the LLT Clarifier has shown a 20-25% more turbidity reduction compared to SRT and Multi-Tray Clarifiers; Achievement of 10 minutes retention time and 95% removal rate of suspended solids in mud filtrate clarification. Recently, the implementation of an LLT Clarifier in Ingenio Tululá (Guatemala) showed a reduction of the purity drop between clarified juice and mud filtrate of 2.79 units, and an increase of almost 14 lb/TC in the yield after setting the clarifier in operation. This presentation aims to discuss the impact of the LLT Clarifier on the performance of different sugar factories.

Strategy implementation of limed juice flow control in a trayless rapid clarifier

A. Montoya, S. Imbachí and S. Orduz

Ingenio Riopaila- Castila Planta Castilla Florida, Valle del Cauca. Colombia.
alexander.montoya@riopaila-castilla.com

Abstract

A strategy for automatic control of juice flow entering into a trayless rapid clarifier was designed, implemented and evaluated. The target was to eliminate the operator manipulation of the flow set point as a response to perturbance caused by changes in crushing rate, mixed juice or back stream flows. These variations are compensated with changes of no more than 4% per minute in the set point of the juice flow entering the clarifier.

The behavior of the mentioned variables caused a higher fluctuation in the flow of limed juice and negatively affected the performance of the clarifier and the quality of the clarified juice. The new control strategy involves a predictive way the flow of juice from the milling tandem and the mixed juice level in the buffer tank through deceleration ramps that adjust the set point of the limed juice in such a way that the flow going to the clarifier changes in a smooth way.

This control strategy was implemented a month ago in remote automatic mode with the following benefits: better pH control, decreasing in juice turbidity and better clarified juice quality.

Keywords

pH control, juice clarification.

Unlocking challenges and developing enzyme products for the sugarcane industry: Enhancing crystallization

E. A. Borges da Silva, J. G. Rodenbusch Destro, B. Vanelli and V. G. Medina

Novozymes Latin America Ltda., Rua Professor Francisco Ribeiro 683, 83707-660 Araucária - PR Brazil.

EABS@novozymes.com

Abstract

Novozymes is dedicating efforts to deliver solutions for challenging issues in sugar industry and showing how industrial biotechnology can make a difference in performance, quality and sustainability within the sugarcane industry. The production costs rise each year, and considering the unstable prices of their commodities, the competitiveness of this important agro-industrial sector is affected. Novozymes has connected with top sugarcane players in Brazil, as well with strategic sugar institutes, to discuss the potential application of biological solutions for improving processing conditions and sugar quality. Some sugar quality specifications that increase the penalties applied on market price are related to high dextran content, with adverse effect on polarimetry, viscosity, clarification/filtration and sugar crystallization, and presence of starch, that has major effect on the specification of filterability by impeding the normal rate of filtration in refineries and reducing throughput and refining capacity. Recent enzyme-solutions prototypes for sugar production were mainly focused in increasing sugar yield at SC mills supported by polysaccharides reduction in sugarcane processing. Relevant data collected from trials included: (i) measurements of viscosity in massecuites, (ii) determination of total polysaccharides and starch in strategic points in the factory and, of course, (iii) the performance and control data captured by the mill. Positive results were achieved in industrial trials at our partner sugarcane mills, showing superior performance when compared to existing products in the market, and improving benefits of enzyme application.

Addressing the dextran problem: applications of dextran rapid detection kit and dextranase in China cane sugar factories

Ying Liu[1], Guo-wei Chang[1], Rong-zhen Lin[2], Gui-yun Liu[1], Bu Ma[2] and Da-feng Liang[1, 2]

[1]Guangdong Provincial Engineering and Technique Research Centre of Enzyme and Biocatalysis, Guangdong Provincial Bioengineering Institute, Guangzhou 510316, Guangdong, China.

[2]Guangxi State Farms Sugar Industrial Group Company Limited, Guangxi Sugarcane Industry R&D Center, Nanning 530002, Guangxi, China.

lynette.liu@qq.com, ldfjt@126.com

Abstract

The problems associated with occurrence of dextran during processing in cane sugar mills are well documented in literature. However, the ability to measure dextran is a limiting factor in recognizing its impact on sugar factory processing. Here we present a rapid detection method of dextran, which is based on monoclonal antibody, and introduce its application with dextranase for addressing the dextran problem in China cane sugar factories.

Over 15 cane factories in China have adopted the rapid detection kit to monitor dextran in incoming cane for evaluation of cane freshness, in juices for guiding the addition of dextranase and in final sugar for quality index. When dextran content of mixed juice exceeds 80 mg/kg Bx, it is recommended to add dextranase. Based on the results of our trials for 5 years, when dextranase was applied at 15 g/ton of cane in the first mill, the content of dextran in process streams and final products were reduced by 76-100%. Sucrose recovery increased by 1.06% on average while adding dextranase.

α-Amylase and glucoamylase use in sugar cane processing

M. Saska, S. Zossi, C. Gusils and M. Ruiz

Estación Experimental Agroindustrial "Obispo Colombres" (EEAOC), Av. William Cross 3150 Las Talitas, Tucuman, Argentina.

drmsaska@gmail.com

Abstract

Starch levels in cane varieties grown in Tucuman are relatively very high, ranging in mixed juice from 100 to 700 mg/L, with an average around 400 mg/L (2017 data). These levels are several-fold higher than the previously reported threshold from South Africa that was deemed to lead to processing difficulties and sugar quality problems, as well as recent data reported for Louisiana cane varieties.

In our tests, application of 1 to 3 ppm of a thermostable α-amylase prior to juice clarifiers was found very effective in reducing starch in clarified juice to negligible levels. A simple method to measure any possible carry-over of the thermostable enzyme to sugar was developed. To date, limited industrial experience from Tucuman indicates that carry-over of the α-amylase activity to plantation white or refined sugar is not a problem. Because the thermostable α-amylase cannot be expected to be completely deactivated at process conditions, it is very important that the dosing be kept to the minimum needed to achieve the targeted starch level, and shut-off completely during any mill stoppage.

α-Amylase produces mostly dextrins, short chain glucose oligosaccharides with DP 2 to DP ~ 8, that are either unfermentable or fermentable only very slowly. With the burgeoning fermentation of molasses and juice to ethanol, conversion of these unfermentable sugars with glucoamylase to easily fermentable glucose presents an interesting option to augment ethanol yield and at the same time to reduce the BOD/COD load in the stillage effluent. Some preliminary tests of this application are presented. With starch in juice extracted from sweet sorghum of up to 2000 mg/L, this application should clearly be economical once the much studied sorghum-to-ethanol process becomes industrial.

Importance of reliable determinations of undetermined pol losses in factory control

R. Broadfoot and D. Moller

Queensland University of Technology, 2 George Street, Brisbane, Australia.
david.moller@qut.edu.au

Abstract

In order to maximise the recovery of pol in raw sugar production from the factory a weekly pol balance is undertaken in terms of the pol in sugar production and the pol in the outflow streams of bagasse, mud cake, final molasses and waste water. Adjustments for the pol in stocks (tanks, receivers, pans, crystallisers etc) are determined and included in the balance. The discrepancy in the pol balance is termed the 'undetermined pol loss' and is attributed to physical/chemical/microbiological losses as well as associated analytical errors. The pol losses for the individual outflow streams and the undetermined losses are compared against target values for the factory. These targets take into account the characteristics and configuration of the factory, the quality of the cane supply and the pol specification of the product sugar. Major shortfalls in performance of the individual sections of the factory then initiate technical investigations to minimise losses and so maximise pol recovery in sugar. Often management focuses on the magnitude of the undetermined loss as this loss is considered an operational (human) shortcoming rather than a deficiency in capital.

This presentation discusses the importance of determining the sucrose loss in final molasses and using this data in the 'pol' balance for the factory. A recent investigation by QUT determined that the sucrose loss in final molasses was greater than the pol loss in final molasses by between 0.6 and 1.7 units through a crushing season (averaging 1.4 units). The difference is attributed to the variations in the optical activity of the impurities in the final molasses.

A more accurate measure of the losses in final molasses (typically the largest loss) provides a more accurate measure of the undetermined loss and so ensures that technical resources are directed to best effect at maximising recoveries from the factory.

Microwave measuring technology for sugar industry

D. Mubarak

Berthold Technologies GmbH & Co. 99 Midway, Oak Ridge, TN 37830, USA.

David.mubarak@berthold-us.com

Abstract

Nowadays the dry substance of sugar syrup and massecuite is measured online using the most advanced microwave measuring technology. The correlations for water content and dry substance allow for accurate control of concentration, Brix content and density in all areas of sugar production. This permits a continuous measurement during the complete crystallization process, both in the solution and the magma phase.

This report explains the measuring effect and signal analysis of microwave measurement systems and illustrates the user benefits, resulting in very good process control. Solutions are proposed for typical application problems such as incrustation, abrasion, purity dependencies and the recognition of breaks between crystallization processes using the MicroPolar Brix measurement system.

Results acquired with different sensors in various processes and applications are presented. Besides the accurate and reliable measurement of all products from sugar beet or sugarcane, a high value is placed on simplicity, low maintenance and easy calibration to ensure optimised process control and cost. The automatic calibration feature, which requires no additional PC, is demonstrated.

Keywords

dry substance, microwave measuring.

Using near infrared spectroscopy and excel spreadsheets to improve sucrose recoveries

S. Davis, S.Walford and S. Madho

Sugar Milling Research Institute NPC, c/o University of KwaZulu-Natal, Howard College Campus, Durban, South Africa.

sdavis@smri.org

Abstract

The Sugar Milling Research Institute NPC (SMRI) has developed sets of equations for the prediction of sugar process stream analytes from Near Infrared Spectroscopy (NIRS) spectra. The prediction equations were developed using around 30 000 factory samples from mixed juice through to final molasses. The SMRI-NIRS prediction equations, for use with Bruker MPA transmission instruments, were tested at a few case study mills during 2016 and 2017 and have now been installed at all South African sugarcane factories during 2018. They offer the facility for rapid, near real-time, analysis of most factory streams for pol, brix, sucrose, fructose, glucose, ash and colour, many of which were previously not readily available to factory operational staff. Some mills are using the technology to determine weekly factory sucrose production balances directly instead of waiting one week for the determination and reporting of weekly pol/sucrose ratios and applying these to pol balances.

The ability to rapidly analyse many samples for several analytes simultaneously opens up new opportunities for factory chemical control and trouble-shooting when high sucrose losses become evident. Along with rolling out of the SMRI-NIRS prediction equations, the SMRI is also developing and rolling out so-called "SMRI-NIRS Toolkits", Microsoft Excel spreadsheets into which NIRS results and other relevant data can be entered so as to calculate or estimate the extent of sucrose losses in particular parts of the process. The knowledge built into these toolkits highlights areas of unacceptably high sucrose loss, suggests areas of concern that may be leading to high losses and possible corrective actions required.

Currently, SMRI-developed NIRS toolkits have been tested at certain factories for: (1) checking the degree of sucrose loss by inversion across evaporator trains (in excess of 34 tests at one factory alone) and (2) for determining abnormally high sucrose losses to molasses across C-centrifuges (tested at several factories). The latter toolkit, coupled with the ability to monitor individual machines on a frequent basis, enables identification of poor performance rapidly for individual machines, enabling timely action to be taken to reduce further losses. Results of some of this work will be presented at the workshop.

Further toolkits are in the process of being developed for monitoring diffuser operation and clarification station losses.

The use of the conductivity method to estimate the true purity of factory process streams

D. Moller[1] and J. Snoad[2]

[1]*Queensland University of Technology, 2 George Street, Brisbane, Australia.*

david.moller@qut.edu.au

[2]*Sugar technology and operation services, Gordonvale, Australia.*

jeff.snoad@ozemail.com.au

Abstract

In order to maximise the efficiency of the factory operation the true purity of each of the factory streams would be analysed as frequently as possible. Due to the cost, in terms of time and operational costs, this is not possible for the majority of sugar factories. With the addition of a conductivity instrument to the laboratory equipment, and conduct of a minimum of two true purity analyses, it is possible to estimate the true purities of other factory streams in the time it takes to fully dissolve the samples to less than 20 brix. This method enables more true purity determinations to be completed in the current analysis timeframe, providing a greater level of detail available for factory efficiency control.

This presentation discusses an efficient method of correlating true purity results to a dilution conductivity result which enables the true purity of many factory streams to be estimated with a minimum of true purity analyses.

Application of probabilistic analysis to identify sources of variations in undetermined losses

S. Peredo, N. Arbelaez, C. A. Moreno and J. V. Realpe

Colombian Sugarcane Research Center, Cenicaña, Calle 58 norte No. 3BN-110 Cali, Colombia.

spereddo@cenicana.org

Abstract

A high variability on the indicator of undetermined losses % cane, can represent limited reliability on the pol balance due to apparent sources of loss. In this work a commercial sugar factory was analyzed, the undetermined losses during the season studied were 0.55 ± 0.26%cane, the variation of this indicator represented of 47% of their undetermined losses.

The main sources of variation of the indicator were identified using sensitivity analysis software such as @Risk and Minitab (also is possible to use SAS and Crystal Ball) in the pol balance. This made possible to prioritize the actions necessary to reduce the variation by 20 percentage points.

The models configured into the software simulate real cases with historical data of the factory balance, for which it was necessary to reconstruct the pol balance and audit the processes involved in the data generation of the factory.

The models have allowed the identification of inadequate practices in the handling of stock in the process, non-conforming materials, problems in sampling systems and analytical measurements.

Keywords

Apparent sucrose losses, sensitivity analysis.

Laboratory control of dextran and starch in sugar and juice

S. Zossi, M. Sastre, N. Sorol and M. Saska

Estación Experimental Agroindustrial "Obispo Colombres" (EEAOC), Av. William Cross 3150 Las Talitas, Tucuman, Argentina.

silviazossi@eeaoc.org.ar

Abstract

It is well known that polysaccharides such as starch and dextran impede and reduce sucrose recovery in the factories. In addition, dextran is a direct indicator of sugar lost due to bacterial contamination in the field, in transport and storage of cane and during juice extraction in the mill. The frequent analysis in the mills for these contaminants in juices and other process streams is an important element in optimizing sucrose recovery through better cane management or for implementing various process measures (enzymes) and monitoring their effectiveness; yet it is rarely done by the mills. The lack of personnel or necessary equipment are frequently cited as reasons for not doing these analyses. However, many published studies have shown that the cost of these analyses is easily outweighed by the benefits from reduced sugar losses.

In our presentation we briefly review the routine methods for determining starch, dextran and total polysaccharides as implemented at EEAOC for internal and third-party analyses of juices and sugar. While the published ICUMSA procedures serve as a useful starting point, in each case we have introduced modifications that either simplify the procedures, reduce their cost or make them more reproducible. Each modification was at least partially validated by determining method's reproducibility, its limit of detection and quantification and analyte recovery. While the starch and haze dextran methods are well within the capabilities of an average sugar mill, total soluble polysaccharide determination is a tedious and demanding procedure not suited for factory labs, but which is frequently requested by soft drink manufacturers.

Physicochemical effects of microbial action and indicators of microbial sugar losses

T. Daza, J. Sierra, C. Prieto and N. Gil

Colombian Sugarcane Research Center, Cenicaña, Calle 58 norte No. 3BN-110 Cali, Colombia.

tdaza@cenicana.org

Abstract

The direct impact of microorganisms in sugar cane processing has traditionally been associated with undetermined losses due to their use of sucrose in their metabolic pathways. Research has shown that the indirect impact by the products (metabolites) of this sucrose conversions may be even more significant than the sucrose loss. The microorganisms that cause most impact in processing are homo- and hetero-fermentative lactic acid bacteria and thermophilic bacteria. By gene sequencing we identified the main microorganisms to be Leuconostoc mesenteroides, Leuconostoc pseudomesenteroides, Weisella confusa, Lactobacillus rhamnosus, Bacillus subtilis and several yeast species. Amongst the metabolites are alcohols, organic acids and polysaccharides. Sugarcane juice entering the factory should have high purity but also be low in microbial metabolites.

Colombian sugarcane industry traditionally uses dextran analyzed by the haze method as a control parameter. However, there are limitations to this method, such as its applicability being limited to juices and sugar. For this reason, in recent years, the quantification and control of other microbial metabolites in various factory materials have become important, especially in sugarcane mills with dual production of sugar and ethanol. In addition to dextran, the quality control laboratories determine lactic acid and more recently also mannitol, both by enzymatic methods. From these parameters, we established a relationship between the juice quality and such factors as the delay time between harvesting and processing. It was found that a 75 hour delay time led to a juice with low quality and high acidity, with pH 4.92 ± 0.07. Average mannitol and lactic acid were 3900 and 160 ppm / Brix, respectively. These same metabolites are used

to evaluate cleaning procedures of different stations, such as mill tandems and mud filters. They are also used to improve operations leading to less recirculation of sweet waters that have high levels of these compounds and produce adverse effects on the quality of dilute juice and molasses that go to fermentation. Dextran also has an impact on polarization, leading to overestimation of sucrose. For each 2000 mg/Kg DS of dextran in primary juice, the pol value was found overestimated by 0,4 units. Other adverse effects involve formation of needle grain in crystallization, increased production of final molasses (> 35 Kg molasses per ton of cane), final molasses with high purity (> 38%) and a high potential for floc formation in sugar (> 0.4 AU).

Keywords

Lactic acid, mannitol, dextrans, sugar losses, microorganism.

Sucrose content and purity drop from field to mill in commercial cane

O. Sanchez, L. P. and D. Luzuriaga

Florida Crystals Corporation, FL, USA.

Omar.Sanchez@floridacrystals.com

Abstract

Measurement of sucrose production, sucrose transport to the mil and sucrose recovery is a topic that have received attention from sugar cane research groups and mill operations. Considerable effort and resources are usually devoted to improving mill recovery by unit operations optimization. However, the results reported in the literature and other shared privately, indicated that there is also a sizeable opportunity in sugar transport from field to mill. In many sugarcane operations, sugar transport to the mill involve mechanical harvesting, cane transport, and cane storage. In order to assess this opportunity, a methodology was designed to measure cane composition change from field to mill. Measurements of commercial cane sampled in the field and mill were carried out during the 2017 crop. Purity drop was assessed to understand the variation of sugar content from field to mill. Two kinds of purity were evaluated: Brix Purity (Pol/Brix) and Total Solids Purity (Pol/(Brix+Fiber)). A positive correlation between change of sugar content and purity drop from field to mill was found. This purity drop might have the potential to be used as an indicator to assess harvesting operations.

Cane sugar loss between harvesting and processing

N. Gil and T. Sanchez

Colombian Sugarcane Research Center, Cenicaña, Calle 58 norte No. 3BN-110 Cali, Colombia.

njgil@cenicana.org

Abstract

During the last two years the Colombian sugar industry has experienced a drop in the sugar yield. This led to the need to explore options how to minimize sugar losses in every step of the process. The first strategy was to estimate pol loss between harvesting and processing. For this purpose, a multi-step sampling of cane in the field was implemented, which led to reducing the uncertainty of pol % cane from ±0,8 to ±0.4 units. The contributions to the overall pol loss from burning the cane, the time lag and the trash content were also updated for the three major sugarcane varieties and for the four harvesting methods (mechanical vs. manual harvesting of green or burned cane. The range of pol losses in these four systems ranged from 1.6 to 2.2 units. These losses are of the same magnitude as those observed in the factory. The next step is to find alternatives for their reduction.

Keywords

Sugars harvesting losses, trash matter, multi-step sampling.

Increased inhomogeneities in the field parameters of industrial vacuum pans - the role of steam bubbles and their nucleation

F. Geisendörfer and E. Flöter

Technical University Berlin, Department of Food Process Engineering, the Berlin Sugar Institute, Seestrasse 13, 13353 Berlin, Germany.

Felix.Geisendoerfer@tu-berlin.de

Abstract

In the course of optimizing the energy consumption in industrial vacuum pans reduced surface temperatures cause less obvious boiling phenomena. This induces inhomogeneous distributions of temperature and concentration within the vacuum pans. This is to be avoided in order to reduce variability of crystals and the undesired generation of fines.

The ongoing study aims at both the evaluation how steam bubbles contribute to the mixing inside pans and how they are generated. Homogeneous nucleation of steam bubbles necessitates high over heating and is practically impossible. Four possible origins of steam bubbles have been identified: Circulating microbubbles (steam or inert gases); cavitation effects at the impeller tips; nucleation at crystal surfaces; microbubbles generated in the calandria. Since the observations at industrial scale do not allow to draw conclusions the problem is downscaled. Nucleation of steam bubbles is studied within droplets dispersed in a temperature-controlled oil, for synthetic and real sugar solutions as well as massecuite of both types. While monitoring the process parameters the actual occurrence of the steam bubbles is also observed using a high-speed digital camera.

For the solutions studied bubble nucleation occurs at overheating of approx. 30 K. Sucrose crystals within the test droplets reduced the maximum overheating to approx. 5 K and displace the source of nucleation from the droplet surface to the interior. Bubble nucleation at the crystal surface is clearly observed. Further experiments to be carried out will focus on surface properties, the presence of inert gases and the effect of reduced system pressures.

Bubble formation at crystal surfaces might degrade the sugar quality, causing irregularities and secondary crystal nucleation. Additionally, heavy flash evaporation as observed above the calandria promotes secondary nucleation. Consequently, improved understanding of the bubble formation process is needed to manipulate it deliberately in order to avoid sugar quality issues and inhomogeneities of temperature and concentration.

Keywords

Steam bubble nucleation, bubble formation on crystal surfaces.

Strategies for pan boiling optimization

B. Morgenroth1 and H. Singh Bola2

[1]*PRO Industrieprojekt GmbH, Celler Straße 67, 38114 Braunschweig, Germany*
Morgenroth@ipro-bs.de
[2]*PRO INDIA Private Limited, SCO 236, 1st & 2nd Floor, Sec- 40 D, Chandigarh, India*
Harjeet.Singh@ipro-india.com

Abstract

The steam demand of modern cane sugar factories has come down in recent years to levels between 26 - 35% steam on cane dependent on the type of sugar being produced.

The pan operation affects the overall energy performance considerably. In order to target process steam demands around 30% and to optimise the process steam demand, in order to export more power, it is important to optimise the pan boiling automation systems as well as to review pan designs.

Another important aspect is the sugar quality. The preparation of a good grain quality is a pre-requisite improving sugar quality and also energy efficiency of the plant. The pre-requisites to achieve very little to zero water addition during pan boiling, ideal energy efficiency and crystal quality as well as optimum crystal contents are described. Another goal is achieving a CV value (crystal uniformity) of less than 35. The overall sugar recovery is influenced substantially by the quality of pan operation and as well by employing proper seed material. Usually slurry, dry seed or sugar magma are employed as seed material for the product pans. Another possibility is developing a seed material of ~ 100 – 120 µm grain size as intermediate product. Instead by evaporation/concentration crystal growth can be achieved by cooling crystallization. A good grain quality and perfect automation are the backbones of good crystal recovery, overall sugar recovery and sugar quality.

Key words

Pan automation, energy efficiency, crystal quality.

POSTERS

PROCESSING

Measures to control sugar loss in processing by combination enzymatic - chemical mechanism

M. K. Srivastava , S. Srivastava and P. Srivastava

Biodeg & Kemtech R&D Division (Sugar), 3/4 East Patel Nagar, New Delhi-110008 India.
biodegmk@gmail.com

Abstract

During crushing season, several times harvesting could not be managed at optimum maturity, resulting in damaged and immature cane supply for milling. Further delay in transportation stale cane results in heavy quantities of dextran, starch and other polysaccharides, oligosaccharides, gums and pectins in delivered cane. Dextran reached over 2500 ppm Brix and starch over 3000 ppm Brix in primary juice. Gums and pectins exceeded 4000 ppm Brix. During processing in most of the factories as Birla Sugars, Bajaj Sugars, Dhampur Sugars, Advntez Group etc in the northern India subtropical region, bacterial contamination was in the shape of microbial colony; in mixed juice, filtrate juice, sulphitor, clarifier, syrup, pipe line etc., consisting of mesophilic bacterial, slime forming bacteria's and thermophilic bacteria. The above-mentioned constituents not only impact on direct sugar recovery but also create trouble during processing. In the present investigation, combination of bacterial dextranase, alpha amylase, protease with special broad spectrum biocides have been applied during processing of juice and raw sugar melt in many sulphitation mills and refineries, on commercial scale. Efforts have been made to control sugar loss during milling and increase of dextran in processing by enzymatic hydrolysis to achieve the best ROI. The sugar losses during milling were maintained in the range of 0.4 to 0.5 kg/MT of sugar. These sugar losses were determined by analysing brix, pol %, purity, rise in reducing sugars and acidity by titration from primary juice to mix juice. The total losses were counted by the addition of all losses (reducing sugars and acidity). About 60% reduction in dextran and starch was seen during hydrolysis at primary juice, mixed juice, filtrate juice, raw sugar melt etc. Control of sucrose loss during milling is more important rather than enzymatic hydrolysis for improving sugar in the bag. Implementation of enzymes at suitable places and optimum pH, temperature and residence time are more important than the dose used.

New starch methodology to measure both insoluble and soluble starch in sugarcane products and what it means for the factory and refinery

G. Eggleston[1,2*] and M. Cole[1,3]

[1]USDA-ARS-Southern Regional Research Center, New Orleans, LA 70124, USA. geggleston@agcenter.lsu.edu

[2]Present Address: Audubon Sugar Institute, LSU AgCenter, St. Gabriel, LA 70776, USA.

[3]Louisiana Tech University, Dept. of Chemistry, Ruston, LA 71272, USA.

Abstract

Starch exists as storage granules (insoluble physical form) in sugarcane and is composed of long, entangled glucose chains (amylose and amylopectin; soluble physical form). With the development of the USDA Research method and Cole Factory method to measure insoluble and soluble starch forms, a much deeper understanding of starch forms at the sugarcane factory and refinery has now been obtained. Both forms of starch affect sugar processing and conversion including: (i) viscosity problems, (ii) insoluble starch persistence across processing streams, (ii) presence of both starch forms in both raw and refined sugars, (iv) efficiency of amylase application at the factory, (v) carbonatation syrup clarification, and (vi) mud creation and filtration at the refinery. Starch from sugarcane (a grass) behaves much more similarly to corn (a grass) than potato (a tuberous root) starch, and this is also discussed.

Sugarcane genotype responses to glyphosate and trinexapac-ethyl chemical ripeners for starch and color

G. Eggleston,[1,2*] A. Triplett,[1] E. Petrie,[3] E. St. Cyr,[1] K. Didier,[1] C. Kimbeng,[4] G. Myers,[5] and H. Waguespack, Jr.[6]

[1]*USDA-ARS-Southern Regional Research Center, New Orleans, LA 70124, USA.*
*geggleston@agcenter.lsu.edu

[2]*Present Address: Audubon Sugar Institute, LSU AgCenter, St. Gabriel, LA 70776, USA.*

[3]*USDA-ARS Houma Research Station, Houma, LA 70306, USA.*

[4]*Sugarcane Research Station, LSU AgCenter, St. Gabriel, LA 70776, USA.*

[5]*School of Plant, Environmental, and Soil Sciences, LSU AgCenter, Baton Rouge, LA 70803, USA.*

[6]*American Sugar Cane League, Thibodaux, LA 70301, USA.*

Abstract

Chemical ripener is routinely applied to sugarcane around the world to accelerate sugarcane maturity and prolong the period of maximum stalk sucrose concentration, and is considered an important economic component of sugarcane management strategy. Unfortunately, little is still known about the impact of chemical ripeners on factory processing parameters. A two year study was conducted in south Louisiana on the effect of glyphosate (Polado®; 5.3 oz/acre) and trinexapac-theyl (Moddus®; 11 oz/acre) chemical ripeners on nine sugarcane genotypes (varieties) harvested 4,5, 6, and 7 weeks after treatment or no-treatment (control). In the first year Polado and Moddus increased ($P<0.05$) theoretical recoverable sugar (TRS) by 4.6 and 4.4%, respectively, while in the second year when yields were significantly higher, they increased ($P<0.05$) TRS by 9.9 and 7.0%, respectively. The two ripeners had more effect on TRS in stalk juice than juice from stalk and leaves and, as expected, there was a strong varietal effect for TRS with and without ripener treatment. Most of the starch in the treated and untreated juiceds was insoluble and in both years both ripeners

increased total starch by at least 20%. In the first year Polado and Moddus increased total (insoluble plus soluble) starch by 20.6 and 20.5%, respectively, while in the second year when yields were significantly higher, they increased ($P<0.05$) total starch by 35.7 and 22.5%, respectively. Total starch was highest 7 weeks after ripener treatment but this strongly depended ($P<0.05$) on sugarcane variety. ICUMSA color was measured at pH 4.0, 7.0, 8.5, and 9.0 and did not vary as much as the starch values. Ripener slightly reduced color (1.1 to 5.2%) and this was not always significant at the 5% probability level. Ripeners did, however, increase in the variation in color. Since starch can increase the viscosity of downstream products at the factory, management of ripened sugarcane varieties that more strongly respond to ripener for starch may need to be changed, e.g., deliver to the factory at different times.

Dextran as an indicator of freshness evaluation of sugarcane

Ying Liu[1], Guo-wei Chang[1], Rong-zhen Lin[2], Gui-yun Liu[1], Bu Ma[2] and Da-feng Liang[1], [2*].

[1]Guangdong Provincial Engineering and Technique Research Centre of Enzyme and Biocatalysis, Guangdong Provincial Bioengineering Institute, Guangzhou 510316, Guangdong, China.

[2]Guangxi State Farms Sugar Industrial Group Company Limited, Guangxi Sugarcane Industry R&D Center, Nanning 530002, Guangxi, China.

lynette.liu@qq.com, ldfjt@126.com

Abstract

The quality of sugarcane has a direct impact on processing data and benefits of sugar factories. Reasonable evaluation of sugarcane freshness is an important part of improving quality management of sugarcane. The drawbacks of traditional indicators of sugarcane quality (including sucrose, reducing sugars, purity, fiber and so on) are as follow: (1) not the characteristic products that appeared only when sugarcane deteriorated. (2) varied by varieties, growth and maturity conditions, lack of a standard value for comparison (3) lag evaluated by relative changes.

The main causes of sugarcane deterioration are enzymolysis, chemical degradation and microbial destruction, among which microbial destruction is the most serious factor. Leuconostoc mesenteroides which is one of the most common bacteria in sugar factory, can infect sugarcane and cane juices, and convert sucrose to dextran. Dextran does not form in the normal growth of sugarcane, it appears only when sugarcane is injured and infected by bacteria, so that dextran could be a direct and reliable indicator of showing deterioration. Presence of dextran is known to cause a variety of processing problems, each having financial impact beyond the mere sucrose loss. The presence of dextran in processing streams following post-harvest degradation of sugarcane prior to milling requires increased use of lime and other chemicals because of the high viscosity and acidity associated with dextran. The high viscosity of dextran also lowers the settling rate in clarification, forms scale deposits, reduces the heat transfer and causes blockage of the filters. The increase of dextran concentration

in the syrup reduces the speed of crystal growth in the crystallizers. Dextran has brought many troubles and problems to sugar industry. Using dextran as an evaluation indicator of sugarcane freshness shows great importance of guiding sugarcane quality management and sugar production.

Monitoring dextran was not part of the daily test in sugar factories in China until the recently developed anti-dextran monoclonal test kit had been introduced. More than 20 sugar mills in China began to use dextran as a daily production indicator from the 2014 / 2015 press season. The freshness of sugarcane was tracked and evaluated through the detection of dextran in the first press juice. The statistical results showed that the higher the dextran in the first juice, the lower the recovery rate of sugar, dextran could be a reliable and direct indicator for evaluating the freshness of sugarcane.

Unlocking challenges and developing enzyme products for the sugarcane industry: Enzymatic bleaching technology

E. A. Borges da Silva, G. Rodenbusch, B. Vanelli and V. G. Medina

Novozymes Latin America Ltda., Rua Professor Francisco Ribeiro 683, 83707-660 Araucária - PR Brazil.

EABS@novozymes.com

Abstract

In the called quality-based payment system, the price of sugar is based on polarization and other quality parameters leading to penalties or bonuses on marketable product. One sugar quality specification that increase level of penalties is related to color (whole raw and refined sugar). White sugar has the highest price in the sugar industry and several chemical and energy intensive steps are required in order to remove color. The exact process stream from extracted cane or beet juice varies but generally the material is flocculated to remove impurities and then sequentially crystallized, dissolved and treated with bleaching agents (flocculants, phosphoric acid, sulphites). The chemical substitution by enzymes are quite attractive by the mills (safety, sustainability, energy and resources savings). Less color in molasses and less water to wash out the molasses from the crystals surface can save 7 to 21% of sugar being dissolved in centrifuges. Novozymes has investigated oxidoreductases as an outstanding enzymatic solution to minimize the color of sugarcane juices, remove non-sugar solids, ensure the improvement of quality of final sugar, with chemicals savings in both sugar factories and refineries. One characteristic of the carbohydrate oxidase enzyme class is the use of molecular oxygen as a terminal electron acceptor thus producing hydrogen peroxide as a by-product for every unit of oxidized product produced. Around 30-40% of colour reduction is reached when oxidases are applied on sugarcane substrates. Kinetic profiles and enzymatic performance with different pH and temperatures were addressed. Novozymes is continuously looking for advantageous partnerships committed to research and delivering this sustainable innovation to sugar bleaching.

Rapid methods for starch analysis in cane juice

M. Saska, S. Zossi, M. Sastre and M. Ruiz

Estación Experimental Agroindustrial Obispo Colombres, Av. William Cross 3150 Las Talitas, Tucuman, Argentina.

drmsaska@gmail.com

Abstract

When large numbers of samples are to be handled, rapid methods for starch in raw juice are needed. Two such procedures are the ones published by the Vasantdada Sugar Institute (VSI) and the Sugar Processing Research Inc. (SPRI). However, in our tests on the same set of raw juices the VSI procedure gave starch levels some 3-6 times higher than the SPRI technique. Our results also indicate that during heating of juice needed to render starch soluble and reactive with the iodine reagent, part of the starch is bound or entrained by the coagulated cane proteins. This coagulated protein–starch complex (or coagulated protein-iodine-starch complex if the iodine reaction is done prior to centrifugation) is to a large degree removed by centrifugation (the SPRI method) and to a lesser degree by coarse filtration (the VSI method). The starch concentration by the overall procedure is then underestimated by the amount of starch bound in the complex and removed by centrifugation or filtration. In view of our findings, the previously published validations of the 'rapid' starch methods for cane juice appear inadequate as they failed to measure recovery of starch added directly to raw cane juice and thus omitted the crucial boiling and solid-liquid separation steps. Our initial experiments indicate that at 15% effective concentration CaCl2 prevents co-precipitation of starch during heat-denaturing of cane proteins and thus may provide a viable modification to the existing rapid starch methods.

Modifications of the Roberts' method for total soluble polysaccharides in refined and raw cane sugars

M. Saska, S. Zossi, M. Sastre, R. Torres and M. Ruiz

Estación Experimental Agroindustrial Obispo Colombres, Av. William Cross 3150 Las Talitas, Tucuman, Argentina.

drmsaska@gmail.com

Abstract

In raw and refined sugar produced from sugarcane, polysaccharides form the third major group of contaminants, on par with reducing sugars and ash. Regardless of their origin or chemistry, at even low levels polysaccharides raise the cost of production, reduce sugar yield and negatively affect commercial quality of the final product. High levels of total soluble polysaccharides (TSP) are a positive indicator for acid beverage floc formation in refined sugar. Their levels in principal process streams should be routinely monitored as part of optimizing field and factory operations. Several modifications to the original Roberts' technique have been introduced to reduce its cost, simplify the procedures where possible and improve its sensitivity so as to render the method applicable also to refined sugar. Partial validation of the modified method was undertaken and the recovery of 100% was found for starch and a high MW dextran. The method is now routinely used in the EEAOC laboratories for both raw and white sugars with the TSP range of about 100 to 2,000 mg/kg. TSP in raws was found to range between 400 and 800 mg/kg, while in the highest quality refined sugars it was between 80 and 100 mg/kg. However, high TSP levels of 200 to 300 mg/kg were quite frequently detected in otherwise high quality refined sugars.

Reduction in sucrose loss by elimination of some stations at a cane sugar plant

M. Narendranath

The Andhra Sugars Ltd., INDIA 534 215, (AP).

narendra.tnk@gmail.com

Abstract

Most sugar mills around the world continue using the milling tandem. The cane sugar industry started using diffusion at the extraction station in the 1960's. With the use of diffusers, some cane sugar plants around the 1990's started sending the clarifier underflow to the diffuser, eliminating vacuum filter station. The Andhra Sugars Ltd., at their Plant-3 which produces plantation white sugar, trials were undertaken to do juice clarification in the diffuser, to eliminate the clarification station where significant inversion losses take place due to the long residence time.

Three process configurations were used to clarify Juice in the diffuser. In configuration 1 with 4.7 minutes filtration time over 4.5 meters of cane bed, steady conditions were not achieved. In configuration 2 with 9 minutes filtration time and 9 meters filtration length, steady conditions were achieved with improvement in color, turbidity and transmittance value. In configuration 3 with 14 minutes filtration time and 13 meters filtration length, the results were similar to configuration 2 but there was a reduction in extraction due to increase in bagasse pol. Of the 3 configurations tested, configuration 2 appears to be the one to use for clarification of juice in the diffuser.

Clarifying juice in the diffuser enables dispensing of the juice clarification station at a cane sugar plant producing raw sugar. By elimination of the vacuum filter station, there is a reduction in sucrose loss to the extent of 0.3 kg per ton of cane, while with the elimination of the juice clarification station there is reduction in sucrose loss to the extent of 0.5 kg per ton of cane. The sucrose yield before modification was 100.2 kg per ton of cane while after modification it was 101 kg per ton of cane.

Keywords

Sucrose loss, Cane Diffuser, Juice Clarifier, Vacuum Filter.

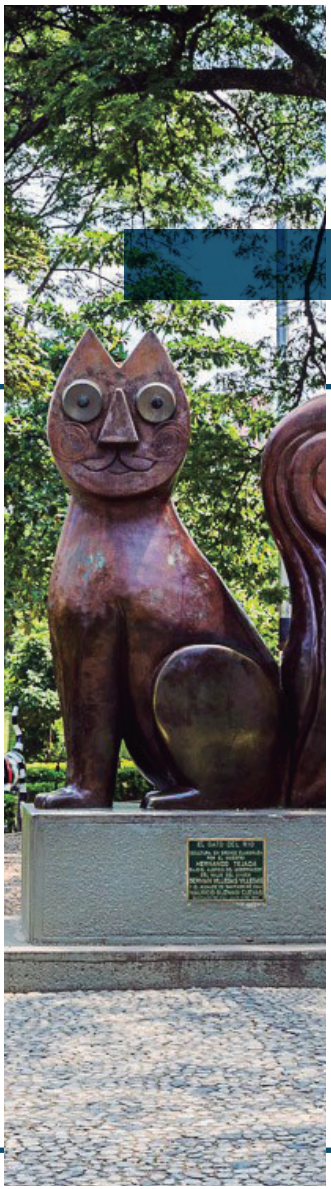


Tourist Information

Monumento a Sebastián de Belalcázar

Cali is a city in the southwest of Colombia, capital of the Valle del Cauca department. It has about 2.5 million inhabitants and is a significant industrial and commercial center of activity in Colombia. Being at around 1,000 meters above sea level it tends to have a warm midday and afternoon with nice Pacific Ocean breezes while nights are cool. Cali is today's world capital of salsa, claiming that competitive distinction even over Colombia's other vibrant big city party scenes, which keep the music going long into the late hours of the morning.

The “Sucursal del Cielo” (literally “the Branch Office of Heaven"), as Cali is known as, has a lot of places to visit and enjoy, each one with different attractions to all kind of tastes some of them are: San Antonio, El Peñon and Granada neighborhoods with their beautiful architecture and the amazing gastronomic proposals; the zoo, the modern art museum “La Tertulia", and “El peñon" park, Gato de Tejada, “La Ermita" church and the Cali Tower among others.



Gato de Tejada

Cali Culture / nightlife In Cali, there are old buildings that form a part of the most important tourist attractions in the city. The majority of the churches, theaters and museums can be found in buildings featuring magnificent architecture that stand out from their modern counterparts. There are also a number of monuments that reflect part of its history and its essence as a city.

The weather, the people, the view, the ambience and the beautiful places get mixed to offer on its uncountable discos, bars and clubs one of the most spectacular parties in Colombia, being the Salsa music one of the emblems of the city and all the establishments offers many options to enjoy this kind of music.

NOTES

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Designer: Andrea Campiño B.

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