



## ISSCT Factory Commission

### Factory Processing Webinar

Thursday 29 September, 2022

11:00 a.m. GMT

#### ***“Current Factory Processing Challenges for the International Sugar Industry”***

As part of the series of Webinars that will be organized by the ISSCT in 2022 for its different disciplines, this will be the second one held by the **Factory Commission** on **Thursday 29 September 2022 at 11 a.m. GMT**

#### **Programme**

Introduction by **Gillian Eggleston, Chair ISSCT Processing Section**

#### **Industry 4.0**

**Industry 4.0 perspectives and challenges for the sugar industry** (20 min) by **Julio Calpa, Cenicana, Colombia**

The dynamics of the market and the variability of the sugarcane quality changes for the harvesting practices and the effects of weather increase the necessity to use other tools in the factory than allow us an operation more flexible and adaptative to meet the standards. Industry 4.0 tools are an opportunity for the sugar industry to improve its performance, control of operations, and decision-making. Some benefits include the possibility of reducing time for analysis, predictability of process performance, and better communication between the different areas of the factory.

**SMRI progress on factory-based industry 4.0 projects** (20 min) by **Steve Davis, SMRI, South Africa**

Fourth Industrial Revolution (4IR) principles and technologies have recently gained much attention in the process industries in terms of generating and interpreting big data sets to better understand and control processes. The Sugar Milling Research Institute NPC (SMRI) is developing appropriate 4IR technologies for application in the South African sugarcane processing

industry to assist the industry to improve sugar recovery and energy efficiency performance. Several research projects are being undertaken in host factories through the Sugarcane Technology Enabling Programme – Sugar Factory 4.0 (STEP-SF4.0), which has been funded by the sugar milling industry and the South African Department of Science and Innovation's Sector Innovation Fund. This presentation will highlight selected projects undertaken and some findings and challenges encountered.

**Progress with SMRI-NIRS roll-out in South and southern African sugarcane factories (20 min) by Steve Davis and Steve Walford, SMRI, South Africa**

The Sugar Milling Research Institute NPC (SMRI) explored the possible use of Near Infrared Spectroscopy (NIRS) for sugar process stream analysis for more than 15 years before introducing the technology, for use at the SMRI, for analysis of final molasses. Following the development of prediction equations for all sugar factory streams, the technology was adopted firstly by the South African sugar industry followed by the southern African members of the SMRI. The technology, referred to as SMRI-NIRS, is now a routine process stream analysis method used by the majority of the SMRI main members, and is fully integrated into the factory control systems.

Besides routine analysis, benefits of the technology include providing users with 'beyond the normal' process metrics such as evaporator inversion results and individual C-centrifugal target purity difference results on a routine basis. Such metrics are now included in factory reporting systems. This in turn has resulted in the development of equipment such as the SMRI Mini-Nutsch filter to complement the SMRI-NIRS analysis method.

Maintaining the robustness of the SMRI-NIRS technology across the industry has required equation maintenance and annual updates, and the development of suitable audit and validation schemes to ensure correct use of the system in the mill environment. Investigation and development of new applications within the industry are continuing, such as the use of discriminant analysis to identify deteriorated cane before it enters the factory to provide mill personnel with advance warning of possible future backend problems.

**Impurities at the Factory and Their Mitigation**

**Impurities in the sugarcane processing industry: what alternatives do we have to mitigate their impact on the quality and efficiency of the process (20 min) by Lina Marcela Arévalo and Juan Gabriel Rodríguez, Cenicana, Colombia**

The progress of the sugarcane industry and the change from burnt to unburnt (green) sugar cane harvesting have represented an interesting opportunity for

increasing productivity and biomass source availability, as a diversification driver. However, significant issues arise in the processing of juice expressed from the whole crop for raw sugar and ethanol manufacture. The impurities composition of sugarcane juices in the Colombian context have shown high levels of organic acids, polysaccharides and minerals that can be related with operational drawbacks in juice clarification, evaporation, and crystallization that have been observed in the last four years. In this regard, the Colombian Sugarcane Research Center, Cenicaña, has been working on understanding impurities dynamics in sugar boiling house and alternative evaluation to remove these impurities. Some challenges have been found on this subject, such as partial efficiency, operational limitations and costs of process chemicals in the use of these treatments in Colombian sugar processing.

### **Fructans are a more pervasive polysaccharide in the sugarcane industry than previously considered by Gillian Eggleston and Giovanna Aita, ASI, USA**

For over 100 years, sugar technologists around the world have focused on the glucose polymer dextran as the major polysaccharide causing processing problems in both sugarcane and sugar beet factories. Fructan (levan) is a fructose polysaccharide connected by  $\beta$ 2 $\rightarrow$ 6 glycosidic linkages but, compared to dextran, the amounts of fructan in factory products are much less known. A large problem was the lack of and/or complexity of a specific analytical method to measure fructan. By using a new enzymatic (research) method that incorporates newly available recombinant enzymes, which comes in kit form from Megazyme®, considerable amounts of fructan (>9000 mg/kg) were consistently found in final (C) molasses from Louisiana sugarcane factories indicating it has been previously underestimated. Results were verified by breaking down the fructan with inulinase and measuring resultant products with ion chromatography. Fructan was observed to be strongly related to the recovery of sucrose in upstream and downstream factory products. Results also have, at least to a partial extent, explained why total polysaccharides are often much greater than Haze dextran values in Louisiana. A major source of fructan is the microbial deterioration of sugarcane outside and/or inside the factory. Using modern isolation and PCR techniques, isolates from cane first expressed juice in Louisiana showed that all dextran-forming microorganisms surprisingly formed fructan as well. All microbial strains could produce fructan over a wide range of pH values (4.5 to 8.5) with the highest concentrations formed at  $\geq$  pH 6.5. Fructan was also formed from 18 to 35 °C with highest concentrations at  $\sim$ 25 °C. Biocides such as sodium hypochlorite (bleach) and sodium carbamate that control dextran can control fructans. Preliminary studies have indicated levan can interact with other cane polysaccharides and enhance viscosity. Research is ongoing on the control of fructan at the factory and what other process parameters it is detrimentally affecting.

**The facilitators/organizers are:**

- Dr. Gillian Eggleston, Audubon Sugar Institute, Louisiana State University AgCenter, USA
- Dr. Boris Morgenroth, IPRO Industrieprojekt GmbH, Germany
- Mr. Steve Davis, Sugar Milling Research Institute, South Africa
- and other Processing Section members

## **Discussions**

## **Q&A Session**

## **Conclusion**

## **Language**

The Webinar will be conducted in English.

## **Registration**

The Registration Form for the Webinar may be accessed through the following link:

[https://us06web.zoom.us/meeting/register/tZ0tcu2grisiEtE\\_JSFMkfac8QXM6oe\\_g5qTP](https://us06web.zoom.us/meeting/register/tZ0tcu2grisiEtE_JSFMkfac8QXM6oe_g5qTP)

The Webinar is only open to compliant members of ISSCT. When you register for the webinar, your registration will be checked against ISSCT membership and payment records, and you will receive an e-mail with the meeting details (Username and Password to access the Webinar). If you have outstanding membership dues, you will be asked to pay these online before your registration is approved. The Individual Membership dues are USD 140 and may be settled through the following link:

[http://members.issct.org/appform/issct\\_india\\_2022.aspx](http://members.issct.org/appform/issct_india_2022.aspx)

## **Further information**

For further information, please contact the ISSCT **Processing Section Chair** – Gillian Eggleston at [geggleston@agcenter.lsu.edu](mailto:geggleston@agcenter.lsu.edu) or the ISSCT Secretariat at [issct@intnet.mu](mailto:issct@intnet.mu)

**Julio Calpa** is an Electronic Engineer and is currently enrolled in a master's degree in Computational Engineering. Julio has over 6 years of experience in the sugar industry at the Colombian Sugarcane Research Center (Cenicaña). He had worked on different research projects at Cenicaña, developing solutions to improve the stability in areas of the factory using better control strategies, selection of instruments, and tools for process analysis. He is currently leading a project for developing better standards for process automation and he is

working on initiatives to promote the adoption of industry 4.0 tools in the factories.

**Steve Davis** is the Research and Development Manager at the Sugar Milling Research Institute NPC (SMRI) in Durban, South Africa, which he joined in 1994. A Professional Chemical Engineer, he studied for his BSc and MSc in Engineering at the University of Natal in Durban. He has diverse sugarcane processing technology research interests, especially clarification and colour removal processes and tracer testing. He manages the Research and Development group at the SMRI in providing research outcomes to assist the processing industry to move towards an integrated biorefinery model to enhance sustainability, as well as developing 4<sup>th</sup> Industrial Revolution technologies to assist the sugar industry to improve performance and recoveries. He has written and presented numerous papers at SASTA, ISSCT and other local and international sugarcane and chemical engineering congresses and workshops.

**Steve Walford** is the analytical Quality & Development Manager, Sugar Milling Research Institute NPC (SMRI), South Africa. Stephen has a research interest in analytical and chemometric techniques and instrumentation, particularly in the analysis of sugars and sugar solutions. He has devoted the last nine years to the development and implementation of the Near Infrared Spectroscopy technology within the mill environment. He has presented at both local and international conferences and is the chairman of the South African National Committee for ICUMSA, the current chairperson of FCAC, a member of the American Chemical Society, the Association of Analytical Chemists, the South African Spectroscopy Society, and a Professional Natural Scientist. Outside of work, he has interests in woodwork and music .

**Lina Marcela Arévalo** is a Chemical Engineer, and has a master degree in Design and Formulation of Chemical Products, and has over eight years of research and consulting experience in the sugar industry. Since joining the Colombian Sugarcane Research Center (Cenicaña), she has knowledge and experience in the development of strategies for sugar boiling house recovery improvement. Lina also trains sugar technologists and supervisors in the sugar manufacturing industry, particularly on undetermined loss control approaches and the area of clarification and mud filtration.

**Juan Gabriel Rodriguez** is a Chemical Engineer and has a Master's degree in Engineering with emphasis in Chemical Engineering and has over 13 years of research experience in the sugar industry working for the Colombian Sugarcane Research Center (Cenicaña). He had worked on projects related to energy efficiency and juice purification. Currently, he is leading projects related to increase efficiency of sucrose recovery and development of tools for process analysis.

**Gillian Eggleston** is the Director of the Audubon Sugar Institute (ASI), part of LSU AgCenter as well as a Full Professor. Before that, she spent 24 years leading the sugar Project of the United States Dept. of Agriculture in New Orleans, USA. During her career, she has had numerous accomplishments with her research having had major commercial and scientific impact in the worldwide sugar and related industries. Her research has resulted in over 400 publications (including 6 books and 169 peer reviewed journal papers). Her major scientific and commercial accomplishments are reflected in 34 national and international awards, and she is also a Fellow of the American Chemical Society. Since coming to LSU she has introduced new outreach programs including the new Audubon Laboratory Service. Dr. Eggleston frequently gives international KeyNote, plenary, and workshop presentations, and consults extensively worldwide, within her field of industrial processing of sugarcane, sugar beet, and sweet sorghum, and even beyond in areas such as food and beverages. She received her B.Sc. in Chemistry and Biochemistry in 1984 from the University of Nottingham, UK, and her Ph.D. in 1989 in Carbohydrate Biophysics from Cranfield Institute of Technology, UK.

**Giovanna M. Aita** is a tenured Professor at the Audubon Sugar Institute at Louisiana State University Agricultural Center with adjunct appointments in the School of Nutrition and Food Sciences and in the Department of Biological and Agricultural Engineering. She has over 20 years of research experience focusing on the bioconversion of renewable biomass (agricultural and woody residues) and sugarcane by-products into alternative chemicals, with applications in the sugar, food, nutraceutical, and pharmaceutical industries. Dr. Aita's research has resulted in over 80 peer-reviewed publications and book chapters, and in the recruitment and mentoring of graduate students, research associates, postdoctoral fellows, and visiting scholars, as well as recognition from both industry and academia. Dr. Aita has received research funding from federal agencies, state agencies, non-profit organizations, and industry totaling USD\$14M. She holds B.S. (biology) and M.S. (food microbiology) degrees from Clemson University, and a Ph.D. degree in microbiology from the School of Nutrition and Food Sciences at Louisiana State University.