

SRDC Travel and Learning Project

Final Report

Project title:	Sugar Processing Research Institute Inc. (SPRI) Conference on sugar processing research
SRDC project number:	TLOP809 NSC015
Participating people and/or organisation(s):	Stephen King NSW Sugar Milling Cooperative Ltd
Project contact(s):	Stephen King
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Summary: (approx. 800 words)

- Project objective/s
 1. Attend the 2008 SPRI sponsored conference on sugar processing research with the theme of 'Diversifying research in processing of raw and white cane and beet sugar'.
 2. Develop an understanding on the focus and direction of international research in refined sugar processing.
 3. Use the information gained to develop a strategy to undertake factory improvements and advancements at the Manildra Harwood Sugars refinery.
 4. Develop a network of contacts of international refinery technologists.
- Overview of key learnings, achievements and/or knowledge gained
 1. The SPRI Conference "Diversifying Research in the Processing of Raw and White Cane and Beet Sugar" was attended from 28 September to 1 October 2008 at Delray Beach, Florida, USA.
 2. Factory visits at: Okeelanta Mill, Refinery and Cogeneration Facility: Sugar Cane Growers Cooperative of Florida Glades Sugar House; and, Clewiston Mill and Refinery.
 3. Key learning/knowledge outcomes were:
 - Industry Diversification. There is an urgent need for the sugar industry to transform into an integrated industry producing food (sugar, syrups, yeasts), biofuels (ethanol, biodiesel, biomethane), power (electricity, heat), and fine and bulk chemicals (petrochemicals substitutes). The USA cane industry has engaged their federal government to provide a regulatory framework that will drive this transformation, eg mandated renewable energy targets, high biomass (sugar and cellulose) canes USDA program, trade support. The Australian industry is yet to achieve this.
 - Biotechnology. A large USA research program targets the development of biotech sugar cane plants with improved herbicide, disease, insect, stress tolerance (ie, cold, drought, etc), enhanced sucrose accumulation and alternative products. The USDA has an ethanol program to develop high biomass yielding varieties, with three varieties already released.
 - Energy. Cellulosic ethanol and biodiesel are the main research focuses for liquid fuel production and involves high fibre cane varieties, companion grasses and oil seeds. A process to produce bioenergy (methane) from filter cake using enzymes and fermentative bacteria that would produce 25,000 cubic metres of methane from a 10,000 tonne cane a day mil.
 - New commercial products.
 - A new designed wet scrubber used in the control of air pollution from bagasse boilers.
 - A fluidised bed sugar conditioner for refined sugar.
 - Refinery liquor stream decolourants chemicals.
 - Solid bowl decanting centrifuge for filtering mill clarifier mud.
 - Horizon science "low GI sugar" produced from molasses polyphenols was presented. There is considerable commercial interest from the Florida industry, which has the benefit of the vast North American market to support the product.

- Processing issues.
 - The benefits of polyaluminium coagulants in mill clarification.
 - Operation of a cane syrup clarifier.
 - Novel method to attach mud filter screens.
 - Cogen stockpile management at Okeelanta mill – control of spontaneous combustion, handling wood waste, dewatering mill at the fuel stockpile.
 - Operation of Kestner evaporators – heat transfer coefficients 20% better than Roberts vessels.
 - Juice heating in Barriquand Platular heat exchangers using surplus hot condensate and 3rd, 2nd and 1st vapours.
 - Multijet condensor operation to avoid the use of vacuum pumps.
- Analytical.
 - The use of NIR spectrophotometry to analyse juice and process streams for pol, brix, reducing sugars.
 - A lead subacetate free sugar laboratory operation.
 - Instrument supplier contacts for refractometers and UV-VIS spectrophotometers.
- Training. After a 30 year sabbatical, a Sugar Technology Degree course has resumed in Florida as a response to industry demands. The Australian industry is experiencing a similar need with the chronic drain of sugar technology skills.
- Summary of implications and recommendations resulting from project
 - Diversification. It is obvious that Australia lags far behind the US and other countries (Brazil, Mexico, Mauritius, Reunion, India) in diversification into biofuels, biopower, and biochemicals. The industry needs to engage the government to recognise sugar cane as the paramount producer of food, renewable energy and biochemicals from sunlight.
 - Biotechnology. The need for high biomass, energy, flood and cold tolerant canes is highly relevant to the NSW Industry and it's cogeneration operations. The NSW industry Agricultural Services Manager has been informed.
 - Energy. The cellulosic ethanol focus supports the NSW industry decision to host the EthTec program and pilot plant at Harwood.
 - New Commercial Products.
 - Boiler Stack Wet scrubber. Of interest is the newly developed MikroPul, Australia "Venturi Scrubber" which requires less space, energy and expense in ducting, and is more compact than the Mikrovane. Harwood will be forced by the Environmental Agency to upgrade it's stack emission control system in the future.
 - The BMA fluidised bed sugar conditioner has direct application to the refined sugar "caking" issues experienced in the Refinery. The supplier has been contracted for further information and pricing.
 - The EcoSorb refinery liquor stream decolourants chemicals have been sourced from the US supplier and bench tested on the Refinery phosphatation clarification with excellent results. A financial analysis is underway before a factory trial is implemented. The products will assist the Refinery to manage the high colour load sugar produced from whole cane milling. Australian suppliers of similar products have been identified and are also currently under evaluation.
 - Processing Issues.
 - Mill syrup clarification. A full factory trial at Harwood was successfully conducted for two days in November 2008 using the Refinery clarifier. This was the first time that such a trial has been done in Australia. The benefits of the process were quantifiable and significant, and is a real option for the improvements in raw sugar quality and process recovery at the Broadwater and Condong whole cane mills. A report is currently being completed.
 - Solid Bowl Centrifuge. The improved wash systems on the machines at Clewiston mill are to be investigated for incorporation on the Refinery Scum Centrifuge to improve sugar recovery. Details have been supplied.
 - Mill clarification coagulants. SPRI have made significant development on the use of polyaluminium chloride / polyamine / poly-DADMAC formulations to remove colour, turbidity and ash. It has been recommended to management that the Cooperative join SPRI to access the formulations for trial at the whole cane mills.
 - Mud filter screens. The method of attachment is to be trailed at Harwood in the 2009 season.

- Barriquand Platular juice heat exchangers. The thermal, hydraulic and maintenance efficiency of these devices make them an ideal option for cogen energy efficiency program.
- Analytical and environmental
 - NIR spectrophotometer analysis of juice and process streams will be examined in terms of accuracy and economy, especially avoiding the use of lead subacetate. The USA has two suppliers of instruments – FOSS and Unity.
 - Substitution of lead subacetate with OctaPol reagent is to be trailed and financially analysed.
 - Suppliers of spectrophotometers for refined sugar analysis are being followed up.

Itinerary (if relevant):

N/A

Summary of conferences attended or meetings held, including persons met and summary of discussions and outcomes (if relevant):

SPRI Conference.

The primary activity was attending the Conference on Sugar Processing Research sponsored by SPRI. The theme of this year's conference was "Diversifying Research in the Processing of Raw and White Cane and Beet Sugar" and was held from 28 September to 1 October 2008 at Delray Beach, Florida, USA. There were 74 delegates from 16 countries representing cane and beet sugar producers, industrial sugar users and suppliers to the industry. In contrast to the ASSCT Conferences, the majority of delegates were from executive ranks (ie, directors, vice-presidents) with very few practising technologists. The technical sessions were for 2 days, with 30 full papers and 4 posters presented. A technical tour was organised for the final day to the Florida Okeelanta Mill, Refinery and Co-generation facility.

Factory Visits – summary discussions and outcomes detailed above.

- Okeelanta Mill, Refinery and Cogeneration Facility – factory visit as part of Conference.
- Sugar Cane Growers Cooperative of Florida Glades Sugar House. Private tour of factory and Laboratory by Aubrey Trotman, Laboratory Supervisor. Highly developed NIR spectroscopy applications. A vacuum pan centre well circulation baffle.
- Clewiston Mill. Private tour with Bruce McManus, Process Manager. Items of interest were: Barriquand Platular juice heat exchangers, Mill syrup clarification, Kestner evaporators, steam economy measures and back end Refinery, solid bowl decanting centrifuge.

Economic, Environmental and/or Social benefits to the Australian sugar industry, the community and/or the participants that will accrue from the project:

Benefits to NSW Sugar:

- The diversification strategy of NSW into a renewable, sustainable energy provider via its cogeneration plants was strongly reinforced and its ongoing expansion should be encouraged from an economic, environmental and social perspective.
- Solutions to current industry issues that will improve the financial viability of the industry and the flow on effects to the economy and community include:
 - Reduced environmental air emissions - MikroPul, Australia "Venturi Scrubber".
 - Fluidised bed sugar conditioner to reduce refined sugar "caking".
 - Decolourants that will assist in refining sugar produced from "whole cane milling".
 - Improved "whole cane milling" sugar quality and recovery by use of clarifier coagulants and syrup clarification.
 - Energy efficient equipment to maximise electricity available for export – Barriquand heat exchangers and Kestner evaporators.

Benefits for the Australian Industry.

- The proposition of an integrated food, biofuel, power and fine / bulk chemical facility to obtain maximum utilisation of the cane plants ability to convert sunlight into biomass was conceptualised.
- A paradigm shift to extended operating campaigns, develop high biomass canes and companion grasses that will allow better utilisation of installed factory capacity to produce not just sugar, but liquid fuel, electricity and fine / bulk chemicals.

- Energy efficient equipment to maximise energy available for export – Barriquand heat exchangers and Kestner evaporators.
- NIR spectroscopy for rapid analysis and as a substitute for toxic lead salts in sugar laboratories.
- The importance of maintaining the sugar industry technological skills and knowledge through formal training.

Means of communicating the findings of the project to relevant stakeholders. (Include copies of any articles, press releases, etc. that have been prepared):

- A 2009 ASSCT paper has been submitted (attached).
- An article will be published in the Sunshine News next quarter.
- Presentation to local Harwood technologists and personnel will be done during the next team meeting in February 2009.

Recommendations on how knowledge or information gained can be used or transferred to projects or the industry (at a local and/or industry-wide level):

- A paper has been submitted for the 2009 ASSCT covering key elements of the Conference and other observations.

Attachment 1.

A REPORT ON THE SPRI CONFERENCE ON SUGAR PROCESSING RESEARCH 2008

By
S KING

New South Wales Sugar Milling Co-operative Ltd, Harwood.

Keywords: SPRI, Conference, Overseas, Visit.

Abstract.

This paper reports on the 2008 SPRI Conference on sugar processing research, new sugar technology, products, processing and energy held in Florida in October 2008.

Introduction.

This paper reports on the 2008 SPRI Conference on sugar processing research, new sugar technology, products, processing and energy held in Florida in October 2008.

The Conference.

The Conference on Sugar Processing Research is sponsored by SPRI and is held in alternate years to provide a forum for the exchange of information among technical leaders in the sugar industry and to report new and important developments. The theme of this year's conference was "Diversifying Research in the Processing of Raw and White Cane and Beet Sugar" and was held from 28 September to 1 October 2008 at Delray Beach, Florida, USA. There were 74 delegates from 16 countries representing cane and beet sugar producers, industrial sugar users and suppliers to the industry. In contrast to the ASSCT Conferences, the majority of delegates were from executive ranks (ie, directors, vice-presidents) with very few practising technologists. The technical sessions were for 2 days, with 30 full papers and 4 posters presented. A technical tour was organised for the final day to the Florida Okeelanta Mill, Refinery and Co-generation facility. The Conference was well organised and held in a comfortable, well-equipped convention centre.

The SPRI organization.

The Sugar Processing Research Institute (SPRI) is an independent non-profit organization that is supported by member companies, which include cane and beet sugar producers, cane refineries and supplier and user companies. SPRI is 69 years old evolving from its 1939 entity as the Bone Char Research Project at the National Bureau of Standards in Washington, DC. It became the Cane Sugar Refining Research Project in 1963 and moved to New Orleans. In 1981, the scope of research was expanded to include beet sugar and raw cane sugar and it took the present name of SPRI.

SPRI claims to be unique in its equal focus on cane and beet research objectives. It is located in New Orleans, Louisiana, USA and has a close association with the US Department of Agriculture, which provides resources, accommodation and technical support. Well known SPRI researchers who have made significant contribution to sugar technology include Mary An Godshall, the late Margaret Clarke, and Les Edye.

SPRI's areas of research include the:

- Nature of cane and beet colourants and colour transfer to crystal;
- Degradation of polysaccharides in cane and beet juice by enzymes and other methods;
- Quality of products – flavour and odour, influences of trace components and macromolecules in processing and product quality;
- Rapid test in sugar processing, starch, dextran and floc problems;
- Scale inhibitors;

- Effect of processing aids on product quality and clarifying agents.

Conference Technical Sessions.

The conference was organised into sessions covering: new technologies, commercial and new products, energy issues and processing issues. Following is a brief summary of papers that may be of interest to the Australian industry.

Plenary Session.

Recurring Themes in Sugar Research, M A Godshall, SPRI, USA. Godshall's thesis is that the sugar industry is at a cross roads where it must expand its portfolio to remain successful and profitable and that research and development must provide the means.

Her central argument is that many industries, such as medicine, communications, genomics, molecular biology, analytical methodology have seen colossal advances over the last 50 years, while other industries such as transportation, agriculture, food chemistry and textile sciences, including the sugar industry, have seen incremental changes and improvements, which have resulted in better products, more efficient production and economies of scale.

She reviewed SPRI proceedings since 1964 to show the major research interests in the sugar industry to date. These have been: (1) Innovation in the form of new products and processes (20% of papers), (2) Quality (48%) and (3) the Analytical Methodology (20%). The majority of research has focused on quality and analytical methodology. Currently, the industry "cross-road" is the challenge to develop new technologies to replace petrochemicals and find viable sources of alternative energy. These challenges also provide "colossal" opportunities for the sugar industry, which must build on its "innovation" research. Godshall envisages there will be more emphasis on new products, energy and biomass ethanol, with less funding available except for large collaborations and partnerships, while the science involved will be "transformational".

The Development and Commercialisation of Dedicated Energy Crops for Biofuels and Power, W Nelson, Ceres Inc, USA. Nelson's paper discusses the utilisation of genomics and composition technologies in the development of a sweet sorghum variety of cane, a high yielding seed propagating crop, which produces large amounts of sugar and biomass with relatively low inputs. The crop has the potential to produce the feedstock required for multiple downstream uses including electricity, natural gas, liquid fuels and fine chemicals. Discussion points included the difficulties and risk in co-ordinating crop production and the infrastructures required for its utilisation.

The Challenges and Opportunities Facing Florida's Sugar Industry, B Miedema, Sugarcane Growers Coop Of Florida, USA. Miedema's paper discussed water management issues within the Everglades Agricultural Area dating back 150 years incorporating the massive flood mitigation schemes, the 2000 Everglades Restoration Plan and Florida State's intention to purchase the state's oldest sugar company, US Sugar Corp, including its sugar mill, refinery, juice plant, lands and railroad for US\$1.75 billion to restore wetlands and decommission flood controls in Lake Okeechobee. The land proposed for purchase will not come out of production for 10 years. The action was viewed as a direct threat to the long-term sustainability of agriculture in Florida, which produces 20% of US sugar and more than half of the cane sugar production.

New Technologies.

Biotechnologies across the world with a focus on Sugarcane, C Richard, SPRI, USA. The United States has formed the Sugar Industry Biotech Council to provide science based information regarding technological advances in both sugarbeet and sugarcane crops and the broad range of environmental and consumer benefits of these advances, including sugar products derived from technologically-enhanced sugarbeet and sugarcane.

The driver of this research has been the fact that by 2050 the world population will require double the present world food and fibre production. Crops are the principal source of food, feed and fibre.

An important part of this challenge will include a crop improvement strategy that integrates conventional and biotech/GM crop approaches.

Current sugarcane traits that are being considered are herbicide, disease, insect, stress tolerance (ie, cold, drought, etc), enhanced sucrose accumulation and alternative products. It is expected that commercial production of sugar from biotech sugarcane plants could be a reality in five years or less.

Biotechnology, the North American beet sugar entrance into this exciting era, T Schwartz, Beet Sugar Development Foundation, USA. Schwartz's paper carried on from the previous, however with a focus on the development and regulatory approval of Roundup Ready© sugarbeet. Commercialisation of the plant was delayed by several years as the industry had not prepared itself well enough for regulatory approval. The first commercial crops were planted this year and have been tremendously successful.

Commercial "new products".

The Florida Sugar Industry and Palm Beach Community College reviving the Sugar Technology Degree in North America, T Johnson, Sugarcane Growers Coop Of Florida, USA. After a 30 year sabbatical, a Sugar Technology Degree course has resumed in Florida as a response to industry demands.

Better process control and large savings by real-time measurement of sugar colour. B C Nielsen, Neltec, Denmark. Nielsen's paper describes the performance and utilisation of an on-line sugar colour measurement instrument. Actual and potential productivity and efficiency improvements are discussed.

Wet scrubber used in the control of air pollution from bagasse boilers. W Brane, MikroPul, Australia. Brane's paper reviews the regulatory, design and operational requirements of bagasse boiler wet scrubbers. It explores the development of the Mikrovane scrubber, the pilot plant operation, reviews installations and details performance. Of interest is the newly developed "Venturi Scrubber" which requires less space, energy and expense in ducting, and is more compact than the Mikrovane. Typical ash plant water treatment is also reviewed.

Fluidised Bed Sugar Conditioner. B Bartels, BMA AG, Germany. Another very interesting development is presented by Bartels. Cooling and conditioning of refined sugar is critical to achieve stable conditions for storage, packaging and transportation and to avoid "caking" problems. BMA have developed the design aspects of the standard fluidised bed cooler to create a more compact, less energy demanding device with a low air flow rate which avoids the need for a costly dust recovery plant. The unit is a vertical arrangement of cooling coils within a fluidised bed, which achieves counter current flow between the sugar (downwards by gravity) and air (upwards by forced draught). Very little air is required to maintain the fluidised bed whereas sugar transport is by gravity only and this reduces all air related equipment and power requirements.

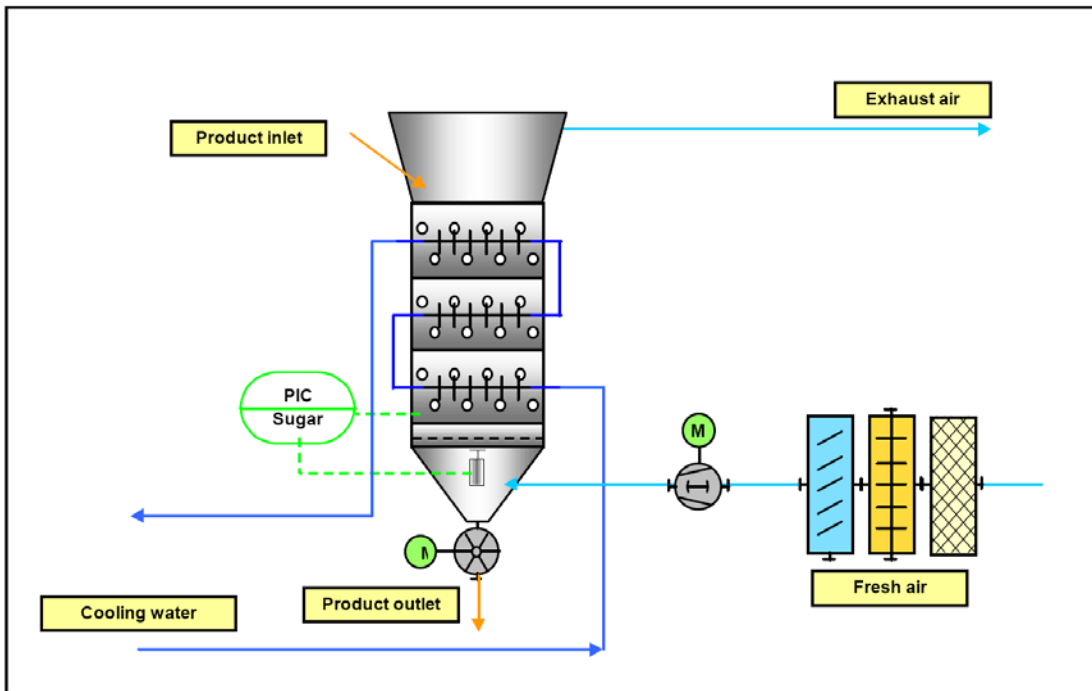


Figure 1. Schematic diagram of the BMA fluidised-bed conditioner.

High Antioxidant – Low GI Sugar, “the Sucrose Revolution”. D Kannar, La Trobe University, Australia. Horizon Science presented their low GI sugar process which consists of membrane filtration of molasses to produce a concentrated syrup of polyphenol antioxidants that is reincorporated with the sugar prior to drying. The result is a lower GI sugar, which provides health benefits by aiding in the control of obesity and diabetes. There is considerable commercial interest from the Florida industry in the process, which has the benefit of the vast North American market to support the product.

Ecocorb “extender” products for complete or partial replacement of PAC in sugar refining. J Kengen, Graver Technologies, USA. The Ecocorb products were presented for decolourisation applications of refinery liquor streams and other liquid sugar streams. The products can be used as direct replacements for powdered activated carbon (PAC) or as an extender to PAC operations. One of the products is a powdered styrenic ion exchange resin on a cellulosic matrix. On a dry weight basis, Ecocorb products remove 3 to 10 times more colour than PAC and DE, providing process and disposal economies. The products are dust free, unlike PAC, and can be used in batch or precoat operations.

Energy Issues.

The role of sugarcane breeding and selection in the development of bioenergy systems. E Richard, et al, SPRI, USA. The US “Energy Independence and Security Act 2007” amended renewable energy fuel mandates requiring a doubling of renewable liquid fuel production (generally ethanol) by 2012. This has provided the basis for major expansion of the USA ethanol market. The USDA has an ethanol program to develop high biomass (sugar and cellulose) yielding sugarcane varieties with levels of cold tolerance to allow an expansion of the geographic range beyond where they are traditionally grown. The uses of companion cane-type grasses are also being explored to further extend the harvesting season. Complimenting this research, SPRI is examining the chemical variations between various species of sugarcane and related genera to determine differences that could either enhance or inhibit energy production. Three high fibre “energy” varieties have been released that have met the target criteria of 18-24% fibre, 17-18% soluble solids and suitable yields per acre.

Bioconversion of sugarbeet processing waste into energy. I Polematids, et al. University of Florida, USA. Polematids paper evaluates a high solids digestion process for co-digesting tailings, spent pulp and reffinate to generate biogas to be used on site to reduce the fossil fuel requirement of beet sugar production.

Production of bioenergy using filter cake mud in sugarcane mill factories. C Baez-Smith, Smith Baez Consulting, USA. Smith Baez Consulting undertook a study to use anaerobic digestion to evaluate the feasibility of using filter cake mud to produce bioenergy in the form of biogas, and value-added biofertilizer. The process incorporates the simultaneous saccharification and digestion system, in which enzymes and fermentative bacteria are added to the same vessel to produce biogas from sugars as soon as they are released. For a 10,000 tonne of sugarcane per day factory biogas (57% methane) production is 44,000 cubic meters per day. Anaerobic digestion features a plug flow reactor (digester) at a temperature of 50 °C (122 °F) and mean cell residence time of 20 days. The volume of the digester is very large, about 15,000 cu meters (about the size of a football field and 1 metre high).

The new generation of ethanol production: cellulosic ethanol. T Eves, Verenium Biofuels, USA. Eves' explores an enzymatic fermentation process to manufacture cellulosic ethanol from renewable, non-food biomass such as bagasse, dedicated energy crops and wood products.

Processing Issues.

Analysis of sugarcane and sugarbeet process streams after clarification with polyaluminium coagulants. M McKee, et al, SPRI, USA. The action of polyaluminium coagulants on mixed juice, clarified juice and molasses are examined by McKee in terms of the quality criteria colour, turbidity and total polysaccharide. All reported decreases. Clarified juice colour decreased 21%, turbidity 62% and total polysaccharide 5%. All process streams showed an increase in *indicator value* demonstrating that colourants formed in the factory may be preferentially removed by PAC, which may aid factories to produce a lower colour and higher quality sugar.

Environmental Impact Management As Guided By Whole Effluent Toxicity (WET) Testing For Discharge Compliance. L Knieper, et al, Southern Minnesota Beet Sugar Cooperative, USA. Knieper's paper describes the regulatory requirement to perform toxicology testing on effluent plant discharge. Toxicology testing involves exposing living organisms to final effluent. Compliance has not been achieved and a toxicant or toxic component has not yet been identified. The search continues.

Dust explosion protection for fine sugar grinding. T Johansson, The Fitzpatrick Co., USA. Johansson presented a commercial paper describing a fine sugar grinding apparatus and the engineering required to mitigate the explosion hazard..

Indirect real-time colour measurement. B C Nielsen, Neltec, Denmark. Neltec has developed an indirect method for real-time determination of solution colour using its ColourQ instrument. The instrument does not work by measuring absorption, instead it measures light reflected from the sugar. Intuitively, this should imply that inner crystal colour is not measured. However, Neltec has developed proprietary calibration techniques to include inner crystal colour in the measurement and tests by many users have shown that the difference between the results provided by the ColourQ instrument and the laboratory results obtained using the ICUMSA solution colour method are insignificant. The repeatability of the indirect method is shown to be an order of magnitude better than that of the laboratory method. Also, the indirect method allows the factory to run the process with targets much closer to the limits and, in practice, the indirect method is more accurate than the direct method.

Elucidation of the Hard-to-Boil Massecurites Phenomenon and the Introduction of Oscillatory Deformation Rheology to the Sugar Industry. Gillian Eggleston, USDA, USA. Eggleston looks at hard-to-boil (HTB) massecurites, with markedly low heat transfer properties. HTB massecurites are a sporadic but continuing problem in Louisiana sugarcane factories. The phenomenon results in poor sugar quality, poor recovery and high molasses loss. It usually occurs after severely deteriorated sugarcane stalks and trash have been delivered to a factory, eg, after heavy and prolonged rains or after a severe freeze. HTB samples had 10-35% lower heat conductivity and 10-50% higher heat resistivity. Oscillatory deformation rheology, whereby a sinusoidal shear force is applied to a sample, and the resultant stress response measured provides

information on the mechanical and viscoelastic properties of the material as well as intermolecular associations. Normal massecuite and molasses samples gave typical mechanical spectra of concentrated solutions. In contrast, strong gel networks were present in the HTB samples explaining the difficulty to remove water on boiling. As HTB samples contained considerably greater total soluble polysaccharides than the normal samples, a polysaccharide is likely to be the cause of the gel network.

Colourants through Cane Sugar Production and Refining – A Review. L S M Bento, Portugal. Bento's paper is an excellent review of one of the most important impurities in the sugar industry – colour. Its origin, production and removal are discussed from sugarcane to refined white cane sugar.

Conference Technical Tour – Florida Crystals, the Florida Okeelanta Corporation.

The technical tour was disappointingly very brief with delegates not leaving the buses except for a short look at the Refinery packaging plant, which at the time was shutdown. Of note was:

- Mill
 - Crush rate: 25,000 tonnes cane per day.
 - Crop size: ~3 million tonnes cane.
 - Season length: ~21 weeks
- Cogeneration plant:
 - Capacity: 75 MW export, there are plans to expand to 120 MWh in the near future.
 - Boilers: Three stoker fired ABB-CE boilers, 105 Bar, 510°C, 200 t/h.
 - Air Emission Control: A multi-cyclone mechanical dust collector and electrostatic precipitator are installed on each boiler for control of particulate matter. A selective non-catalytic reduction system is also installed on each boiler for the control of nitrogen oxides.
 - Turbine: MHI/Westinghouse design 3,600 rpm, extraction/condensing turbine directly coupled to a two pole synchronous 13.8 kV, 60 Hz generator manufactured by Siemens Westinghouse.
 - Fuel: season – 850,000 t bagasse; slack – 900,000 tonne of wood waste, which includes clean construction and demolition material, land clearing debris, yard trimmings and other clean vegetative and cellulose matter. The wood waste material is collected from suppliers within a 100-mile radius.
 - Fuel stockpile management: A very large operation. It is not covered and is continuously watered and “worked” by several dozers and loaders to prevent spontaneous combustion. A shredder and trommel is used to process wood waste to particle size similar to bagasse. The fuel is put through a dewatering mill at the stockpile before being conveyed to the boiler. The biomass fuel handling cost is roughly three times more than if coal were used.

Privately arranged mill visits.

Glades Sugar House, Sugar Cane Growers Cooperative of Florida (SCGC).

SCGC is owned by 49 grower-members who have under cultivation some 60,500 acres of land, which in turn produces more than 3 million tonnes of cane. The Mill crushes 24,000 tonnes of cane per day.

Of interest is the cane analysis and process control laboratory's extensive utilisation of NIR spectroscopy analysis. First roller juice pol and brix analysis for cane payment is performed on a Foss NIR Beverage Analyser. Also, pol analysis of all other products is done by NIR. Leaded pol analysis is not performed in any of the Florida mills. Calibration analysis is performed with Octapol Clarifying Reagent (Baddley Chemicals, US) and hplc.

US Sugar Corporation, Clewiston Mill.

A 35,000 tonnes of cane per day mill and back-end refinery. The future of the mill is under a cloud with the current intention for the mill to be bought by the state of Florida for US\$1.7billion. The factory was expanded in 2006. The new “A” milling tandem can process 22,000 tonnes of cane per day.

Juice is heated in Barriquand Platular heat exchangers using surplus hot condensate and 3rd, 2nd and 1st vapours.

Mud filtration is innovatively and successfully performed through two solid bowl decanting centrifuges. The only apparent issue has been wear of the feed ports, but a suitable surface treatment has solved this issue.

There are standard rotary vacuum filters as back-up at this stage.

There are four evaporation trains each having five effects. There are three trains in operation and one in standby after cleaning. The first two effects are Kestner and the remainder Roberts vessels. Liquor phosphation flotation clarification is practised to remove bagacillo and other insoluble solids and to optimise raw sugar quality. Sugar boiling is the CBA scheme. There are 14 batch pans and four continuous pans. All batch pans are stirred and operate on 30 kPag steam, while the CVPs operate on 3rd vapour at 0 kPag. Mutlijet condensers are used to avoid the need for vacuum pumps.

Acknowledgements

The author wishes to acknowledge the support of the Sugar Research and Development Council in providing a “Travel and Learning Opportunity Program” grant for this project and also the backing of Manildra Harwood Sugars.