

**MANUFACTURING ABSTRACTS
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C Massecuite Re-Heating Using Microwaves

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C massecuite processing is an important step in cane sugar industry. Massecuite, discharged from vacuum pans, is cooled in cooling crystallizers in order to crystallize the maximum amount of sucrose possible. The high molasses viscosity in massecuite at low temperatures makes purging in continuous centrifugals difficult and massecuite must be re-heated before the centrifugation step. In order to avoid sucrose dissolution in molasses, this re-heating must be done as quickly as possible. Normally this operation is executed in heat exchangers using hot water. This process has some disadvantages: a long residence time, around 30 minutes, the possibility of massecuite channeling, the possibility of water leaking into the massecuite and the large area foot print of the equipment. Microwave technology can be an answer to increase the efficiency of this operation. With this technology, massecuite can be heated in a small piece of equipment in a fraction of a minute, with the advantage of no heating fluids be necessary. Also, as there are no heating surfaces, localized hot zones do not occur, avoiding sugar dissolution and massecuite channeling. Heating is uniform throughout the liquid phase. This heating process was tested using a 5 kW continuous microwave system at North Carolina State University. Results of these tests are presented in this paper.

Process of Turning Sugarcane Bagasse into Cellulose and Lignin-Derived Products

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Biomass materials such as agricultural residues, herbaceous crops, and woody tree species are complex mixtures of cellulose, hemi-cellulose, lignin, and other minor components. Ox-B™, an oxidant developed at Audubon Sugar Institute, was found to remove lignin and hemi-cellulose from sugarcane bagasse. Pre-treated bagasse was processed to paper pulp or fermentable sugars for the production ethanol. Additional treatments of sugarcane bagasse with organic solvents enhanced the release of total phenols.

**Predicting Processing Problems from Deteriorated Sugarcane:
A Factory Method to Measure Mannitol**

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Mannitol, formed by *Leuconostoc* bacteria, is a very sensitive indicator of sugarcane deterioration that directly affects processing and can predict problems from dextran and levan polysaccharides. An enzymatic method has been developed to measure mannitol in juice pressed from consignments of sugarcane delivered to the factory. This quantitative screening tool will allow factory staff to rapidly know which consignments of cane will affect processing negatively or reject consignments that will cause unacceptable processing problems. Mannitol is directly measured on a spectrophotometer using mannitol dehydrogenase as the enzyme catalyst. The stability of the reagents, limited cane juice preparation and linearity are described. This method is precise, accurate, compares favorably with an ion chromatography method, and can be easily performed using existing equipment in sugarcane factories. Mannitol can be measured after ~7 min at room temperature and within 4 min if a 40° C water bath is used. The method is highly specific for mannitol and was not affected by the presence of sucrose, glucose, fructose, or dextran. The current cost is only ~60 U.S. cents per analysis. The relationship of mannitol with Haze dextran in pressed and crusher juices, and raw sugars, collected across the 2004 grinding season of a Louisiana factory is reported.

Optimization of Applications of Dextranases in Sugarcane Factories

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Further studies on the optimization of the use of commercial dextranases to breakdown dextran in Louisiana sugar manufacture were conducted in the 2004 grinding season. Several factories are now successfully using the simple, titration method (Eggleston, 2004) for the determination of the relative activity of dextranases to a) economically compare activities of different dextranases, b) measure the activity of delivered batches, and c) monitor the changing activities on factory storage. Several factories have also chosen to use Aconcentrated@ dextranase rather than traditional Anon-concentrated@ dextranases. An approximate 14 to 20-fold difference in activity now exists between the two concentration forms, as measured by the titration method. As laboratory studies had shown dextranase applications to syrup were relatively uneconomical, only juice

applications were studied at two factories. For dextranase application, one factory had installed a 5 min retention time (R_t) tank adjacent with the crush tank, and the other factory used a 17 min R_t incubation tank. Dextran removal across the tanks was measured using both monoclonal antibody and Haze methods. Higher ppm levels of dextranase were required for application to juice in the factory than to juice studied in the laboratory. The greater the amount of dextran the easier it is to breakdown by dextranase, because of increased substrate/enzyme ratios. The effect of increasing the temperature from ~90 °F to ~120 °F is reported. Pre-dilution of the concentrated dextranase at the factory to improve juice dextran/dextranase contact is also reported, and includes the stability of the pre-diluted dextranase in water or a 25° Brix raw sugar solution. Dextranase application did not always alleviate all processing problems in factory boiling stations, because lower molecular weight dextrans and other *Leuconostoc* deterioration products still existed.

Trial at Appleton Estate Using a Combined Treatment of Biocide, Dextranase and Amylase to Reduce Dextran and Enhance Sugar Recoveries

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The adverse effects of dextran on the manufacturing process, and the resultant penalties imposed by the refiners, continue to be a major concern to the management of the Appleton Estate and to the entire sugar industry.

To surmount this problem, a collaborative study involving the Management at Appleton Estate, the Sugar Industry Research Institute and the Jamaica Cane Product Sales Limited was established. A trial utilizing a combination of Biocide, Dextranase and Amylase to reduce the dextran levels in sugar were conducted during the 2003-2004 crops.

The results showed a 45% reduction in dextran levels and a 28 % reduction in starch. Other improvements observed were the reduction in pol losses in final molasses and undetermined losses, also improvement in boiling house recoveries and sugar quality.

The trial offers great potential in reducing dextran levels and enhancing sugar quality which could save and earn the industry million of dollars.

Composition and Processing of Sugarcane Green Leaves and Tops

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Over the last three years, composition has been monitored of hand-separated samples of sugarcane stalk, green leaves and tops. Cane samples, primarily of the LCP

85-384 variety were taken at the LSU AgCenter Sugar Research Station in St. Gabriel at two-week intervals, during the growing season up until the time of harvesting. In a small number of field tests, four other cane varieties were also sampled, and the effects of application of a chemical ripener on the cane composition were monitored. The samples were subjected at Audubon to direct cane analysis and the composition of the extracted juice was determined in terms of its sugar, cation and anion profiles with HPLC and HPIC, respectively. The much higher content in the green cane residues (leaves and tops) of calcium, oxalate and aconitate salts have implications for processing in the sugar mills of green un-burnt cane. One hundred pound batches of mixed green leaves and tops (CLM, or cane leaf matter) were processed by shredding and milling with imbibition in the Audubon Sugar Institute pilot plant. The extracted juice was then used as a feedstock for ethanol fermentation. The residual stillage after removal of ethanol by distillation was found to be rich in aconitic acid and its recovery from this feedstock is presently under investigation. The extracted CLM has similar composition to bagasse, but its smaller particle size and less fibrous nature make it an easier material to handle. Its use as a feedstock for conversion to ethanol, syngas and chemicals is being investigated in a parallel, U.S. Department of Energy - funded program at Audubon.

Corrosion in Sugar Mill Boilers

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As the boilers are the heart of any sugar cane mill, reducing boiler failures is an important goal for the effective operation of any mill. There are numerous ways boilers can fail and a number of these are related to corrosion of the boiler internal surfaces. This paper provides an overview of the mechanisms which cause corrosion in boiler internals and how those mechanisms practically occur in sugar mill boilers both while operating and during the long periods of lay up. More importantly, the paper discusses how the effects of these corrosion mechanisms can be minimized or eliminated. The discussion will include theoretical means of eliminating corrosion potential as well as practical means that are currently in use in sugar cane mills in Louisiana and Florida.

The Influence of an Induction Period on Color Formation in Model Syrup Systems

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Research toward the economical production of white sugar is not exclusively limited to realm of color removal. Recognition of the chemical behavior of colorant groups has led to several ideas that are potentially useful toward manufacture of product sugars of low color. Of these, the inhibition of color formation is of significant interest as

producing less color in process can extend the cycle times for polishing carbon (whilst increasing economic feasibility).

One such realization involves a chemical induction period prior to the rapid formation of color (and rapid destruction of sucrose) in caramel and “Maillard” modeled systems. During this induction period, little color is formed, and sucrose levels remain stable. After this period, however, colorant production accompanies the rapid destruction of sucrose. This study aims to investigate colorant induction in model systems toward process modifications that could lead ultimately, to the production of low color sugar.

It was found that Maillard reaction models developed color more quickly, relative to controls when spiked with active caramels. Samples spiked with active caramel developed 40-50% more color, and at a much greater rate than controls. This suggests that the inductive phase was bypassed, yielding a more rapid condensation of intermediates into color bodies. In light of this, it may be useful to re-evaluate the practice of “footing” pans when regarding both color and massecuite purity.

Bagasse Fly Ash as a Potential Adsorbent for Waste Materials

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Bagasse fly ash, the material remaining after bagasse has been burned in the boilers during sugarcane processing, is considered a waste product. Recent literature has shown that fly ash may have the potential for use as an adsorbent trap for many different organic and inorganic materials such as pesticides, dyes, and metals. This makes way for a new value-added product for the sugar industry. In this study, we have examined the usefulness of the bagasse fly ash as an adsorbent for textile waste dyes and heavy metals. We also examined the composition of the bagasse fly ash from a Louisiana mill over two seasons. Promising preliminary results have been observed with the bagasse fly ash removing 99.8 % of textile waste dyes upon treatment of the waste textile dye solution at 55°C and pH 3. The heavy metals tested include arsenic, cadmium, chromium, mercury, and lead. The effectiveness of the bagasse fly ash at removing the metals varied from 7.5% removed for arsenic to 99.9% removed for chromium, mercury, and lead.

The Use of a Coriolis Flow Meter for Measuring Molasses Production in a Sugar Mill.

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In order to obtain a reliable estimate of the loss of sugar in molasses and improve the accuracy of the estimated undetermined loss, a precise measure of molasses

production is necessary. A Coriolis meter can measure mass flow rate with a quoted accuracy of better than 0.15%. It also measures density simultaneously and can be installed directly in the molasses line. Experience with two different makes of Coriolis meters installed at Raceland mill is described. The accuracy of the meters is compared with routine molasses production figures from tank levels and from a newly installed molasses scale. Advantages and problems with the installations are discussed and the suitability for use on this duty is assessed.