Due to elevated amounts (>700 mg/kg) of starch found in raw sugar during the 2010 grinding season, the Domino refinery formulated a schedule of penalties which it released to all Louisiana sugar factories. In response, the milling factories began to titrate their processes with amylase in order to comply with the >250 mg/kg limit. Upon performing the recommended assay (ICUMSA GS1-17, 2005), it was found that many of the sugars demonstrated residual amylase activity. It was also noted that most of the amylolytic sugars were assayed to contain >250 ppm of starch. How can sugar treated with so much amylase that it contains residual activity also contain starch? While Domino specified the ICUMSA method, most of the factories were using an older Domino method that dissolves the samples in phosphoric acid (H₃PO₄). The acidic pH will deactivate any residual enzyme. Thus, if there is amylase in the sugar, the results produced by the H₃PO₄ method will always be higher (and ostensibly, more accurate) than those performed following GS1-17. To further complicate matters, Louisiana Sugar Refining, LLC, LSR requested the use of a hybrid method. Each method can give significantly different results. The clarified juice, syrup and raw sugars produced by three Louisiana sugar factories were assayed using three analytical methods. It was found that 22-25% of the starch in syrup can end up in the sugar. The results via the H₃PO₄-based assay were, on average, 22% greater than those generated using the ICUMSA method. Testing of sugars with added amylase revealed that up to 60% of the material which assays as starch is not amenable to hydrolysis using α-amylase and based upon that definition, most of the “failing” sugars contained significantly less than the penalty-level. This was clearly demonstrated in sugar sampled at a factory which ran without amylase prior to sampling.

New Developments of Centrifugals for High- and Low-purity Massecuites

R.Hempelmann and S.Stiegert

BMA Braunschweigische Maschinenbauanstalt AG, Braunschweig, Germany.

Centrifugals count among the core equipment in sugar production. Consistent product development for increased efficiency has led to new BMA centrifugal series for both batch-type and continuous sugar centrifugation. With the new E series (batch) and the K3300 machine, completely new solutions could thus be implemented. The new batch-type centrifugals have been developed on the basis of the latest calculation methods. Essential results are (a) a new basket design, with a much longer expected service life, (b) a compact housing that provides for smoother running thanks to its higher stability, and (c) a new discharger with only one motion axis. The syrup separation device accounts for the results of practical tests, which have led to a simple and yet highly effective solution. The continuous K3300 centrifugal, too, is a completely newly developed machine. The basket incorporates an additional pre-separation stage and therefore provides for higher throughputs - at an enhanced sugar quality and lower power.
consumption. Thanks to a compact drive and housing, the machine also features (a) a small footprint, (b) easy operation, and (c) low maintenance requirements, because all parts are easily accessible. The expectations placed upon the design innovations have been confirmed in practical operation.

The Audubon Sugar Institute

B.L. Legendre

Audubon Sugar Institute, LSU Ag Center, St. Gabriel, LA 70776

The Audubon Sugar Institute had its beginnings in 1885 when the Louisiana Sugar Planters Association (LSPA) established the Louisiana Sugar Experiment Station in Kenner, Louisiana. In 1887, this station moved to New Orleans in what is now Audubon Park. In 1891, under the direction of Dr. William C. Stubbs, the Audubon Sugar School was established on the station’s grounds. It was the intent of the school to produce experts in the sugar industry and designed to meet the needs of the planters’ sons who were expected to assume ownership of the plantations and factories. Over the years the mission and direction of the school changed and in 1977 it was separated from the Department of Chemical Engineering and became an independent department. Funding from the state and the American Sugar Cane League allowed the sugar factory, which had stopped commercial operations in the 1960s, to be converted into a research institute. The Audubon Sugar School became the Audubon Sugar Institute. In the course of over 100 years the Audubon Sugar School and now the Institute have served as a world leader in sugar technology. The Audubon Sugar Institute is currently conducting research aimed at determining commercial feasibility of new processes and development of technologies suitable for local industries. The goals of the Institute are as follows: 1. Enhance the productivity and profitability of the Louisiana sugar and sugar process-related industries; 2. Improve the practice of sugar manufacture through education and technology transfer; 3. Attract, retain, and develop a world-class staff to serve stakeholders; 4. Encourage the use of environmentally-safe technologies in sugar processing; and, 5. Conduct research toward a diversified sugar process industry-biorefinery. It is the objective of this paper to briefly discuss the history of the Audubon Sugar Institute and to describe current research projects that are in keeping with its mission and goals.

A Look at the Relationship between Sugar Color and Grain Size

M. McKee, R. Triche, M.A. Godshall, and C. Richard

Sugar Processing Research Institute, Inc. New Orleans, Louisiana 70124

Color is an important parameter indicating sugar quality. SPRI has a long history in the examination of color of various types of sugar products. It has been shown that color of raw sugar changes over time during storage both in laboratory conditions as well as storage in the warehouse. The objective of this study is to illustrate the importance of grain size in production of high quality raw sugar with good “storability”. Several raw sugars were collected from raw sugar factories and stored under laboratory conditions. In this study of color during raw sugar
storage, it was found that raw sugars with visually smaller crystals had a tendency to increase in color over time at a faster rate than sugars with larger crystals. Additionally, it was observed that raw sugars with higher initial colors increased in color more than lower color raw sugars with identical storage conditions. The sugars were also separated using a series of sieves to determine the grain size distribution of the raw sugars. Various quality parameters were measured for the whole raw sugar as well as the various grain size portions of the sample. Color increases in the raw sugar samples as grain size decreases. Color over time, turbidity, ash, and starch in relation to grain size will also be discussed.

**Design and Operation of Low Residence Time LLT Clarifier at Lula Factory**

V. Kochergin¹, S. Savoie²

¹Audubon Sugar Institute, LSU AgCenter, St. Gabriel, LA  
²Lula-Westfield, LLC, Paincourtville, LA

In the recent years, new LLT (Louisiana Low Turbulence) clarifiers have been successfully tested and installed in several Louisiana sugar factories. The principal difference of the new concept is that juice is introduced into a trayless clarifier through a uniformly distributed network of distributors. Patent pending design of the distributor end points reduces turbulence and eliminates formation of large-scale eddies in the clarification vessel. Superior performance of LLT clarifiers had been previously demonstrated in comparison with conventional designs (Dorr, Graver and SRT) operated in parallel at the same plants. A new 26-feet diameter LLT clarifier has been designed and operated at Lula factory in 2011 in parallel with two Graver clarifiers at one half of residence time. It resulted in decreased sugar losses and increase of temperature of the clarified juice. For the last week at the end of the season, the throughput was increased to achieve the residence time of less than 30 minutes without loss of juice quality. Capital cost analysis, observations and operating experiences will be discussed.

**Entrainment Losses in Louisiana Sugar Factories**

H. Birkett and J. Stein

LSU Ag Center Audubon Sugar Institute, St. Gabriel, Louisiana

Sugar concentrations in evaporator condensates and in the barometric condenser water were measured at ten Louisiana factories in 2009, 2010 and 2011 using the phenol-sulfuric acid method. The concentration of sugar varied from 0.2 to 1650 ppm in evaporator condensates and represented an average sugar loss of 0.07 lb/ton at the average concentration of 53 ppm. In the case of the condenser water, once through injection water systems had sugar concentrations of 1 to 1547 ppm with an average of 171 ppm which represented an average sugar loss of 1.7 lb sugar/ton cane. For recirculating injection water systems (cooling towers and spray ponds) the sugar concentration in the injection water varied from 13 to 7120 ppm. Assuming a blowdown rate of 2%, the losses in the recirculating systems averaged 0.9 lb sugar/ton cane. The paper highlights the need for frequent testing of both condensate and condenser water streams to minimize sugar losses.
Measuring Moisture in Cane Bagasse and Beet Pulp in Real Time with LED lights

C. Ferrin
HK Instrument Systems, Pittsburgh, PA

One of the most important Process Parameters in Beet Sugar and Cane Sugar Production is the moisture of the product after the juice has been removed. The moisture value is important to Cane Bagasse because you want to burn it and to Beet Pulp because you want to pelletize it and sell it for feed. HK Instrument Systems and its German Partner have developed, installed, tested and proven an In Line Moisture System using LED lights in the NIR part of the spectrum. This system has been designed to measure moisture on a belt, in a chute, or possibly even in a screw conveyor. With this system we finally have a moisture measuring platform that overcomes most of the problems which all other NIR Systems have when faced with changes in ambient conditions, like the loading on the belt, or the color of the product. These issues are no longer a problem for our system. This paper will go over the technique we have used, some of the installation issues, and names of installation sites in Europe where it has been very successful at Nord and Sud Sugar in Germany and Eastern Europe.

Flow of C-Massecuite in Cooling Crystallizers: Results of Pulse Testing

V. Kochergin, K. Miller
Audubon Sugar Institute, LSU AgCenter, St. Gabriel, LA

Advantages of vertical crystallizers in sugar factories are well-known; their performance sometimes does not correspond to the claimed benefits. Attempts to evaluate flow characteristics of C-massecuites in vertical crystallizers have been made in the past. Results indicated short-circuiting of massecuite leading to reduced residence time. Tracer testing has been performed in a Louisiana sugar factory to compare flow characteristics in a horizontal (Blanchard) and a vertical crystallizer. Pulse testing was performed using zinc sulfate as a tracer. Samples were collected on an hourly basis for over 50 hours. Temperature profiles in the crystallizers were evaluated along with crystal size distribution in the C-massecuite. Early tracer breakthrough was detected in vertical crystallizers. Bimodal residence time distribution indicates potential shortcuts and presence of dead zones within the crystallizer. Residence time in Blanchard crystallizers also appeared to be shorter than estimated. It was found that molasses exhaustion was more complete in the Blanchard crystallizer with Nutsch purities of C-massecuite several points lower compared to vertical crystallizers. The cooling profiles in both crystallizers followed a “straight line” pattern that is not considered optimal to maximize molasses exhaustion. Modifications on vertical crystallizers are recommended to improve their performance.
Pretreatment Technologies for the Conversion of Lignocellulosic Biomass to Fuels and Chemicals

G.M. Aita and S. Mahalaxmi

Audubon Sugar Institute, Louisiana State University Agricultural Center
Saint Gabriel, LA 70776

The concept of energy crops, a renewable source of energy, has been around for decades. It was not until the discovery of fossil fuels, a non-renewable source of energy, in 1859 that agricultural and forestry crops and their residues stopped being the primary source of energy. However, energy consumption of non-renewable fuels has increased steadily over the last century as the world population has grown and more countries have become industrialized. In the U.S., the demand for transportation fuels is currently around 140B gal/year for gasoline, and 48B gal/year for diesel. Increasing energy security concerns, fluctuating oil prices, problems with CO₂ emissions, and concerns over possible future supply constraints have strengthened the interest in alternative non-petroleum based sources of energy. A study supported by both the U.S. Department of Energy (DOE) and the U.S. Department of Agriculture (USDA) has indicated that the U.S. has sufficient land resources to sustain production of over 1 billion dry tons of biomass annually, enough to replace at least 30% of the nation’s current consumption of liquid transportation fuels. Lignocellulosic biomass such as agricultural residues, forest products, and dedicated crops are considered potential sources for second generation fuels and chemicals.

Fuels and chemicals from lignocellulosic biomass can be produced mainly by two different conversion routes, biochemical or thermochemical. The thermochemical route involves the use of pyrolysis, liquefaction, and gasification technologies to produce synthesis gas (CO, H₂) from which a wide range of fuels and chemicals can be derived. The biochemical route employs enzymes and microorganisms to convert cellulose and hemicellulose fractions to sugars prior to their conversion into fuels and chemicals. The overall process can be summarized into six main steps: pretreatment, enzyme hydrolysis, detoxification, fermentation, fuel/chemical recovery, and effluent treatment. Pretreatment of biomass is an extremely important step in the conversion of lignocellulosic biomass to fuels and chemicals and adds approximately 30% to the total processing cost. This presentation will provide an overview of the chemical and physical characteristics of lignocellulosic biomass and on the processing of lignocellulosic biomass to fuels by the biochemical route with emphasis on new developments of pretreatment technologies.

Dissipation of Atrazine and Metribuzin in High Organic Matter Soil

Dennis C. Odero¹ and Dale L. Shaner²

¹Everglades Research and Education Center, University of Florida, Belle Glade, Florida
²USDA-ARS, Fort Collins, Colorado

Triazine herbicides are extensively used to provide residual control of many broadleaf weeds and certain grasses in sugarcane. However, there are reports of reduced residual weed control with
Atrazine retention by sugarcane residue and soils: Atrazine retention characteristics were carried out for sugarcane (Saccharum Spp. Hyb.) residue grown on Sharkey clay and Commerce loam soils. The residue which covers the soil surface following combine harvesting was sampled over several growing seasons. Batch methods were used to quantify adsorption and desorption for a wide range of atrazine concentrations and reaction times. Desorption was carried out using successive dilutions. Atrazine retention by the residue exhibited linear adsorption where the partitioning coefficient ($K_d$) increased over time of retention. Adsorption-desorption exhibited strong hysteresis indicative of time-dependent retention and slow release by the residue. Limited atrazine sorption kinetics was observed by the two soils and their $K_d$ values were an order of magnitude lower than that for the residue. A multireaction model which accounts for kinetic and equilibrium type retention of was successful in describing the time-dependent atrazine adsorption and desorption behavior by the sugarcane residue over a wide range of applied concentrations. Atrazine was strongly sorbed by the residue where some 40% of the amount adsorbed was non-extractable by methanol. Moreover, retention results indicated that a decreasing or increasing trends of atrazine retention by the sugarcane residue with time of decay was not observed. The use of an average retention ($K_d$) value to represent atrazine retention over an entire growing season is recommended.
Sugarcane (Saccharum spp.) cultivar improvement programs have not yet systematically utilized most of the genetic sources of yield potential and resistance to biotic and abiotic stresses that may exist in the Saccharum germplasm. Two collections of genetic material potentially useful to sugarcane breeding programs, which are maintained in India and USA, are known collectively as the ‘World Collection of Sugarcane and Related Grasses’. The objectives of this study are 1) to genotypically evaluate the World Collection of Sugarcane and Related Grasses maintained at the National Plant Germplasm System in Miami, FL, and 2) to select representative accessions in the collection that sugarcane breeders can utilize as a core breeding collection. In total, 1002 accessions in the world germplasm collection, comprising 16 species, were sampled for genotypic evaluation using microsatellite markers. A total of 192 microsatellite markers were initially screened on eight species of sugarcane accessions and about 76 markers were found polymorphic with polymorphic information content ranging from 0.22 to 0.89. These polymorphic markers will be used to genotype the 1002 accessions. Meanwhile, accessions will also be evaluated on several phenotypic parameters and phenotypic data will be merged with genotypic data. Based on diversity parameters of cluster and phylogenetic analyses, a sugarcane core collection will be identified, which will be useful in sugarcane breeding programs after thorough evaluation and later for genetic studies such as association mapping and genomic selection.