

## América Latina: Un Vistazo a Vuelo de Pájaro de Avances Tecnológicos de la Industria Azucarera en la Región

Este trabajo pretende dar un vistazo rápido a la industria azucarera de la regiones norte, centro y sur américa y un poco del caribe. Tratar de actualizar en términos generales el estado de la industria y sus proyecciones, es una tarea ardua y muy compleja, haremos un esfuerzo y por todos los medios trataremos de ser objetivos y llenar en alguna forma algunas expectativas, me disculpan de antemano por omisiones no intencionadas, simplemente son parte de lo extenso de un trabajo de este calibre.

Nuestra región no escapa a situaciones políticas, económicas y sociales en cada país, a las fluctuaciones constantes de los precios internacionales del azúcar y la melaza, aumento del precio del petróleo, embates de la naturaleza, sequías, daños a la agricultura, cambios climatológicos, violentas tormentas tropicales, huracanes de categorías peligrosas, etc. Todos estos factores negativos hacen que nuestra industria enfrente estos embates de la naturaleza, sin embargo ha demostrado a través de todos estos años un desarrollo sostenido y fortalecimiento, que han hecho que se distinga como una industria estable, progresista, generadora de trabajo tanto agrícola como industrial y también de otras especialidades, siendo la industria de gran contenido social y económico. Teniendo el enorme potencial de convertirse en el futuro en una región productora de combustibles en gran escala con la producción de etanol para vehículos y de bio-combustibles, sin que necesariamente afecte la producción de azúcar. La industria azucarera por su sensibilidad social y económica, es siempre tratada de especial manera en los convenios comerciales entre países.

A pesar de todos los problemas que se enfrentan a diario, la industria ha demostrado aceptar los retos actuales de conversión de sub-productos a energía, ya sea para alimento humano con las diferentes clases de azúcares de consumo diario, alcohol etanol proveniente de melaza o jugos y mieles de bajo grado, para ser mezclado con la gasolina y energía eléctrica bajo grandes proyectos de co-generación eléctrica proveniente del bagazo usado eficientemente como combustible bajo balances térmicos sofisticados dentro de la planta y calderas con generadores de altas presiones. Hoy en día podríamos llamar a los tradicionales ingenios azucareros como “plantas generadoras de energía de la caña de azúcar.” A excepción del brasil quien lidera por mucho tiempo la producción del etanol, el resto de países están haciendo grandes esfuerzos para aumentar su producción, observamos con claridad el desarrollo de producción de etanol en colombia, bolivia, paraguay, centro américa, el caribe (aunque estos en menor escala). No dudamos que muy pronto veremos grandes

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## Latin America: A Look at the Technological Advances of the Sugar Industry in Latin America

This report attempts to give an overview of the advances in technology of the sugar industry in the Latin American countries, northern, central, and southern regions, including part of the Caribbean. This article will try to update the status of the industry and projections. This task is not an easy one. The subject is very difficult and complex but an effort will be made to be objective and fulfill some of the expectations. Apologies are made for any unintended omissions which are simply due to the extent of a work of this magnitude.

Our industry is subject to political, economical and social changes in each area, due to the constant up and downs of international prices of sugar and molasses, oil price increase, natural disasters, droughts, damage to agriculture, weather changes, violent tropical storms, hurricanes of dangerous categories, river overflows, etc. However, regardless of all these negative difficulties, the sugar industry has sustained and developed as a stable and progressive industry that generates agricultural, industrial and other means of labor, being the industry of enormous social and economic impact, having great potential of becoming one of the most productive region of alcohol for fuel in a large scale with the production of ethanol for vehicles and bio-fuels, not necessarily affecting the production of sugar. Because of the social and economical sensibility of the sugar industry in each country, it always has had a special treatment in the commercial agreements between countries.

Despite all the problems that the industry faces on a daily basis, it has proved to accept the challenges of converting the sub-products into energy: either for human consumption with different types of sugar for daily use; alcohol ethanol to be mixed with gasoline from low grade molasses and other molasses grades; and electrical energy through large scale co-generation projects from bagasse efficiently burned in sophisticated high pressure boilers with well engineered thermo-balance in the plant that results in co-generated electrical power with no additional fuel other than bagasse. More likely, we can call the traditional sugar mills as units of energy production from sugar cane. For example in Brazil who leads in the production of ethanol, all of the sugar mills are oriented to sugar, ethanol and co-generation. The rest of the countries in Latin America are making great efforts to increase their ethanol production, as we can see from the development of ethanol production in Colombia, Bolivia, Paraguay, Central America and some countries in the Caribbean. We have no doubt that in the near future we will see great production of ethanol in the entire Latin American region. The same applies to the electrical energy through large co-generation projects as the ones

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carried out in Brazil and Guatemala.

At the same time and parallel to the production of renewable energy, the region has made continuous improvement to the technological procedures applied to the production of sugar and energy. We will try to mention the most important ones, and because of their importance, have made great impact in the efficiencies of the factories. Some of these technological advances are concentrated to the improvement in the raw material and naturally to the improvement of the industrial process, more so to sugar as to alcohol, as well as in the energy balance that is the key to any electrical co-generation project.

We all agree that the price of sugar is sometimes high in the world market, that there are solid prices in the preferential quotas, and stable prices in the local markets. Additional revenues from the production of ethanol and electrical generation and increases in the sale price of the final molasses, in general have contributed to modernize the sugar

industry by maximizing the efficiencies in the agricultural and industrial plants, using the company resources to carry on important technological projects of new generation.

Important technical support for the improvement of the industry is the investigation centers that exist in many countries for agricultural sectors as well as experimental stations, industrial investigation institutes, or sugar institutes. In many countries there are different centers located all over the country area.

In regards to the improvement of the raw material, significant steps have been taken regarding cane variety programs. New and improved varieties of sugar cane have been introduced and developed in the same countries with characteristics of resistance to abrupt climatic and weather changes, high in yield performance by planted area and of course high sugar yield in the factory.

Better cultural practices in the field, technical irrigation, and the use of ripeners have also contributed to the improvement of efficiencies.

We can not disregard the huge advances made in the aspect of mechanized harvest and low cost transportation resulting in delivery of fresh sugar cane to the mill at low cost, thus optimizing the costs of cane transportation.

In the industrial sector, there has been many and various introductions of new technologies made all along the line of production, from the moment that the sugar cane is received in the cane yard up to when the different products and sub-products are being finished. The normal procedure would be to describe in details the technical benefits and the contributions that have been successfully accomplished with each of the technologies introduced in the mill. However, this paper is limited in space and we will concentrate to name the best of our knowledge with a short comment when necessary.

**Cane Preparation.** Powerful heavy duty shredder and fiberizer machines have been introduced; this has significantly improved the results of extraction, milling, and moisture in bagasse.

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mills. This has improved the uniform flow of juice and bagasse in the entire mill stream.

**Diffusion or Milling.** This aspect is frequently discussed; whether to expand through diffusers or mills. The latter ones have been preferred; however, lately we often see more diffusers being installed.

**Size of Mills.** In order to obtain higher extractions, larger and heavy duty constructed mills are being introduced. We can see now mills of 54" diameter rolls x 100" long already in operation. Also, we see more and more the change from steam turbines to electric motor driven mills. This of course benefits the efficiency of the actual demand of steam to power the mills.

**Juice Treatment.** New practices of liming, heating, sulphitation of juice heating have proven to be successful. Hot liming, plate juice heaters, use of the condensed water temperature to heat up the primary juice and cool off the condensed water, barometric heaters using the steam of the last evaporation body, sophisticated schemes of the use of steam number two, three, and four to heat

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up or rectify the juice, also minimizing the use of process steam to be able to have enough available steam for the distillation of alcohol as well as to increase the left over bagasse are all utilized.

**Clarification.** Adequate heating of clarified juice along with fast settling and low retention time clarifiers (s.r.t. type) plus improving the handling of filtered juice has made possible high quality juice clarification reporting minimum losses in the sucrose degradation. Ultra-filtration, ionic interchangers and other chromatographic methods are becoming attractive to the industry in regards to juice clarification.

**Syrup clarification.** Extensive and continuous progress has been made in this field that has become an almost indispensable tool for the production of high quality white sugar or plantation white, effectively contributing to reduction of turbidity, ash, and viscosity in the syrup. This process is always showing improvement and modifications have greatly helped in the production of high quality white sugar.

**Evaporation.** Diverse and sophisticated systems of evaporation looking for appropriate thermal balances not only for the thermal efficiency of the factory but also to find the possibility of obtaining considerable quantity of surplus bagasse to obtain a continued co-generation of electric energy during the maintenance or downtime period. The bleeding on each body is oriented to triple heating and the juice rectification with vapors two, three and four, i.e. the vapor III to be used in the continuous vacuum pans (cvp), size of equipment, their designs, caloric surfaces, and the strategic position of each body in the evaporation of multiple effects. The evaporation is considered a key element for a good thermal balance to perform co-generation installations of normal size. In the region there are sugar mills of high thermal efficiency reporting steam utilization of 40/45% per ton of cane meaning 800/900 lbs of steam consumption per ton of cane. This allows for sugar refinery projects, ethanol production and co-generation to be supplied with the same energy avoiding

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the sugar mill to consume auxiliary fuels, consequently all of these together in the economy of the company.

**Crystallization.** In the boiling house area, continuous vacuum pans (cvp) have been introduced for the different types of massecuites. The introduction of the continuous pans operated with vapor iii considerably reduces process steam consumption. The new generation of continuous pans is being used with absolute pressures (psia); this of course, represents considerable savings of process steam, making the various projects of sub-product in the mill more feasible. In addition to the energy advantage, the continuous vacuum pans result in a uniform flow of crystallized massecuites eliminating the intermittent use of steam and other flows. The heavy automatic operation of the cvp improves the percentage of crystals much better than the batch type pans. This has helped a lot in the quality of white sugar in places where the cvp has been installed.

**Centrifugals.** Every day the region is more and more inclined to the use of large,

fully automatic centrifugals. These new generation centrifugals, in addition to offering the advantages of improving the quality of the crystal with high capacities, offer an advantage that could be called the key factor to the energy balance because of their low level on power demand in spite of the high loads of massecuite to be centrifuged.

**Crystallizers.** Only a few countries have adopted the continuous vertical crystallizers but the final molasses exhaustion is acceptable.

**Steam Generation and Boilers.**

Many and various improvements have been made in this area as the tendency is to convert the actual steam pressures to high pressures up to 60/65 bar and temperatures of 500/600 C. This of course results in the production of kw/hr with a much lower use of steam, if the turbo-generators are of condensable design with the required extractions when necessary. These high pressure boilers are of special design compared with the traditional ones in sugar mills. They burn the bagasse efficiently and all in suspension to reach high thermal efficiencies up to 72/75% in gvc. At the same time they are fully equipped with elements for environmental protection, as, cyclonic ash arrestors, wet scrubbers, or electrostatic-precipitators (esp). By generating steam at these high pressures, the mill is capable of increasing the co-generation capacity with more electric energy available to be produced from the bagasse.

**Electrical Generation/**

**Co-generation.** In all areas of the region electricity is being exported to the national grid thru co-generation operations. High capacity turbo-generators and condensable steam turbines are used and in some cases turbines with different pressure extractions. Co-generations up to 50.0 mw are reported; it is normal in many of the countries that mills are co-generating 25.0/30.0 mw. All of these co-generation projects are based on the use of bagasse as the only major fuel consumed; there is no doubt that there might be cases where some auxiliary fuel such as gas, oil, or carbon is used to generate during the downtime period.

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show more concern about environment contamination. Also, every day the environmental agencies demands are more severe. The quality of the air is being treated with appropriate technologies. The effluent from the alcohol distilleries is handled in different ways, either converting these in fertilizer by means of composting, plants, mixing it with the mud filter and ashes from the boilers, or with water and other nutrients to prepare a mixture that in some countries is called "ferti-water." Almost all of the countries have carried out important projects concerning the protection of the environment. There is a great concern for this issue in the whole region and this is shown by the friendly environmental projects that are already in operation or in construction.

**Alcohol Distilleries.** There is a variety of different types of alcohol being produced in the region: potable for beverage and rum, industrial and chemical industries, pharmaceuticals, cosmetics, etc. But the one that has more volume and capacity are the ethanol plants for fuel. These distilleries come from different technologies, mainly from Europe, USA, Brazil, and India. All ethanol production is for 99.6/99.7 degrees. The feedstock comes from sugar cane products such as, direct mill juice, clarified juice, syrup, "b" molasses, and final molasses. There is a wide range of distillery capacities in liters per day, ranging from 10,000 up to 500,000 liters /day. The effluent (slops) is been treated in different ways, irrigation for cane fields, composting, fertilizers, methanol gas, or the effluent (called slops, vinasse or distillage) recycled into the same fermentation process reducing the volume of effluent. We will consider briefly the main by-products from the distillery, carbon dioxide (CO<sub>2</sub>), fusel oil, glycerol; they usually come from oxidation, dehydrogenation, dehydration, etc. The ethanol production has a great impact in the whole region due to its large demand and also attractive prices in the international markets.

**Final Notes**

Since the colony times Latin America has been and will continue to be a traditional producer of sugar and sub-

products from sugar cane.

The same centuries old sugar industry is currently making very important contributions to the development of bio-degradable and renewable fuels.

Latin Americans should be proud to have an industry in the process of modernization which is dynamic and a key player for our sustained progress.

The author has intended to describe in general and summarize the different technologies and most relevant improvements for all the agro-industry process, and would have hoped to have had more space to be more explanatory.

It goes without saying that we owe all of the people involved directly or indirectly in the sugar industry for the great amount of technological accomplishments. To all of them, directors, managers, technical staff, laborers, technology providers, please allow me to say that you are the strength of our industry and without your strong will, these achievements would not be possible.

Congratulations to all of you. Many thanks for the opportunity. **SJ**



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