

ISSCT CO-PRODUCTS WORKSHOP

Organizers:

International Society of Sugar Cane Technologists - ISSCT
São Paulo State Sugar Cane Producers Cooperative - COPERSUCAR

Place: COPERSUCAR Technology Center located in Piracicaba, Brazil

Date: 14 to 18 July 2003

Piracicaba, the heart of Brazil sugar and ethanol industry was the place where about 50 ISSCT affiliates got together to discuss recent advances on sugarcane production and conversion technology. Brazil, particularly in the last two decades, became a world reference in several topics related to sugarcane technology. This happened mainly after the national fuel ethanol programme was implemented in the country to alleviate oil imports. The increase in overall sugarcane industry productivity followed by a rapid cost reduction benefited not only the ethanol industry and its use as a fuel but also sugar production and exports.

The ISSCT Workshop received several participants from many different regions of the world: Mauritius, India, Guyana, Germany, Iran, Colombia, Bolivia, Japan, and Brazil. The main objective of this workshop was to share the technical experiences from these producing regions, focusing in the Brazilian experience in fuel ethanol.

The main topics addressed in the workshop were:

- Ethanol programs in Brazil and other countries;
- Automotive use of ethanol;
- Alternative raw materials for ethanol production;
- Energy balance in ethanol production;
- Ethanol production technologies;
- By-products of the ethanol production;
- Other co-products from sugarcane;
- Integration of co-production with the sugar factory and energy cogeneration.

The ISSCT workshop opened with a presentation by Mr. Luiz Carlos de Carvalho, a Brazilian consultant, on the evolution of fuel ethanol in Brazil, and how it achieved competitiveness after deregulation. He showed the consolidation of ethanol in the Brazilian energy matrix and the development an ethanol world market. He also presented the perspectives for using ethanol in flex-fuel engines and in biodiesel blends. In the following presentation Mr. Ezatollah Rezaee from Sugar Cane & Products Development Co. - Iran has presented a new concept of a sugar cane complex with all co-products, just like a refinery using all streams. This new ethanol and yeast complex in Iran is presently under construction and will be all completed in the next 4 years. Mr A. Shriram has presented some interesting advances in ethanol production in India where E5 and E10 are being considered. This work considered these possibilities of producing ethanol in small distilleries (30,000 l/d) using cane molasses as feedstock and looking at stillage disposal by incineration. Mr. C.O. Briceño from Cenicaña - Colombia and Mr Harold Davis from Guyana Sugar Co. - Guyana presented the perspectives to produce ethanol in their home

countries. The general impression is that the ethanol production, together with sugar, can have a positive impact by the creation of an important source of extra revenue and also generating positive impacts on the overall process efficiency with correspondent costs reduction.

The following session dealing with the automotive use, started a presentation by a Volkswagen do Brasil representative, Mr Henry Joseph Jr., discussing the necessary engine modifications for different blends gasoline-ethanol. The company just launched a model equipped with flex-fuel engine which allows the operation with any gasoline-ethanol blend, from E25 (Brazilian market does not use pure gasoline) to E100 (hydrated ethanol). The new flex-fuel vehicle market price is about the same as the 100% gasoline model. The following presentation referred to the environmental aspects of fuel ethanol in Brazil. Mr Alfred Szwarc, from União da Agroindústria Canavieira de São Paulo - Unica, discussed the benefits of ethanol fuel for the greenhouse effect and stressed the reduction of aldehyde and other emissions, particularly after the use of catalytic devices in the vehicles exhaust pipes. Mr. Szwarc, a former CETESB engineer, emphasized how fuel ethanol helped to improve air quality in São Paulo metropolitan area, particularly after fuel injection and catalysts were used. Mr José Felix Silva Jr., from Copersucar, presented the specification and quality of fuel ethanol and they are controlled in the factory and at the distribution system. Mr. Felix's considerations demonstrated that ethanol specification is a key issue for countries starting new ethanol programs. Countries that are importing ethanol need to develop their own specification and not just import patterns from other countries. Mr. Armando Dal Bem, also from Virgolino de Oliveira S.A. from Copersucar, presented field test results obtained from the use of ethanol/diesel blends in cane transportation trucks. Significant improvements have been obtained by the automotive industry, but probably the two most important achievements referred to the flex-fuel engines and the studies related to the use of ethanol in diesel engines, particularly in trucks, buses. Although significant improvements were observed more research is needed in this field to improve the performance of diesel engines operating with ethanol blends.

In the following session, Mr. José Luiz Olivério from Dedini, presented the Dedini Rapid Hydrolysis Process named DHR which has the objective to produce ethanol from sugarcane bagasse allowing to increase the overall energy efficiency of sugarcane. This Dedini project, with Copersucar assistance, was partly financed by São Paulo Research Funding Foundation (Fapesp). Dedini is now installing a 5,000 l/d pilot plant of the DHR process at the São Luiz Sugar Factory. The pilot plant is at the moment in the trouble-shooting stage. Still about the use of alternative raw materials for ethanol production, Mr. B.P. Lavarack from Sugar Research Institute – SRI - Australia presented an interesting work about the opportunities found in his country to boost ethanol production. In this research Mr. Lavarack and his group investigated the possibilities for Australia to produce enough ethanol to adopt the E10 alternative.

The following session dealt with the energy balance in ethanol distillation. Mr. Frank Seeman from IPRO - Germany discussed the possibilities to reduce energy use in distillation using the molecular sieve technology. Mr. Pedro Avram also from IPRO - Germany discussed the integration of ethanol production with a sugar factory in order to maximize cogeneration efficiency by reducing low pressure steam use. This session was closed by a presentation of Mr. Manoel Régis Leal from Copersucar presenting the life cycle analysis of energy use in sugar/ethanol production indicating that a significant

improvement took place in the Brazilian sugar/ethanol industry particularly in the last two decades.

The first day of the ISSCT co-products workshop ended with a session dealing with ethanol production technologies. Mr. Sérgio Barreira from Dedini – Brazil presented the PDE process for beer-enrichment-based lowering of the steam consumption in an azeotropic dehydration of ethanol. Mr. Kori Yamada from the Bio Nanotec Research Institute – BNRI from Japan discussed the ethanol dehydration by zeolite membrane, a technology with a bright future. Mr. David Heck from Rocky Point Sugar Mill and Distillery from Australia presented an interesting paper on how his mill survived in competitive through cogeneration and ethanol production. Mr. N. Mullapudi discussed the ethanol production using vapor phase molecular sieve technology and continuous fermentation with cane molasses.

The second day of the workshop was also dedicated to oral presentations and discussions. The day was opened by Mr. Paulo Nogueira Jr. about the production of ethanol – the mill's point of view since Mr. Nogueira owns Ester Sugar Mill, a large sugar/ethanol factory near by Piracicaba. Then the following talks were dedicated to the fermentation evolution in the last 30 years in Brazil by Mr. Jaime Figueirut from Copersucar and Mrs. Idalina Spina from Santa Adélia Mill. Brazil improved significantly fermentation efficiency, following the learning curve, proving that more ethanol was produced more we learned from it, and showing how every detail is important. Both presentation stressed the advantages of continuous and also the fed-batch processes with respect to their specific application and context. The session was closed by a presentation of Mr. Américo Vera from Ingenio Azucarero Guabirá S.A. from Bolivia who addressed the issue of productive diversification of Guabira Sugar Factory located in Bolivia.

The next session dealing with the by-products of ethanol production started with the presentation of Mr. K. H. Leimer about the alternatives for use of yeast and its products, for example to replace antibiotics. Mr. Narendranath Mullapudi from Andhra Sugars Ltd. From India discussed the sugar plant based co-products and cogeneration at the Andhra Sugars. He showed how it possible to produce more than 40 different products using chemical engineering and creativity. The session was closed by a presentation of Mr. Jorge L. Donzelli from Copersucar discussing the use of fertirrigation, a technique developed in Brazil to dispose the stillage (also named vinasse) in which the effluent is disposed in the cane fields in specific dosage depending on economics and local conditions. A good lesson learned in this session is that vinasse is still considered an important barrier outside Brazil and it has to be overcome. Vinasse is not a residue but an important co-product as the Brazilian experience has demonstrated.

The following session dealt with other co-products from sugar cane. Mr. Zahid Mehmood from Shakarganj Mill Limited presented a biocomposting of sugar mills effluents. Mr Carlos Rossel from Copersucar presented a review of sugar cane potential for the production of chemical products from bagasse, sugar and vinasse. Mr. Rossel also presented an interesting innovation: the Copersucar production process of the biodegradable plastic (PHB) from cane sugar.

The first afternoon session dealt with the integration of co-production with the sugar factory and energy conservation. The first presentation was delivered by Mr. Kassiap Deepchand from Mauritius Sugar Authority and the ISSCT chairman. Mr. Deepchand's speech was about sharing of revenues from cogenerated bagasse energy in Mauritius, and how engineering relates with people talking about social life and sharing revenues of

electricity. The next talk, presented by Mr. A.F.Lau from Mauritius Sugar Industry Research Institute, was about the factors influencing surplus electric production in bagasse cogeneration plants. The following presentation by Mr. Celso Procknor from Procknor Engenharia – Brazil discussed the energy balance in the combined production of sugar and ethanol, a successful experience in Brazil benefiting the entire industry. The last presentation was delivered by Mr. Djalma Lahr Filho and treated the integration of DHR process with a typical sugar and ethanol factory.

The overall impression is that there is a great potential, yet to be properly exploited, for the production of new co-products from sugar cane. A good example of that is the biodegradable plastic presented by Copersucar. Again more research is needed to develop new products from sugar cane industry.

The remaining days of the workshop were dedicated to visit the Copersucar Technology Center and field trips to São Luiz Sugar/Ethanol Mill located in Pirassununga and Pedra Mill, in Ribeirão Preto area.

The participants had a great opportunity to share their experiences on sugar and ethanol technology. More collaborative research is, off course needed, between the producing countries and ISSCT is playing an important role in this regard. Particularly the participants could get a close look on the successful Brazilian experience of producing ethanol and sugar. This flexibility given by the dual production characteristic of the Brazilian industry permits strong comparative advantages and lower costs. Also, it was the workshop conclusion that more R&D is verified to be necessary to continuously increase the overall efficiency of sugar cane industry all over the world.