BIOMASS IN THE SPOTLIGHT

The 2nd Brazil-Finland Biomass Conversion Workshop discussed the potential of utilizing biomass and residues, including those from pulp and paper and the agro-industry as renewable raw material to feed the generation of energy, production of chemical compounds and biomaterials.

By Thais Santi

From now to 2035, all forms of energy generation will continue to grow, but the use of fossil fuels in the mix of energy raw materials shall drop from 83% down to 76% during this period. Low carbon renewable energy sources will occupy the space left by fossil fuels and satisfy roughly 40% of the demand increase for primary energy, according to data from *World Energy Outlook*, published by the International Energy Agency (IEA) in November 2013.

The outlook regarding cleaner energy sources was presented, among other things, during the 2nd Brazil-Finland Biomass Conversion Workshop held on October 31, 2013, in São Paulo (SP), and included the presence of scientific editors from *O Papel* magazine, Pedro Fardim and Song Won Park, among other celebrities from the world of science and technology. Promoted by Rede Nobre ***(Read more about the institution in the box)***, the event presented the challenging scenario of global growth.

Within this context, viable alternatives for sustaining the future development of industries will be necessary, and biomass has been pointed out as one of the best solutions by scientists, researchers, companies and institutions for substituting most of the materials, chemicals and energy produced today. In the socio-economic and environmental scenario, modern society's paradigm of "producing more with less" and in a cleaner manner is associated to the strengthening of emerging economies and, consequently, a significant increase in energy, food and product consumption. This explains the demand for "green" raw materials, such as biomass.

"Through biomass it is possible to seek sustainability. It is estimated that more than 5,000 products can be generated from its residues. Planted forests and forest-based industries could become the biggest suppliers of raw material, which would result in a sustainable cycle for their potential of being used in various sectors, without causing and even mitigating environmental impacts," said Luiz Cornacchioni, representative from the Brazilian Association of Planted Forests (ABRAF) and Brazilian Pulp and Paper Association (Bracelpa), during his presentation at the international event.

However, even though he believes in the utilization of biomass as a renewable resource, Cornacchioni does not envision significant results for generating energy in the near future. "The price of energy today is very vulnerable. There are no regulators for prices, therefore, investments are not made in biorefineries that do not receive any subsidy for production, despite being a clean production alternative," he said.

A "technological bridge" solution, which would allow avoiding the high investment pointed out by Cornacchioni, is to use Brazil's refinery sector – which received huge investments. In this conception, biomass is co-processed with fossil sources (nonrenewable) in a single industrial plant. "In this sense, the gasification technique is the most mature for making this condition possible," said Prof. Ofélia de Queiroz Fernandes Araújo, from the Chemical School at the Federal University of Rio de Janeiro (UFRJ), who spoke at the workshop and is a member of Rede Nobre.

"On one hand a country with major potential for utilizing biomass and, on the other, technical knowledge applied," said Pedro Fardim about the creation of Rede Nobre (Network of Excellence in Biomass and Renewable Energy), which aims to develop research cooperation between the two countries

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The synthesis gas obtained would be used to generate energy and steam or be used as raw material by chemical industries to produce synthetic rubbers, plastics and fertilizers. "Such initiative would allow us to migrate to a low-carbon economy and become much more competitive. Co-processing is an alternative for developing sustainability," added Ofélia.

The proposal presented by the professor is aligned with the supply increase of this fossil raw material, which reduces the competitiveness of biomass as a source of energy for the chemical industry. This observation is based on shale gas reserves, which have increased considerably in some regions of the globe, particularly United States. The professor also points out that, in Brazil, the pre-salt discoveries increase the supply of fossil raw material – natural gas and oil. Co-processing allows introducing biomass in the refinery sector, through gasification, taking advantage of expansion investments dedicated to fossil fuels. This conception would allow for the transition to renewable sources in a scenario of abundant fossil sources.

Finland teaches

While Brazil still fights for biomass and does not receive exclusive government subsidies for promoting its development, Finland has its economy based on technological development, with more than 4% of its Gross Domestic Product (GDP) earmarked for the research and development sector, of which part of this amount is invested in projects that focus on renewable energy and biomass utilization.

All this support was also made evident by the presence of the minister of education, Jaana Palojärvi and others Finnish government authorities at this workshop, which included a virtual lecture by senior environmental adviser for Finland's Ministry of Environment, Sauli Rouhinen, as well as face-to-face presentations by Finland's Ministry of Education counselor, Tiina Vihma-Purovaara, and other Finnish government authorities.

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"Co-processing is an alternative for developing sustainability," said Ofélia de Queiroz Fernandes Araújo (UFRJ)

Rouhinen and Purovaara defended the importance of sustainability being inserted in the education and training of students in order to make this theme intrinsic to the country's development, as well as the importance of knowledge being shared with other countries that have potential for developing this "green" technology, such as Brazil. In practice, one of the main biotechnology advancements in Finland is associated to metabolic engineering, combining biomass utilization and biochemistry in production of bioproducts. One of the main projects is an EU funded project NEMO - Novel High Performance Enzymes and Micro-Organisms for Conversion of Lignocellulosic Biomass to Bioethanol.

NEMO aims to introduce technologies for the development of high-performance enzymes and enzyme mixtures with the objective

Rede Nobre

With the objective of developing research cooperation, Rede Nobre (Network of Excellence in Biomass and Renewable Energy), which promoted the workshop, comprises Brazilian and Finnish biomass and renewable energy researchers and is coordinated by professor Pedro Fardim, from Åbo Akademi University, in Finland, who is also international scientific editor for *O Papel* magazine. NOBRE's coordination in Brazil is headed by professor Claudio Oller do Nascimento, from the University of São Paulo's Polytechnic School. The network also includes companies and the government's participation.

Created in 2012, one of the proposals already formatted by the Network, besides the workshop, is the creation of a "biomass and renewable energy" international PhD course in partnership with the main universities in Brazil and Finland. According to Fardim, both will be pillars for sustainability in the future and for this reason shall be studied more and more.

"By fostering this type of discussion, bringing Brazil and Finland closer together, we will have on one hand a country with major potential for utilizing biomass and on the other technical knowledge applied. It's a win-win situation," said Fardim. Chemical Engineering professor Osvaldo Chiavone Filho from the Federal University of Rio Grande do Norte (UFRN), who also participates in Rede Nobre and is responsible for the web coordination of the project, added that it is already possible to envision partnerships based on what was presented during the workshop.

"The cell factories presented by the VTT research professor, for example, would be an easily applicable reality in Brazil, on account of its geography. With the development of coastal regions, we neglected exploring the central region of the country where there's a large amount of sun, that is, an inexhaustible source of energy is not being tapped," said Chiavone Filho.

It looks like viscose, but isn't

One of the characteristics of Scandinavian industries is the creation of so-called clusters, companies that collaborate with each other in the pursuit of development, accelerating their growth. And it seems like these partnerships are a success. The Paper Province cluster, in Sweden, is an example. The cluster aims to become a model of bio-economy for forests and fruit of this integration of ideas and bioinnovation came a new product, CelluNova. It is a textile fiber extracted from wood cellulose and was developed by SP Technical Research Institute in partnership with Swerea IVF.

The product will be a heavyweight competitor for cotton, and has grown with the increase in population and increase in demand for textiles. While the cotton production process involves environmental risks, since many times it is irrigated with contaminated water, in intensive conditions and in regions with little water availability, CelluNova is a more environmentally friendly product, but contains some details not yet presented regarding its production process.

The fiber can be compared to the highest quality viscose and be processed in such a way to reach superior properties and, contrary to viscose production, it does not require large quantities of carbon disulfide, whereby 400 kilos are produced with one ton of wood. In terms of next steps, the cluster will build a pilot plant to test the manufacturing process and, if all tests are successful, CelluNova will be commercially introduced in 2017, probably through production licenses granted to companies that already produce soluble cellulose, where the introduction of CelluNova's production process will be easier.

of achieving efficient hydrolysis of lignocellulose and transform the complex polysaccharides into C5 and C6 sugars, which are easier to ferment, as well as promote the generation of yeasts that are tolerant to process stress, in order to achieve an efficient fermentation of these sugars, leading to the production of this 2nd generation ethanol – cellulosic ethanol.

"Our objective is to develop the second generation of biofuels, where corn is no longer used, but instead lignocellulose from agricultural and forest residues, or bagasse. The work focuses on the development and attainment of an effective production cost for these biofuels," said Instituto VTT research professor Merja Penttilä, who presented NEMO during the workshop. This and other related projects are conducted in the "Cell Factory" research area at VTT, and will allow for the production of various bioproducts. Some of the "Cell Factories" developed by VTT, can also utilize solar energy. The aim is to develop cells that are energy and carbon efficient, making the entire process even more sustainable. With the engineered cell factories, it is possible to produce platform chemicals, precursors for polymers and biofuels to fine chemicals, such as drugs, as well as fermentation processes for production of enzymes and other proteins. "Still in their experimentation phase, in the long term, cells will have to be engineered to be more efficient, robust and tolerant. We are on the right track," said Penttilä. In addition to this type of bioproducts, innovations in the special cellulose area are also being divulged by Finnish companies, as is the case with CelluNova, a textile fiber extracted from wood cellulose. ***(Read more about the subject in the "It looks like viscose but isn't" box)*** Brazil, on the other hand, is also in search of "green" raw material, but it is chemical companies like Braskem that currently has a green polyethylene in its portfolio called I'm green™, not pulp companies.

Since 2010, the company has been producing this plastic on a commercial and industrial scale, supplying the market with 200 thousand tons of this polyethylene. Produced from sugarcane ethanol, the green plastic has the same properties as fossil-based polyethylenes, which facilitates its immediate use in the plastic's production chain and its recycling. "Since it's made from a renewable raw material, green polyethylene captures and sets carbonic gas in the atmosphere during its production, helping reduce greenhouse gas emissions," said Augusto Morita, materials engineer at Braskem, the global market leader in biopolymers.

Morita also said that, according to a preliminary ecoefficiency study of the biopolymer, conducted in partnership with Fundação Espaço Eco, for each ton of green polyethylene and polypropylene produced, roughly 2 million tons of CO_2 are sequestered and fixed in the atmosphere. And this would be an opportune space for developing a green economy in the market in the future. ■

Did you know?

Brazil: a low carbon economy

Brazil's energy sector will continue being one that emits the least amount of carbon, despite the greater availability and use of fossil fuel. Brazil is already the global leader in renewable energies and is expected to double its production by 2035, with this type of energy accounting for 43% of its energy grid. CO_2 emissions per capita will increase 50%, reaching 3 tons of CO_2, but this amount will still only be 70% of the global average in 2035.

Source: International Energy Agency